TECHNICAL SPECIFICATIONS FOR PLUMBING AND FIRE FIGHTING WORKS

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I. COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and poly phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 400 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 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.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 and NEMA 13 enclosure protection unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 46 deg C and at sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: Squirrel cage, induction type NEMA MG 1 or BS 5000 and BS 2757, Design B, medium induction motor with minimum Class F insulation.

B. Efficiency: Premium efficiency motors as per NEMA Premium, shall be provided above 3.73 kw.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.

2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading above 3.73 KW.

H. Temperature Rise: Class B.

I. Insulation: Class F

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.

3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Pre lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection for each winding, to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

II. EXPANSION FITTINGS & LOOPS FOR PLUMBING PIPING

PART 3 - GENERAL

3.1 SUMMARY

A. Section Includes:

1. Grooved-joint expansion joints.
2. Alignment guides and anchors.

3.2 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

3.3 SUBMITTALS

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

B. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

C. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

D. Welding certificates.

E. Product Certificates: For each type of expansion joint, from manufacturer.

F. Maintenance Data: For expansion joints to include in maintenance manuals.

3.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 4 - PRODUCTS

4.1 MANUFACTURERS

A. Manufacturers are subject to compliance with requirements. Provide products in accordance with the approved manufacturers list or approved similar products.

4.2 GROOVED-JOINT EXPANSION JOINTS

A. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

B. Standard: AWWA C606, for grooved joints.

C. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

D. Couplings: Seven, flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

4.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 5 - EXECUTION

5.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install packed-type expansion joints with packing suitable for fluid service.

C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

D. Install rubber pack less expansion joints according to FSA-NMEJ-702.

E. Install grooved-joint expansion joints to grooved-end steel piping

5.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

5.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

III. SLEEVES AND SLEEVES SEALS FOR PLUMBING PIPING

PART 6 - GENERAL

6.1 SUMMARY

A. Section Includes:

1. Sleeves.

6.2 SUBMITTALS

A. Product Data: For each type of product indicated

PART 7 - PRODUCTS

7.1 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

7.2 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

A. Supply, deliver and install all pipework materials and fittings for the pipework services installation.

7.3 PIPE SLEEVES AND PLATES

A. All pipework passing through floors or walls shall be provided with sleeves of similar material and of such diameter as to allow free movement of pipework.

B. Sleeves shall be of sufficient length to finish flush with finished faces of wall or ceiling and 15mm of the finished face of floors. All sleeves shall be retained in position before making good by lugs or plates welded on at sub-floor level.

C. The weight of pipework shall not be borne by sleeves.

D. Sleeves shall be manufactured from mild steel tube painted with two coats of zinc rich primer.

E. Copper sleeves shall be used in conjunction with uninsulated copper pipework.

F. Where pipework is insulated, the pipe sleeve shall be of sufficient size to allow the thermal insulation to pass between the pipe and the sleeve over its entire length.

G. In areas where floors are washed down install with a 50 mm protrusion above floor finish and shall have its edge rounded or bevelled.

H. Chromium plated plates shall be installed wherever pipes pass through walls, floors and ceilings exposed to view.

7.4 PIPE SLEEVES THROUGH FIRE BARRIERS

A. Sleeves which are contained in walls, ceilings or floors which are fire barriers shall be additionally packed with a non-combustible material for the entire length to form a fire/smoke stop of the required fire rating.

B. The material must comply with Civil Defence requirements.

C. The ends of sleeves packed with material shall have suitable fire resistant mastic applied to seal the fibres and present a neat appearance.

D. Sleeves for UPVC pipes shall contain an in tumescent material to BS 476.

7.5 PIPE SLEEVES THROUGH ACOUSTIC BARRIERS, ENCLOSURES AND PLANT ROOMS

A. Sleeves on pipes which are contained in walls, ceilings or floors which are acoustic barriers, or through acoustic enclosures, or plant room walls, floors or ceilings, shall be packed with a 12 mm thick resilient neoprene inner sleeve around the pipe and filled with a non-setting mastic

compound. The outer edges of the sleeve shall be made air-tight by sealing with a dense non-setting mastic compound. Where such barriers are also fire barriers the material shall comply with Local Authority regulations.

7.6 PUDDLE FLANGE ASSEMBLIES

A. Provided where pipes pass through walls or floors which require proofing against liquid penetration, shall consist of a length of pipe and an un-drilled flange welded onto the pipe at a distance midway through the structural thickness, extend beyond both sides of the wall or floor, terminated in flange connections, manufactured from the same class of piping as the adjoining pipework and be wrapped in two coats of petroleum jelly impregnated tape.

PART 8 - EXECUTION

8.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Refer to detailed installation information in the Plumbing Services Particular Specification in Division 22 0001 of this Specification.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements for fire stopping specified in Division 07 Section "Penetration Fire stopping."

8.2 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Galvanized-steel wall sleeves

2. Exterior Concrete Walls below Grade:

   a. Galvanized-steel wall sleeves with water tight sealing

3. Concrete Slabs-on-Grade:

   a. Galvanized-steel wall sleeves with water tight sealing.

4. Concrete Slabs above Grade:

   a. Galvanized-Steel-Pipe Sleeves.

5. Interior Partitions:

   a. Galvanized-Steel-Pipe Sleeves

IV. ESCUTCHEONS FOR PLUMBING PIPING

PART 9 - GENERAL

9.1 SUMMARY

A. Section Includes

1. Escutcheons
2. Floor plates

9.2 SUBMITTALS

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

PART 10 - PRODUCTS

10.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

10.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 11 - EXECUTION

11.1 INSTALLATION

A. Install escutcheons for piping penetrations of finished floors and wall.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

11.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

V. METERS AND GAUGES FOR PLUMBING PIPING

PART 12 - GENERAL

12.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermo wells.
4. Dial-type pressure guages.
5. Guage attachments.
6. Test plugs.

B. Related Sections:

1. Division 21 fire-suppression piping Sections for fire-protection pressure gages.
2. Division 22 Section “Domestic Water Piping" for water meters inside the building.

12.2 SUBMITTALS

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

B. Product Certificates: For each type of meter and guage, from manufacturer.

C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 13 - PRODUCTS

13.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type; stainless steel with 5-inch (127-mm) nominal diameter.

D. Dial: Non reflective aluminum with permanently etched scale markings and scales in deg F and deg C.

E. Connector Type(s): Union joint, with unified-inch screw threads.

F. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.

H. Window: plastic.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1percent of scale range.

13.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers:
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch (152-mm) nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non reflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Plastic.
8. Stem: Aluminum or brass and of length to suit installation.
9. Design for Thermo well Installation: Bare stem.
10. Connector: 3/4 inch (19 mm), with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

13.3 THERMOWELLS

A. Thermo wells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Type: Stepped shank unless straight or tapered shank is indicated.
4. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
5. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
6. Bore: Diameter required matching thermometer bulb or stemming.
7. Insertion Length: Length required to match thermometer bulb or stem.
8. Lagging Extension: Include on thermowells for insulated piping and tubing.
9. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

13.4 PRESSURE GUAGES

A. Locate gauges for easy reading. Install gauges as shown and on all pumps. Equip each gauge with an integral or separate siphon and connect by means of a brass snubber pipe and fittings containing a shut-off cock.

B. Water system pressure gauges shall have a range to cover pumping head as well as static head

C. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers:
2. Standard: ASME B40.100.
3. Case: Liquid-filled Sealed type (cast aluminum or; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Match pressure connection size in first subparagraph below with gage attachment size.
6. Pressure Connection: Brass, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Non reflective aluminum with permanently etched scale markings graduated in psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Plastic.
11. Ring: Metal.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of whole scale range.

13.5 GUAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball with ASME B1.20.1 pipe threads.

13.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers:

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread: ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C) .

F. Core Inserts: Chlorosulphorated polyethylene synthetic self-sealing rubber.

PART 14 - EXECUTION

14.1 INSTALLATION

A. Install thermo wells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermo wells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermo wells with extension on insulated piping.

D. Fill thermo wells with heat-transfer medium.

E. Install direct-mounted thermometers in thermo wells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermo wells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

2. Inlet and outlet of each domestic hot-water storage tank.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.

2. Inlet and outlet of each pressure-reducing valve.

3. Suction and discharge of each domestic water pump.

14.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

14.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility

VI. GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 15 - GENERAL

15.1 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Iron, grooved-end butterfly valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron, grooved-end swing-check valves.
8. Bronze gate valves.
9. Iron Gate valves.
10. Bronze globe valves.
11. Iron globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

15.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

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

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

15.3 SUBMITTALS

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

15.4 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.

15.5 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.

PART 16 - PRODUCTS

16.1 GENERAL REQUIREMENTS FOR VALVES

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

B. Generally, all valves of the same type shall be of the same manufacturer. All gate, globe, angle, and swing check valves as a group shall be of the same manufacturer.

C. All valves 50 mm and smaller shall be threaded and have bronze bodies.

D. All valves 65 mm and larger shall be Iron Body Bronze Mounted (IBBM) type, i.e. with bronze trim, and shall be flanged (or grooved for grooved coupling joints).

E. All valves 100 mm and larger mounted in excess of 2.15 m above the floor in mechanical rooms shall be equipped with chain operators. Extend chains to within 2 m of floor.

F. Each valve shall be marked (engraved, stamped, or cast on each valve or metal tag, permanently attached to the valve) at the factory with the following minimum information's:

1. Manufacturer's Name
2. Catalogue or Figure No
3. Size and Pressure Class
4. Arrows to indicate direction of flow on check, globe, angle, non-return, and eccentric plug valves.

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

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

I. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
2. Hand wheel: For valves other than quarter-turn types.
3. Hand lever: For quarter-turn valves NPS 6 (DN 150) and smaller.
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.
5. Chain wheel: Device for attachment to valve hand wheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

J. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
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.

K. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Solder Joint: With sockets according to ASME B16.18.

3. Threaded: With threads according to ASME B1.20.1.

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

16.2 BRONZE ANGLE VALVES

A. Class 125/150/200/300. Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: as required.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Hand wheel: Bronze

16.3 BRONZE BALL VALVES

A. Class 150/200/300 Retain one or more of eight paragraphs in this article if bronze ball valves are required. MSS SP-110 covers both brass and bronze, copper-alloy ball valves NPS 1/4 to NPS 4 (DN 8 to DN 100). See the Evaluations and manufacturers' catalogs before selecting either brass or bronze ball valves or including both.

1. Manufacturers: Subject to compliance with requirements, Subject to compliance with requirements, provide from the list of approved manufacturers.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 1035 kPa.
c. CWP Rating: 4140 kPa.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Stainless steel.
j. Port: Full.

16.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Class 150/200/300 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, Manufacturers: Subject to compliance with requirements, provide from approved list of Manufacturer's.

2. Furnish valves designed for minimum PN16 and 120 degrees C. water service. Valves shall have extended necks. Operator shall be 10-position lever lock for sizes 50 - 100 mm and totally enclosed and sealed worm gear actuators with 4-arm or wheel handle for sizes 150 mm and larger. Infinite adjustment and memory stop options shall be included. Valves shall be bi-directional suitable for drop-tight shut-off at full rated pressure with flow in either direction.

3. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 2000kPa or higher as required.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: Ethylene Propylene Diene Terpolymer (EPDM).
   f. Stem: Type 416 stainless steel.
   g. Disc: Stainless steel.

16.5 BRONZE SWING CHECK VALVES

A. Class 150/200/300, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide from approved list of Manufacturer's.

2. Description:

   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 2000kPa or higher as required.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: PTFE or TFE.

16.6 IRON FLANGED/GROOVED SWING CHECK VALVES

A. Class 150/200/300, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide from approved list of Manufacturer's.

2. Description:

   a. Standard: API 594.
   b. DN 65 to DN 300, CWP Rating: 2000kPa or higher as required
   c. DN 350 to DN 600, CWP Rating: 2000kPa or as required.
   d. Body Design: Wafer, spring-loaded plates.
   e. Body Material: ASTM A 126, gray iron.
   f. Seat: NBR.

16.7 BRONZE GATE VALVES

A. Class 150/200/300, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide from approved list of Manufacturer's.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 2000kPa or higher as required.
   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. Hand wheel: bronze.
   i. Non rising stem

16.8 IRON GATE VALVES

A. Class 150/200/300, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide from approved list of Manufacturer's.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. DN 65 to DN 300, CWP Rating: 2000kPa or higher as required.
   c. DN 350 to DN 600, CWP Rating: 2000kPa or higher as required.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. With bolted bonnet for size 65mm and larger and screwed-in bonnet for size 50mm and smaller
   h. Non-rising stem
   i. Disc: Solid wedge.
   j. Packing and Gasket: Asbestos free.

16.9 BRONZE GLOBE VALVES

A. Class 150/200/300, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide from approved list of Manufacturer's.

2. Description:

   a. Standard: MSS SP-85, Type I.
   b. CWP Rating: 2000kPa or higher as required.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Packing and Gasket: Asbestos free.

3. Size 50mm and Smaller Furnish valves designed for minimum PN20 nonstock water, oil, and gas working pressures. Valves shall have union bonnets, integral seats, and renewable Teflon discs. Valves shall permit disc and bonnet replacement without removing valves from piping.

4. Size 65 mm and Larger Furnish valves designed for minimum PN20 water, oil, and gas working pressure. Valves shall have bolted bonnets, guided bronze or bronze faced disc, outside screw and yoke, (0 S and Y) and flanged ends. Discs and seats shall be renewable without removing valves from line.

16.10 DOUBLE REGULATING VALVES

A. Size 50mm and smaller Furnish bronze double regulating valve designed for minimum PN20. Parabolic and slotted disk double regulating device. Screwed bonnet, rising stem, hand wheel operated with micrometer style indicator.

B. Size 65mm and larger Furnish cast iron double regulating valve for minimum PN16. Fitted with EPDM coated regulating disk, double regulating device and indicator, flanged to BS 4504 PN16. Inside screw, non-rising copper alloy stem, back seating feature

C. Commissioning sets shall comprise a metering station and a close coupled double regulating valve. The metering station, containing an orifice shall be fitted with test points so that the pressure drop across the orifice can be measured. The commissioning set shall provide +/- 5% accuracy and should be installed with a minimum of 5 times pipe diameter uninterrupted upstream length of straight pipe.

PART 17 - EXECUTION

17.1 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.

17.2 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.

B. Locate valves for easy access and provide separate support where necessary.

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

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

E. Install chain wheels on operators for valves DN 100 and larger and more than 2400 mm above floor. Extend chains to 1520 mm above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

17.3 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.

17.4 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. DN 50 and Smaller: Bronze swing check valves with bronze disc.
    b. DN 65 and Larger: Iron swing check valves

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. Pipes DN 50 and Smaller: Threaded ends
2. Pipes DN 65 to DN 100: Flanged ends
3. Pipes DN 125 and Larger: Flanged ends.

VII. HANGAR AND SUPPORTS FOR PLUMBING PIPE AND EQUIPMENT

PART 18 - GENERAL

18.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment support.
2. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

18.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

18.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to [ASCE/SEI 7].

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

18.4 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations; include Product Data for components:

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.

2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates

18.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Select and apply pipe hangers and supports complying with MSS-SP-69.

D. Except as otherwise indicated, provide factory-fabricated hangers and supports. Specified field fabricated items shall be made from quality structural steel.

E. All holes required shall be drilled and not gas cut. Give two (2) coats of primer and one coat of zinc rich paint prior to installation.

F. Cutting, welding or any such operation, which damages the finish, is not permitted on galvanized or other factory finished surfaces.

PART 19 - PRODUCTS

19.1 METAL PIPE HANGERS AND SUPPORTS

A. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

B. TRAPEZE PIPE

1. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two paragraphs and list of manufacturers below. See Division 01 Section "Product Requirements."

19.2 PLASTIC PIPES.

A. Where non-ferrous pipe work is to be supported using ferrous pipe clamps or rings, an approved plastic coating applied to the clamp or ring shall be used to prevent contact between the ferrous and non-ferrous surfaces.

B. Supports for Plastic pipes to be proprietary and as specified by the pipe manufacturer.

19.3 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

19.4 HANGERS AND SUPPORTS FOR COPPER PIPING

A. Support horizontal piping as scheduled below.

Pipe Size	Maximum Spacing	Hanger rod dia.
Upto 25 mm nom. dia	1.8 Ms	8 mm (5/16 inch)
32 to 50 mm nom. dia	2.4 Ms	10 mm (3/8 inch)
65 and 75 mm nom. dia	3.0 Ms	10 mm (3/8 inch)

B. Provide riser clamps with shield 60 cm (2 feet) /above floor level and at branch take offs for vertical piping.

19.5 SUPPORTS AND HANGERS FOR PLASTIC PIPING

A. Horizontal piping shall be supported as scheduled below.

Pipe Size	Maximum Spacing	Hanger rod dia.
Upto 25 mm nom. dia	1.2 Ms	8 mm (5/16 inch)
32 to 50 mm nom. dia	1.5 Ms	10 mm (3/8 inch)
65 and 75 mm nom. dia	1.8 Ms	10 mm (3/8 inch)
100 to 150 nom. dia	2.4 Ms	12 mm (1/2 inch)

PART 20 - EXECUTION

20.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Install fasteners according to powder-actuated tool manufacturer's operating manual.

D. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

20.2 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

20.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 0.05 mm.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

VIII. DISINFECTION OF WATER SUPPLY SYSTEM

PART 21 - DISINFECTION OF WATER SUPPLY SYSTEM

21.1 DISINFECTION OF WATER SUPPLY SYSTEM

A. This section covers the water treatment of hot and cold water pipework systems.

B. Water treatment and pipe cleaning processes shall comply with statutory authority, COSHH Regulations and health and safety requirements.

C. Obtain approval from the local Water Authority for the disposal of contaminated flushing water, and in particular, for the disposal of cleaning chemicals. If approval cannot be obtained make preparations for removal of the waste by other means.

D. During the fabrication and installation of pipework systems, the installer shall comply with the recommended Codes of Practice and take sufficient care to prevent the ingress of extraneous matter.

E. Chemical cleaning shall not be undertaken unless the system has been thoroughly clean-water flushed to the satisfaction of the cleaning specialist.

F. Notify manufacturers and suppliers of equipment of proposed system cleaning and chemical treatment processes. Establish for all equipment requirements of any particular cleaning and chemical treatment process due to size of waterways or materials used.

G. All chemicals for system cleaning, corrosion inhibition and bacteria control must be selected by a water treatment and chemical cleaning specialist and agreed with the Engineer prior to commencement of the works.

H. Maintain progressive records of a staged cleaning process.

I. It is the responsibility of the installer to advise the water treatment specialist of the materials used in the construction of the plant and systems.

J. Cleaning and flushing activities shall comply with the Water Supply Regulations.

K. Domestic Hot and Cold Water:

L. Disinfect all domestic water pipework with Sodium Hypochlorite in accordance with British Standards 6700.

M. The installer shall ensure that inspection and witnessing of the cleaning process shall be conducted as the work is in progress and shall be carried out in accordance with BSRIA Application Guide AG 1/2001.1.

N. All water samples taken for chemical and microbiological analysis shall be submitted to an independent laboratory. The laboratory used shall have NAMAS accreditation or equivalent for the tests to be undertaken. Results shall be submitted to the Engineer for review, if poor results are obtained, then remedial action shall be taken at no additional cost to the contract. Under this condition tests shall continue until stability of the system(s) is proved. Water samples from agreed locations shall be taken throughout the cleaning process to prove the quality and chemical and microbiological stability of the systems. Water samples shall be taken from representative system extremities and low points.

O. Prior to commencement of the Works on site obtain an analysis of mains water taken from the site supply point and ensure the results are typical for the site location with the local water authority.

P. Submit a sample of water to the water treatment specialist.

21.2 DISPOSAL OF CHEMICALS:

A. All necessary permissions from the local water authority before any chemical is discharged into public foul or surface water drains and comply with the requirements of all necessary legislation.

21.3 INITIAL FLUSHING OF PIPEWORK

A. Flushing of water systems shall be carried out in accordance with BSRIA Application Guide AG 1/2001.1.

21.4 STERILIZATION OF DOMESTIC WATER PIPEWORK SYSTEMS:

A. All cold water mains, rising mains, storage tanks, cold water down services and hot water services pipework systems used for domestic purposes shall be sterilized by a water treatment specialist in accordance with BS. 6700 and the requirements of the local water authority.

B. Submit samples following sterilization for microbiological analysis to an independent laboratory. The laboratory used shall have NAMAS accreditation or equivalent for the tests to be undertaken. Results shall be submitted to the Engineer.

C. Prior to handover, samples shall be retaken and submitted for analysis and report.

D. The installer's attention is drawn to the importance of carrying out a thorough initial cleaning of all systems using mains cold water from an independent source to avoid the possibility of re-chlorination.

E. The installer shall ensure:

1. Deposits of iron oxide or other foreign materials such as brick dust, cement, etc., all of which allows the "hide-out" of bacteria in pipework systems have been thoroughly flushed out.

2. Tanks are cleaned of extraneous matter and left in a thoroughly clean condition.

F. The installer shall comply with the latest Water Regulations and ensure that:

1. Cold water installations

a) Water storage tanks are situated in cool locations, shaded from sunlight.
b) Water storage tank rooms are adequately ventilated either by natural or mechanical means, dependent on location.
c) Cisterns and tanks are insulated to ensure water in storage is held below 20°C.
d) Equal flow occurs through each tank on a multi tank coupled installation.
e) Ball valves are installed on the opposite side of the tank to the outlet pipe to minimise the risk of static water.
f) Insulation of all distribution pipework.
g) Dead legs to drinking water points, low water consuming fixtures, showers and spray taps are avoided
h) Pipes are installed to falls to avoid air locks.

2. Hot water installations

i) Construction of calorifiers and cylinders shall include the following features:

a) Bolted access doors for cleaning purposes

b) Sparge pipe on cold feed inlets to avoid stagnation

c) Drain valves sized to drain the contents of water within 30 minutes in order to remove sludge and debris. On large calorifiers longer periods may be permitted.

d) Bottoms to be convex - concave bottoms should be avoided.

e) Where duplicate vessels are employed, equal flow rates must be achieved through each calorifier or cylinder.

f) Minimise the lengths of dead legs, especially to showers, spray taps and low water consuming fixtures. Secondary pumped return connections to extend beyond the last draw-off connection on branches.

g) Install pipes to falls to avoid air locks.

3. Control the storage of water at 60°C and maintain return water at not less than 50°C.

4. Avoid temperatures of storage water exceeding 60°C in order to prevent excessive corrosion and scale formation.

G. Should the installer have any queries relating to the above provisions, these must be discussed and approved by the Engineer prior to commencement of the works.

21.5 TEMPORARY PUMP SETS

A. Temporary pumps shall be provided to circulate chemicals and achieve flushing velocities in new circuits which do not have their own pumps.

B. The temporary pump set shall be sized so that it can achieve the flushing velocities in accordance with BSRIA Application Guide AG 1/2001.1 or the design velocity plus 10%, whichever is the greater. The flushing velocity shall be selected based on the largest pipe size in the system or circuit to be flushed.

PART 22 - EXECUTION

A. Refer to detailed installation information in the Plumbing Services Particular Specification in Division 22 00 01 of this Specification.

B. Refer to part 2 for general details of installation and workmanship.

IX. VIBRATION & SEISMIC CONTROLS FOR PLUMBING PIPING & EQUIPMENT

PART 23 - GENERAL

23.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Freestanding and restrained air-mounting system.
12. Restrained vibration isolation roof-curb rails.
13. Seismic snubbers.
14. Restraining braces and cables.
15. Inertia vibration isolation equipment bases.

23.2 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

23.3 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: As per wind tunnel report.
2. Building Classification Category: III.
3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading: as per local conditions and regulations.

23.4 SUBMITTALS

A. Product Data: for the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

    a. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

        1) Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.

        2) Annotate to indicate application of each product submitted and compliance with requirements.

2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

C. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

D. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

E. Seismic-Restraint Details:

1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

2. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

3. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

4. Preapproval and Evaluation Documentation: an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

F. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

G. Welding certificates.

H. Qualification Data: For professional engineer.

I. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

J. Field quality-control test reports.

K. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

L. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

23.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 24 - PRODUCTS

24.1 MANUFACTURERS

A. Manufacturers are subject to compliance with requirements. Provide products in accordance with the approved manufacturers list or approved similar products.

24.2 VIBRATION ISOLATORS

A. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

B. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

C. Restrained Mounts: All-directional mountings with seismic restraint

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.

3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

G. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

24.3 AIR-MOUNTING SYSTEMS

A. Air Mounts: Freestanding, single or multiple, compressed-air bellows.

1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows.

2. Maximum Natural Frequency: 3 Hz.

3. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).

4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.

5. Levelling Valves: Minimum of 3 required to maintain levelling within plus or minus 1/8 inch (3 mm).

B. Restrained Air Mounts: Housed compressed-air bellows.

1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows and spring, with angle-iron frame having vertical-limit stops and channel-section top with levelling adjustment and attachment screws.

2. Maximum Natural Frequency: 3 Hz.

3. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).

4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.

5. Levelling Valves: Minimum of 3 required to maintain levelling within plus or minus 1/8 inch (3 mm).

24.4 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

A. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.

B. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches (50 mm) of rigid, glass-fiber insulation on inside of assembly.

C. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- (6-mm-) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or wind restraint.

a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and levelling bolt.

b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

c. Minimum Additional Travel: 50 percent of the required deflection at rated load.

d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

D. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

E. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter flashed over roof materials.

24.5 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 25 - EXECUTION

25.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

25.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

25.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in the Architectural Specifications for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.

3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

25.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

25.5 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.

6. Measure isolator restraint clearance.

7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

10. Air-Mounting System Operational Test: Test the compressed-air levelling system.

11. Test and adjust air-mounting system controls and safeties.

12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

25.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring levelling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation

X. IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 26 - GENERAL

26.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

26.2 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

26.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 27 - PRODUCTS

27.1 EQUIPMENT LABELS

A. Provide machine-engraved brass or black anodized aluminium nameplates to identify each major equipment item.

B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

C. Lettering shall be black on white background, unless expressly specified otherwise.

D. Nameplates for major equipment shall be engraved in lettering 16 mm in height.

E. Uniquely identify such materials using a numbering system similar to that shown on the Drawings for major equipment items. Uniquely list such materials in the Operating and Maintenance Manual.

F. Attach labels by instant adhesive or stainless-steel rivets. Do not mount labels on removable covers. Attach labels to valves with chromium plated brass chain.

27.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1.6 mm thick, and having predrilled holes for attachment hardware.

B. Letter Color: White

C. Background Color: Red

D. Minimum Label Size: Length and width vary for required label content, but not less than 64 by 19 mm.

E. Minimum Letter Size: 6.4 mm for name of units if viewing distance is less than 600 mm, 13 mm for viewing distances up to 1830 mm, and proportionately larger lettering for greater viewing distances.

F. Fasteners: Stainless-steel rivets or self-tapping screws

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

27.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches (38 mm) high.

27.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.

2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.

27.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link or beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

27.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.

2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Yellow background with black lettering.

PART 28 - EXECUTION

28.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

28.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

28.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:
   a. Background Color: Blue.
   b. Letter Color: Black.
2. Sanitary Waste and Storm Drainage Piping:
   a. Background Color: Black.
   b. Letter Color: White.

28.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions

28.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

XI. PLUMBING INSULATION

PART 29 - GENERAL

29.1 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Calcium silicate.

b. Cellular glass.

c. Flexible elastomeric.

d. Mineral fiber.

e. Phenolic.

2. Insulating cements.

3. Adhesives.

4. Mastics.

5. Lagging adhesives.

6. Sealants.

7. Factory-applied jackets.

8. Field-applied cloths.

9. Field-applied jackets.

10. Tapes.

11. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

29.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

5. Detail removable insulation at piping specialties, equipment connections, and access panels.

6. Detail application of field-applied jackets.

7. Detail application at linkages of control devices.

8. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sample Sizes:

a. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).

b. Sheet Form Insulation Materials: 12 inches (300 mm) square.

c. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).

d. Sheet Jacket Materials: 12 inches (300 mm) square.

e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

F. Field quality-control reports.

G. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

29.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

a. One 10-foot (3-m) section of NPS 2 (DN 50) straight pipe.

b. One each of a 90-degree threaded, welded, and flanged elbow.

c. One each of a threaded, welded, and flanged tee fitting.

d. One NPS 2 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) or larger valve.

e. Four support hangers including hanger shield and insert.

f. One threaded strainer and one flanged strainer with removable portion of insulation.

g. One threaded reducer and one welded reducer.

h. One pressure temperature tap.

i. One mechanical coupling.

2. Equipment Mockups: One tank or vessel.

3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.

4. Notify Architect seven days in advance of dates and times when mockups will be constructed.

5. Obtain Architect's approval of mockups before starting insulation application.

6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

8. Demolish and remove mockups when directed.

29.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

29.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

29.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 30 - PRODUCTS

30.1 MANUFACTURERS

A. Manufacturers are subject to compliance with requirements. Provide products in accordance with the approved manufacturers list or approved similar products.

30.2 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Calcium Silicate:

1. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

3. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Block Insulation: ASTM C 552, Type I.

2. Special-Shaped Insulation: ASTM C 552, Type III.

3. Board Insulation: ASTM C 552, Type IV.

4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

5. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.

6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation [without factory-applied jacket] [with factory-applied ASJ] [with factory-applied FSK jacket]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

L. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

M. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ / FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in/h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

N. Phenolic:

1. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.

2. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

4. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.

30.3 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

30.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).

G. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

30.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.

2. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).

3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.

4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
2. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
3. Solids Content: 63 percent by volume and 73 percent by weight.
4. Color: White.

30.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
4. Color: White.

30.7 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminium.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

4. Color: White.

5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

30.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminium-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminium-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

5. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

30.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. inch (2 strands by 2 strands/sq. mm) for covering equipment.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment and pipe.

30.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 ozi/sq. yd. (271 g/sq. m).

30.11 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.

2. Color: [White] [Color-code jackets based on system. Color as selected by Architect].

3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Aluminium Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing / Factory cut and rolled to size.

b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper / 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper / 2.5-mil- (0.063-mm-) thick Polysurlyn].

d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper / 2.5-mil- (0.063-mm-) thick Polysurlyn].

e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.

2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.

3) Tee covers.

4) Flange and union covers.

5) End caps.

6) Beveled collars.

7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing / Factory cut and rolled to size.

b. Material, finish, and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper / 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper / 2.5-mil- (0.063-mm-) thick Polysurlyn.

d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper / 2.5-mil- (0.063-mm-) thick Polysurlyn.

e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.

2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.

3) Tee covers.

4) Flange and union covers.

5) End caps.

6) Beveled collars.

7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

30.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches (75 mm).

2. Thickness: 11.5 mils (0.29 mm).

3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches (75 mm).

2. Thickness: 6.5 mils (0.16 mm).

3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches (50 mm).

2. Thickness: 6 mils (0.15 mm).

3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.

4. Elongation: 500 percent.

5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches (50 mm).

2. Thickness: 3.7 mils (0.093 mm).

3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

4. Elongation: 5 percent.

5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches (75 mm).

2. Film Thickness: [4 mils (0.10 mm)] [6 mils (0.15 mm)].

3. Adhesive Thickness: 1.5 mils (0.04 mm).

4. Elongation at Break: 145 percent.

5. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

30.13 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminium Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminium according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 31 - EXECUTION

31.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

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

31.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

31.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Manholes.

5. Handholes.

6. Cleanouts.

31.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" ire stopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

31.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.

3. Protect exposed corners with secured corner angles.

4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

   a. Do not weld anchor pins to ASME-labeled pressure vessels.

   b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.

   c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.

   d. Do not overcompress insulation during installation.

   e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.

   f. Impale insulation over anchor pins and attach speed washers.

   g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches (75 mm).

8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.

2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.

2. Fabricate boxes from galvanized steel, aluminum or stainless steel, at least 0.040 inch (1.0 mm) thick.

3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

31.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable

insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

31.7 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Domestic Water Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.

3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

2. Install insulation to flanges as specified for flange insulation application.

3. Finish valve and specialty insulation same as pipe insulation.

31.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

31.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

31.10 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

31.11 PHENOLIC INSULATION INSTALLATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

31.12 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.

3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.

2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using

adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.

3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.

4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

31.13 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: [Two] <Insert number> finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

31.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of

flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

PART 32 - EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic water pump insulation shall be one of the following:

1. Cellular Glass: 2 inches (50 mm) thick.

2. Mineral-Fiber Board: 1 inch (25 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

3. Phenolic: 1 inch (25 mm)] thick.

D. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:

1. Cellular glass.

2. Mineral-Fiber Board: 6-lb/cu. ft. (96-kg/cu. m) nominal density.

3. Mineral-fiber pipe and tank.

4. Phenolic.

E. Domestic water storage tank insulation shall be one of the following:

1. Cellular Glass: 2 inches (50 mm) thick.

2. Flexible Elastomeric: 1 inch (25 mm) thick.

3. Mineral-Fiber Board: 1 inch (25 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

4. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.

5. Phenolic: 1 inch (25 mm) thick.

32.2 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.

2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

32.3 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.

b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm thick.

c. Phenolic: 1 inch (25 mm) thick.

2. NPS 1-1/4 (DN 32) and 2 (DN 50) Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

d. Phenolic: 1 inch (25 mm) thick.

3. Above (DN 50): Insulation shall be one of the following:

a. Cellular Glass: 2 inches (50 mm) thick.

b. Flexible Elastomeric: 2 inch (50mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch (50 mm) thick.

d. Phenolic: 2inch (50 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be[one of] the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 3/4 inch (19 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

d. Phenolic: 1 inch (25 mm) thick.

2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

d. Phenolic: 1 inch (25 mm) thick.

C. Roof Drain and Overflow Drain Bodies: (not required except on horizontal pipes in ceiling void above occupied space).

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 25 mm thick.

b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 25 mm thick.

c. Phenolic: 25 mm thick.

D. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 3/4 inch (19 mm)] [1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

d. Phenolic: 1 inch (25 mm) thick.

E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 3/4 inch (19 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

d. Phenolic: 1 inch (25 mm) thick.

32.4 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

32.5 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

32.6 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

XII. DOMESTIC WATER PIPING

PART 33 - GENERAL

33.1 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.

33.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to [ASCE/SEI 7].

33.3 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Backflow preventers.
6. Water meters
7. Water penetration systems.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

C. Water Samples: Specified in "Cleaning" Article.

D. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which all services are shown and coordinated with each other, using input from Installers of the items involved.

E. Field quality-control reports.

33.4 QUALITY ASSURANCE

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

B. Comply with NSF 14 for plastic, potable domestic water piping and components. [Include marking "NSF-pw" on piping.]

C. Comply with NSF 61 for potable domestic water piping and components.

PART 34 - PRODUCTS

34.1 PIPING MATERIALS

A. Refer to Division 22 Section 22 00 01 Part 2.2 Piping Material.

34.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

34.3 PPR PIPES AND FITTINGS

A. PPR Pipe : PN20 to DIN 8077

B. PPR Fittings : PN20 to DIN 8077

C. Jointing : Electro-fusion

34.4 PEX TUBE AND FITTINGS

A. PEX Distribution System: ASTM F 877, SDR 9 tubing.

1. Fittings in first subparagraph below are available in NPS 3/8 to NPS 1 (DN 10 to DN 25).
2. The inner pipe shall be a cross link polyethylene pipe withstanding up to 95 deg. C at a max. pressure of 10bar without deformation or damage. Short time temperature loading up to 110-degree C.
3. The pipe shall be resistant to all natural constituents of drinking water to DIN 2000, disinfectants and cleaning agents to DVWG – W291 and DIN 2000, anti-corrosion agents to DIN 1988 T4 (E) and common building materials, such as mortar, cement and plaster.
4. The pipe manufacturer shall offer minimum of 50 years guarantee for the pipes and 10 years guarantee for the complete system.
5. 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.
6. All pipes shall be laid so that the 16mm Pex water pipe can be replaced, if necessary.

B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper crimp rings and matching PEX tube dimension.

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. All valves, box elbows, tees, bends shall be of bronze. Connection shall be of a cone grip unions type allowing: full flow capacity, minimum pressure loss, easily detachable with torque clearly defined for a fool proof installation. Contractor shall use proper tools for

assembly as recommended by manufacturer, i.e. Assembly pliers, Ratchet torque wrench, cutters, etc.

34.5 HDPE PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, [Schedule 40] [and] [Schedule 80].

1. PVC Socket Fittings: [ASTM D 2466 for Schedule 40] [and] [ASTM D 2467 for Schedule 80].

2. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

34.6 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, non-metallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. PPR Pipes and Fittings: Using Electro-fusion fittings and appropriate machine as per Manufacturer's recommendation to DIN 8077.

E. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

34.7 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.

34.8 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. Plastic-to-Metal Transition Fittings:

C. Description: one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.

34.9 FLEXIBLE CONNECTORS

A. 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 250 psig (1725 kPa).

2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.

3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

34.10 WATER METERS

A. Displacement-Type Water Meters:

1. Description:

a. Standard: AWWA C700.

b. Pressure Rating: 150-psig (1035-kPa) working pressure.

c. Body Design: Nutating disc; totalization meter.

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.

e. Case: Bronze.

f. End Connections: Threaded.

B. Turbine-Type Water Meters:

1. Description:

a. Standard: AWWA C701.

b. Pressure Rating: 150-psig (1035-kPa) working pressure.

c. Body Design: Turbine; totalization meter.

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.

e. Case: Bronze.

f. End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.

g. End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

C. Compound-Type Water Meters:

1. Description:

a. Standard: AWWA C702.

b. Pressure Rating: 150-psig (1035-kPa) working pressure.

c. Body Design: With integral mainline and bypass meters; totalization meter.

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.

e. Case: Bronze.

f. Pipe Connections: Flanged.

D. Fire-Service-Type Water Meters:

1. Description:

a. Standard: AWWA C703 and UL listing.

b. Pressure Rating: 175-psig (1200-kPa) working pressure.

c. Body Design:

1) Proportional, Detector-Type Water Meters: With meter on bypass.

a) Bypass Meter: AWWA C701, turbine / AWWA C702, compound type with bronze case; size not less than one-half nominal size of main-line meter.

2) Turbine-Type Water Meters: With strainer, and with meter on bypass.

a) Strainer: Full size, matching water meter.

b) Bypass Meter: AWWA C701, turbine type with bronze case; not less than NPS 2 (DN 50).

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.

e. Case: Bronze.

f. Pipe Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.

g. Pipe Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

E. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

F. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

34.11 SUB METERS FOR EXTERNAL & INTERNAL WATER CONSUMPTION

A. Positive Displacement-Type Water Meters:

1. Description:

a. Standard: AWWA C700.

b. Pressure Rating: 150-psig (1035-kPa) working pressure.

c. Body Design: Nutating disc; totalization meter.

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.

e. Case: Bronze.

f. End Connections: Threaded.

B. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

C. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

D. All meters must have data logging capability and be connected to BMS system so that information on interior water consumption can be recorded; the monitoring system must have minimum following capabilities.

a. Provide hourly, daily, weekly, monthly and annual water consumption for each major use;

b. Compare consumption to previous days, weeks, months and years for trend analysis;

c. Determine ‘out-of-range’ values to alert building operators to unusually high consumption; and Record peak water consumption for each major use.

PART 35 - EXECUTION

35.1 EARTHWORK

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

B. PIPING INSTALLATION

C. Install shutoff valve, inside the building at each domestic water service entrance.

D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

E. Rough-in domestic water piping for water-meter installation according authority requirements.

F. 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.

G. Provide for the expansion and contraction of all pipes. Install expansion joints to have sufficient flexibility to prevent end thrust and movements caused by thermal expansion and contraction causing damage to piping and joints. For all PVC piping, provide expansion joints as required to absorb all movements in piping systems

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. Provide fire stops and or sleeves where combustible piping penetrates fire walls and or provide fire stops and or sleeves where combustible piping penetrates fire walls and or barriers. These fire stops and sleeves shall have the same rating as the penetration.

J. 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.

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

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

M. Provide water hammer arrestors to prevent development of water hammer in the distribution system. Water hammer arrestors shall be installed in accordance with the recommendations of the Plumbing and Drainage Institute.

N. Install piping to permit valve servicing.

O. 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.

P. Install piping free of sags and bends.

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

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

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

T. 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 Gauges for Plumbing Piping" for pressure gauges.

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."

35.2 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. PEX Piping Joints: Join according to ASTM F 1807.

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

35.3 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 NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) 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."

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 NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) 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.

35.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

35.5 DIELECTRIC FITTING INSTALLATION

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

35.6 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 bronze-hose flexible connectors in copper domestic water tubing.

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

35.7 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.

35.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Tests:

1. The pipes shall be jointed, plugged and shall have been in position for at least 24 hours, before the tests are carried out.

2. The piping shall be tested for line, gradient and water tightness. The Contractor shall furnish all labour, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer. A minimum of two (2) nos identical pressure gauges shall be installed at extremities of the piping circuit to be tested.

3. Fill the piping with clean fresh water, leaving all high points open to allow for purging of air. Allow a soaking period of at least 24 hours for cement lined or concrete pipes.

4. Pressurize the system using manual pumps in increments of 25 percent of the test pressure. Allow a standing period of 10 minutes after each pressure increment. Pressure testing using motor driven pump is not permitted.

5. Do not over pressurize the system under any circumstance. If the test pressure is close to the maximum permissible pressure of any of the system components, install calibrated pressure relief valves in the tested circuit.

6. Prior to testing keep all valves and control devices in open position. After completion of pressure test, close each valve one at a time starting from the pressure release end, so as to ensure tightness of the valve.

7. The piping shall be hydrostatically tested at a pressure of 690 Kpa (100 psig) or 1.5 times the system working pressure, whichever is greater, The pressure shall be maintained for at least 4 hours. In metallic piping, allow for pressure fluctuations due to ambient temperature variations. Record the circuit temperature along with the pressure readings.

8. Check for leaks by swabbing with a dry tissue. Drop in pressure to the order of 10 Kpa (1.5 psig) per hour shall be considered as acceptable.

9. Do not subject sanitary fixture chrome fittings to the pressure test.

10. Piping shall be tested in segments during the progress of the work. Maintain an official log book for recording the tests carried out on sections of piping, including test pressure, date of test and approval signature of Engineer's representative witnessing the test.

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

D. Prepare test and inspection reports.

35.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibs.

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.

35.10 CLEANING

A. Clean and disinfect 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 and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

   b. Fill and isolate system according to either of the following:

      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.

      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

B. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time

XIII. DOMESTIC WATER PIPING SPECIALTIES

PART 36 - GENERAL

36.1 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Adjust list below to suit Project.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Strainers.
6. Hose bibs.
7. Drain valves.
8. Water hammer arresters.
9. Air vents.
10. Float Valves
11. Relief Valves
12. Solenoid Valves
13. Automatic Air Valves
14. Expansion Compensators
15. Flexible Pipe Connection
16. Water Chemical Feeder
17. Union
18. Puddle Flange
19. Flow Sensing Devices

B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure guages, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.

36.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: to be based on the working pressure of the system.

36.3 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

36.4 QUALITY ASSURANCE

A. 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.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.

2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 37 - PRODUCTS

37.1 BACKFLOW PREVENTERS

A. Unless otherwise required by BS Standards and Codes, backflow preventers shall be of the double check valve type incorporating resilient elastic and positively tight seals designed to permit water to flow in one direction only.

B. Backflow preventers shall be suitable for installation in horizontal or vertical position. They shall be pressure rated for 16 bar or as required and BS kite marked.

C. Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1024.
2. Operation: Continuous-pressure applications.
3. Body: Bronze with union inlet.
4. Seal: NBR Rubber
5. Spring/Bolts/Nuts: Stainless Steel

37.2 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Standard: ASSE 1003.
2. Pressure Rating: Minimum initial working pressure of 150 psig (1035 kPa).
3. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
4. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

B. Water Control Valves:

1. Description: Domestic water lines pressure reducing valves shall be pilot-controlled, hydraulically operated, diaphragm-type with a low by-pass capability, single-seated main water control valve. The low-flow by-pass capability shall be achieved by using a balanced direct acting PRV as an integral part of the main valve. At very low flows when the main valve is almost completely closed, to percent the possibility of cavitation the direct acting valve shall by-pass the main valve and maintain flow
2. The pressure reducing valves shall be suitable for maximum working pressure that exist within the system and downstream pressure should be site adjustable between 2 and 7 bar. Refer to Schematic drawings for the minimum locations at which PRV's shall be required.
3. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
    a. Pattern: [Angle] [Globe]-valve design.
    b. Trim: Stainless steel.
4. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged type for NPS 2-1/2 (DN 65) and larger.

37.3 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Y-pattern globe valve with two readout ports and memory setting indicator.
2. Body: Bronze
3. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
2. Size: Same as connected piping, but not smaller than NPS 2-1/2 (DN 65).

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

37.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Furnish "Y" type strainers throughout the job unless specifically noted otherwise. Furnish one manufacturer throughout Project.

B. Y-Pattern Strainers:

1. Pressure Rating: 2000kPa or as required.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Type 304 Stainless Steel with round perforations, unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).
   b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
   c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm).
6. Drain: Factory-installed, hose-end drain valve.
7. With bolted cap
8. Strainers shall be provided with a medium grade screen sized such that in their clean condition the maximum pressure drop at the design flow rate shall not exceed 6kPa

37.5 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.

5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 150 psig (1035 kPa).

7. Vacuum Breaker: Integral, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

8. Finish for Equipment Rooms: Chrome or nickel plated.

9. Finish for Service Areas: Chrome or nickel plated.

10. Finish for Finished Rooms: Chrome or nickel plated.

11. Operation: Wheel handle or operating key.

12. Include operating key with each operating-key hose bibb.

13. Include integral wall flange with each hose bibb.

37.6 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.

3. Size: NPS 3/4 (DN 20).

4. Body: Copper alloy.

5. Ball: Chrome-plated brass.

6. Seats and Seals: Replaceable.

7. Handle: Vinyl-covered steel.

8. Inlet: Threaded or solder joint.

9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.

2. Pressure Rating: Class 125.

3. Size: NPS 3/4 (DN 20).

4. Body: ASTM B 62 bronze.

5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.

6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

37.7 WATER HAMMER ARRESTERS

A. In all open circuit water systems install water hammer arrestors in each branch connection and in particular each vertical branch or pipe run.

B. Water hammer arrestors shall be with nesting type bellows contained within casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Both casing and bellows shall be constructed of stabilized 18-8 stainless steel.

C. Water hammer arrestors shall be selected for following conditions.

D. Water Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows/Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
4. Maximum working pressure: 8 Bar.
5. Maximum temperature: 150 deg.C

37.8 AIR VENTS

A. Air vents shall be installed on all coils and all other high points required for efficient operation and venting of system.

B. Air vents shall be provided at all high points in the pipework, whether indicated on the drawings or not. Large diameter automatic air vents shall be provided at all primary venting positions, such as plant rooms and at the head of vertical risers.

C. Each automatic air vent shall be preceded by a lock shield pattern stop valve, and the discharge from the air vent shall be 12 mm copper pipe terminating with an open discharge in a position to be agreed over a conveniently located drain, gulley or sump.

D. The vents on coils and other mechanical equipment shall be as per approved equipment manufacturer's standards. Only these may be manual type and all other vents shall be automatic.

E. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating at 140 deg F (60 deg C) or as required
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 (DN 15) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

F. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

37.9 FLOAT VALVES

A. Float valves shall be installed as indicated in the drawings to provide consistent level control in reserve supply water storage tanks. The valve shall meet the requirements of the Water Byelaws for air gaps and shall be constructed throughout in approved materials and shall prevent back siphoning. Inlet flow shall be co-axial with the piston movement, to ensure high discharge capacity and smooth, quiet operation. The valve shall have 'O' ring piston seals, resilient seated disk, Dezincification resistant bronze fabricated approved solder and shall be hydraulically tested to ensure buoyancy and constructed in accordance with BS1968.

B. Bronze equilibrium float valves 80 and above shall be flanged end, flat faced and drilled to suit BS4504 PN16. Bronze equilibrium float valves up to 50 shall be screwed end BS2779 parallel and shall be provided complete with back nut.

37.10 RELIEF VALVES

A. Domestic Water Temperature and Pressure Relief Valve. On hot water storage tanks provide an ASME rated thermostatic, self-closing, temperature and pressure relief valve, located in the relief valve openings of tanks. Valve shall have a minimum thermal discharge capacity equal to the input capacity of the heater standard pressure setting of 600 kPa and standard temperature setting of 100 degrees C. Relief valve pipe to discharge to floor drain.

37.11 SOLENOID VALVES

A. Electrically operated solenoid valves shall be single phase 220V and shall be rated for the system pressure.

37.12 AUTOMATIC AIR VALVES

A. Automatic air valves shall have a bronze body with bolted cover and a 9mm top outlet. They shall each incorporate a suitable float mounted on a stainless steel spindle terminating in a needle valve for closure against a stainless steel seating at the outlet. For low pressure systems the valve shall be provided with a test cock and a brazed float, but for medium and high pressure systems the float shall be of stainless steel. Automatic air valves for low pressure systems shall, incorporate an internal ball check valve at inlet to prevent air entry to the system. Automatic air valves for cold water services shall be to the approval of the local water authority.

37.13 EXPANSION COMPENSATORS

A. Expansion compensators for 75 mm diameter pipe and larger shall be pack less bellow type with equalizing rings, stainless steel bellows, limit stops, internal telescoping sleeves and carbon steel beveled welding ends.

B. Expansion compensators for 65mm diameter and smaller shall be pack less bellows type with stainless steel bellows, anti-torque device, limit stops, guides and threaded pipe ends.

37.14 FLEXIBLE PIPE CONNECTORS

A. The flexible connector shall be made of multi-layer in nylon tire cord fabric reinforcement with EPDM cover and liner. Straight connectors shall have minimum two spheres. Connectors 50mm and smaller may have threaded ends. Larger sizes shall have baked enamel ductile iron floating flanges. There shall be a molded in ductile iron reinforcing ring

B. Standard duty flexible connector shall be rated for 1723 kPa at 76.6°C, and 1130 kPa at 121 °C.

C. Where flexible connectors are connected to unanchored piping or isolated equipment, provide control cables and rods when pressure exceeds the maximum recommended for this application by the manufacturer.

D. Flexible hoses shall be stainless steel braid and carbon steel fittings.

37.15 WATER CHEMICAL FEEDER (I.E MANUAL DOSING POT)

A. The unit shall be a steel one, shot type with the design pressure in accordance to the system pressure. Feeder shall be supplied complete with fill and drain valves, filling funnel, and air cock. Provide non return valve at pipe connections to dosing pot.

37.16 UNIONS

A. All unions in steel pipes shall be minimum 1200 kPa malleable iron, screwed, with brass to iron ground joints.

B. All unions in copper pipe shall be cast bronze, wrought copper or wrought bronze, with threaded or solder-joint tube ends.

37.17 PUDDLE FLANGES

A. Where pipework passes through the external walls of the buildings or trenches below ground level, the Contractor shall supply and cast or built puddle flanges into the structure.

B. Puddle flanges are to be manufactured from the same material as the pipework of which they form a part.

C. Each puddle flange shall comprise a length of pipe, flanged or screwed at end according to diameter with an undrilled slip on flange welded on the outside at a point where it will be located mid-way in the thickness of the wall. The puddle flange is to be painted externally with two coats of bituminous paint before being built into the structure.

37.18 FLOW SENSING DEVICES

A. Contractor shall provide all flow sensing devices as indicated on the drawings. Proper schedule indicating the flow rate that is to be sensed, the type of flow sensing device, and the permanent pressure loss at the design flow rate shall be submitted for approval of the Consultant.

B. The flow sensors shall be one of following types:

C. PITOT TUBE FLOW SENSORS: Multi-port averaging type flow sensor designed to sense the velocity of a fluid flowing in a pipe and produce a pressure output that is proportional to the fluid velocity

D. VORTEX SHEDDING FLOW SENSORS: Wafer type, unit with an analog output

PART 38 - EXECUTION

38.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install Y-pattern strainers for water on supply side of each control valve/water pressure-reducing valve/solenoid valve and pump.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

38.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

38.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

XIV. DOMESTIC WATER PUMPS

PART 39 - GENERAL

39.1 CODES AND STANDARDS

A. BS 21:1985 Specification for pipe threads for tubes and fittings where pressure–tight joints are made on the threads (metric dimensions)

B. BS EN 1092-1:2007 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges

C. BS 3790:1995 Specification for endless wedge belt drives and endless V-belt drives

D. BS 4814 Specification for expansion vessels using internal diaphragm, sealed hot water systems

E. BS EN ISO 5198:1999 Centrifugal, mixed flow and axial pumps. Code for hydraulic performance tests. Precision class.

F. BS 5257:1975 Specification for horizontal end-suction centrifugal pumps (16 bar)

G. BS 7074:1989 Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems. Code of practice for domestic heating and hot water supply.

H. BS EN ISO 9906:2000 Rotodynamic pumps. Hydraulic performance acceptance tests. Grades 1 and 2.

I. BS EN 60335-2-51:1991 Specification for safety of household and similar electrical appliances. Particular requirements. Stationary circulation pumps for heating and service water installations.

J. BS EN 1092-2:1997 Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges.

K. BS EN 1092-3:2003 Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges

L. BS EN 10226 Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation

39.2 SUMMARY

A. Section Includes:

1. Horizontally mounted, in-line, close-coupled centrifugal pumps.
2. Vertically mounted, in-line, close-coupled centrifugal pumps.

3. Circulating Pumps

B. Related Sections include the following:

1. Division 22 Section "Domestic-Water Packaged Booster Pumps" for booster systems.

39.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50V or for remote-control, signalling power-limited circuits.

39.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

39.5 QUALITY ASSURANCE

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

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

C. Pump operating point shall be within 5% of the maximum efficiency point. The pump casing so selected shall be able to accommodate an impellor one size larger than the selected impellor.

D. Pump motor speed shall not be more than 1500 rpm, unless otherwise approved by the supervision engineer.

39.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

39.7 COORDINATION

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

PART 40 - PRODUCTS

40.1 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers:

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

C. Pump Construction:

1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections.
2. Impeller: Stainless Steel; Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Stainless Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

40.2 VERTICALLY MOUNTED, IN-LINE, MULTI-STAGE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers.

B. Description: Factory-assembled and -tested, in-line, multi-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.

C. Pump Construction:

1. Casing: Radially split, cast iron, with wear rings and threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections Pump manufacturer's base attachment for mounting pump on concrete base shall be provided..
2. Impeller: Stainless steel, statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Stainless-steel.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
   A. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.

D. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.

40.3 CIRCULATING PUMP

A. Pumps shall have the performance and duty as stated elsewhere.

B. All pumps shall be suitable for the service pumped and the operating temperatures and pressures stated elsewhere.

C. Pumps shall be capable of providing the duties required at the design operating conditions.

D. The Contractor shall recalculate the total system resistance based upon the final plant selection and installed drawings and revise the pump duty as necessary to achieve the design flow rate.

E. The Contractor shall similarly reselect the necessary electrical requirements or any other variation in associated equipment caused by a change in system pressure drop.

F. Pumps shall be 'type' tested in accordance with BS EN ISO 5198 and BS EN ISO 9906.

G. Performance curves showing head, volume flow rate, efficiency and absorbed power of each pump shall be submitted to the Engineer prior to equipment being ordered. Pump curves shall indicate performance under all likely operating conditions. Pump test data shall comply with BS EN ISO 9906 and BS EN ISO 5198. Data shall be related to pump speed to allow the effect of speed changes to be assessed.

H. Pumps shall be selected to ensure that they are not operating at the extremes of their range by basing the selection on a mid range impeller.

I. Where pumps are operated under variable speed control then they shall be selected to the right hand side of the best efficiency point (BEP). A constant speed pump shall be selected within +/- 20% of the BEP. For constant flow pumps the contractor shall allow for trimming of the impellor at commissioning.

J. All pumps shall have the motor, motor frame, impeller casing and drives of sufficient size to allow the capability of a 10% minimum increase in head generated at the stated flow rate by increasing the impeller size only. The motor shall be selected such that the power curve does not cross the pump curve at any point (non-overloading).

K. Pumps shall comply with the requirements of BS EN 60335-1, BS 4082 Parts 1 and 2 and BS 5257, as applicable.

L. Connecting pipework shall be arranged to ensure that no stresses are transmitted to the pump casings.

M. Pumps shall be provided with anti-vibration mountings and flexible connections. The Contractor shall ensure that the complete unit is effectively balanced to eliminate noise and vibration.

N. Pumps shall be arranged to be fully accessible for maintenance with adequate space to allow motors to be safely removed from the pump assembly and with space for left available lifting equipment if required.

O. Single case twin impeller/twin motor pumps shall be provided with a blanking plate to allow one pump to continue operating while the motor of the other is removed.

P. Unless otherwise stated pumps shall have a maximum sound pressure level of 75 dBA at a distance of 1 meter

Q. Minimum pumping efficiency shall be 70-75% at the stated duty unless stated otherwise.

R. Pumps on closed circuit systems shall be selected with a maximum operating speed of 1450rpm unless otherwise stated or agreed with the Engineer.

S. Motors shall comply with the relevant sections of this specification. All motor selections shall be agreed with the Engineer prior to the equipment being ordered.

T. Where stand-by pumps are indicated with automatic change-over, the change-over shall be initiated and verified by means of flow sensing devices of an approved type. Non-return check valves, selected to have low resistance flow, shall be incorporated in each discharge line.

U. Each pump shall be fitted with an isolating valve on the inlet and outlet connections. Valves and strainers shall be pipeline size, not connection size and shall be in accordance with the relevant sections of this specification.

V. Pump connections shall be provided with flanges or unions, as appropriate, to permit the pipework to be removed for casing and impeller inspection and cleaning without draining the system or major dismantling of pipework.

W. Pump connections shall be screwed to BS 21 for sizes up to 50mm diameter, and flanged to BS EN 1092 to suit the system maximum pressure on sizes 65mm and above.

X. Pumps shall be complete with a drain plug and, except where the pump is inherently self-venting, a manual air vent.

Y. Bedplates, incorporating drain pans shall have a piped drain arranged to discharge over a protected tundish.

Z. The contractor shall be responsible for providing all dimensions and details to enable pump bases to be set out.

AA. Equipment shall be arranged so that is safely accessible for maintenance.

40.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

40.5 CONTROLS

A. Pressure Switches: Electric, adjustable for control of water-supply pump.

1. Type: Water-immersion pressure sensor, for installation in piping.

2. Enclosure: NEMA 250, Type 4X.

3. Operation of Pump: On or off.

4. Transformer: Provide if required.

5. Power Requirement: 24V, ac.

B. Thermostats: Electric; adjustable for control of hot-water circulation.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Enclosure: NEMA 250, Type 4X.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: 24V, ac.

C. Timers: Electric, for control of hot-water circulation pump.

1. Type: Programmable, seven-day clock with manual override on-off switch.
2. Enclosure: NEMA 250, Type 1.suitable for wall mounting.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: 24V, ac.

D. Transfer/Booster pump control panel shall be complete with water resistant enclosures, main disconnect switch, fused circuit for each motor, magnetic starters with three overloads, selector switch for each pump, control circuit transformers, minimum run timers, circuit breaker for each pump, 'Power-on' indicating lights, panel mounted gauges, alternating relay circuit to alternate pumps, hand-off-automatic switches for each pump and all other components required to achieve the control sequence specified. The control panel shall also contain all required contacts for monitoring and control from a building control system including pump status, low pressure, motor overload.

PART 41 - EXECUTION

41.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

B. Refer to detailed installation information in the Plumbing Services Particular Specification in Division 22 00 01 of this Specification.

41.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install vertically mounted, in-line, multi stage, -coupled centrifugal pumps with shaft vertical.

C. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using restrained spring.

1. Minimum Deflection: 1 inch (25 mm).

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

D. Install pressure switches in water supply piping.

E. Install thermostats in hot-water return piping.

F. Install timers.

G. Install time-delay relays in piping between water heaters and hot-water storage tanks.

41.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

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

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the pumps:

2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section "Domestic Water Piping Specialties."

3. Install pressure guage at suction of each pump and pressure guage at discharge of each pump. Install at integral pressure-guage tapping's were provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

D. Comply with Division 26 Sections for electrical connections, and wiring methods.

E. Connect pressure switches/thermostats/time-delay relays/timers to pumps that they control.

F. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

41.4 IDENTIFICATION

A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

41.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set pressure switches/thermostats/timers/time-delay relays for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.
6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

41.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 11 23

XV. DOMESTIC WATER PACKAGED BOOSTER AND TRANSFER PUMP SETS

PART 42 - GENERAL

42.1 SUMMARY

A. Section Includes:

1. Constant-speed Transfer pumps.

2. Variable-speed booster pumps.

B. Related Sections:

1. Division 22 Section "Domestic Water Pumps" for domestic-water circulation pumps.

2. Division 22 Section "Facility Indoor Potable-Water Storage Tanks" for separate hydro pneumatic domestic-water tanks for multiplex booster pumps.

42.2 DEFINITIONS

A. VFC: Variable-frequency controller(s).

42.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7]

1. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified [and the booster pump will be fully operational after the seismic event]."

42.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Seismic Qualification Certificates: For booster pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify centre of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

42.5 QUALITY ASSURANCE

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

B. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."

2. UL 508A, "Industrial Control Panels."

3. UL 778, "Motor-Operated Water Pumps."

4. UL 1995, "Heating and Cooling Equipment."

D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

42.6 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

42.7 COORDINATION

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

PART 43 - PRODUCTS

43.1 CONSTANT-SPEED TRANSFER PUMPS

A. Manufacturers: Subject to compliance with requirements; provide from the list of approved manufacturers.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump, piping, valves, specialties, and controls, and mounted on base.

C. Pump:

1. Type: End suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.

2. Casing: Radially split; bronze.

3. Impeller: Closed, ASTM B 584 cast bronze; statically and dynamically balanced and keyed to shaft.

4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.

5. Seal: Mechanical.

D. Motor: Single speed, with grease-lubricated, ball-type bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.

E. Valves:

1. Shutoff Valves NPS 2 (DN 50) and smaller: Gate valve or two-piece, full-port ball valve, in pump suction and discharge piping.

2. Shutoff Valves NPS 2-1/2 (DN 65) and Larger: Gate valve or lug-type butterfly valve, in pump suction and discharge piping.

3. Check Valve: Silent type in pump discharge piping.

4. Control Valve: Adjustable, automatic, pilot-operated, pressure-reducing type in pump discharge piping.

F. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

G. Hydro pneumatic Tank: Pre charged, ASME-construction, diaphragm or bladder tank made of materials complying with NSF 61.

H. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for single-pump, constant-speed operation, with load control and protection functions.

1. Control Logic: Solid-state system with transducers, programmable microprocessor, and other devices in the controller.

2. Motor Controller: NEMA ICS 2, general-purpose, Class A, full-voltage, combination-magnetic type with under voltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.

a. Control Voltage: 24 V ac, with integral control-power transformer.

3. Motor Controller: NEMA ICS 2, solid-state, reduced-voltage type.

a. Control Voltage: 24-V ac, with integral control-power transformer.

4. Enclosure: NEMA 250, Type 12.

5. Motor Overload Protection: Overload relay in each phase.

6. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.

7. Pump Operation: pressure- sensing method.

8. Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.

9. Instrumentation: Suction and discharge pressure gauge.

10. Light: Running light for pump.

11. Thermal-bleed cut-off.

12. Water-storage-tank, low-level cut-out.

13. High-suction-pressure cut-out.

14. Low-discharge-pressure cut-out.

15. High-discharge-pressure cut-out.

16. Building Automation System Interface: Provide auxiliary contacts for interface to building automation system. Building automation systems are specified in Division 23 Section "Instrumentation and Control for HVAC." Include the following:

    a. On-off status of pump.

    b. Alarm status.

I. Base: Structural steel. (as required)

1. Hydro pneumatic Tank:

    a. Pressure Rating: 250 psig (1725 kPa).

43.2 VARIABLE-SPEED BOOSTER PUMPS (ALL THE BOOSTER PUMPS ARE VARIABLE SPEED).

A. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump, piping, valves, specialties, and controls, and mounted on base.

C. Pump:

1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.

2. Casing: Radially split; bronze.

3. Impeller: Closed, ASTM B 584 cast bronze; statically and dynamically balanced and keyed to shaft.

4. Shaft and Shaft Sleeve: Stainless Steel shaft, with copper-alloy shaft sleeve and deflector.

5. Seal: Mechanical.

D. Motor: Single speed, with grease-lubricated, ball-type bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.

E. Valves:

1. Shutoff Valves NPS 2 (DN 50) and smaller: Gate valve or two-piece, full-port ball valve, in pump suction and discharge piping.

2. Shutoff Valves NPS 2-1/2 (DN 65) and Larger: Gate valve or lug-type butterfly valve, in pump suction and discharge piping.

3. Check Valve: Silent type in pump discharge piping.

4. Control Valve: Adjustable, automatic, pilot-operated, pressure-reducing type in pump discharge piping.

F. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

G. Hydro pneumatic Tank: Pre charged, ASME-construction, diaphragm or bladder tank made of materials complying with NSF 61.

H. Control Panel: Factory installed and connected as an integral part of booster pump; automatic for single-pump, variable-speed operation, with load control and protection functions.

1. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in the controller.

2. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.

3. Control Voltage: 24 V ac, with integral control-power transformer.

4. Enclosure: NEMA 250, Type 12.

5. Motor Overload Protection: Overload relay in each phase.

6. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.

7. Pump Operation: Pressure-sensing method.

8. Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.

9. VFC: Voltage-source, pulse-width, modulating-frequency converter; installed in control panel.

10. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.

11. Instrumentation: Suction and discharge pressure gauges.

12. Light: Running light for pump.

13. Thermal-bleed cut-off.

14. Water-storage-tank, low-level cut-out.

15. High-suction-pressure cut-out.

16. Low-discharge-pressure cu-tout.

17. High-discharge-pressure cut-out.

18. Building Automation System Interface: Provide auxiliary contacts for interface to building automation system. Building automation systems are specified in Division 23 Section "Instrumentation and Control for HVAC." Include the following:

    a. On-off status of each pump.

b. Alarm status.

I. Base: Structural steel.

1. Hydro pneumatic Tank:

a. Pressure Rating: 250 psig (1725kPa).

1.1 MOTORS

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

PART 44 - EXECUTION

44.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

44.2 INSTALLATION

A. Equipment Mounting: Install booster pumps on concrete base using restrained spring isolators.

1. Minimum Deflection: 1 inch (25mm).

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450mm) centers around the full perimeter of concrete base.

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

44.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic-water piping to transfer/ sbooster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge piping.

1. Install shutoff valves on piping connections to booster-pump suction and discharge piping. Install ball, butterfly, or gate valves same size as suction and discharge piping. Comply with requirements for general-duty valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Division 22 Section "Domestic Water Piping."

3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Division 22 Section "Domestic Water Piping."

4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge piping. Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping."

5. Install piping adjacent to booster pumps to allow service and maintenance.

44.4 IDENTIFICATION

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

44.5 FIELD QUALITY CONTROL

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

B. 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.

C. Tests and Inspections:

1. Perform visual and mechanical inspection.

2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

44.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

44.7 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested, provide on-site assistance in adjusting booster pump to suit actual occupied conditions.

44.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

XVI. WATER STORAGE TANKS AND ACCESSORIES

PART 45 - GENERAL

45.1 SUMMARY

A. Sleeves, Puddle Flanges, Suction Strainers, Float Valves etc

B. Metal work like Ladders, Access Doors etc

C. Water Tank Level Control and Indication Instrumentation

D. Water Tank Ventilation

E. Manufactured Water Storage Tanks (GRP)

45.2 RELATED WORK

A. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

B. Section 22 11 19 – Domestic Water Piping Specialties

C. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment

D. Section 10 44 00 – Fire Protection Specialties

45.3 REFERENCES

A. ASTM A 106 - Steel Pipes, Black, for High Temperature Service (BS 1600, Part 1) – Ref "Wrotsteel" in schedule.

B. ASTM A 193 - Alloy steel and stainless-steel bolting materials for high temperature service.

C. ASTM A 632 - Seamless and Welded austenitic stainless-steel tubing (small diameter) for general use.

D. ASTM A 666 - Austenitic stainless-steel sheet, strip, plate and flat bar for structural applications.

E. ANSI B 16.5 - Steel Flanges.

F. ANSI B 16.9 - Pipe Fittings of Wrot Carbon Steel or Alloy Steel for Moderate and Elevated Temperatures.

G. BS 5486 - Enclosures of Electrical Appliances.

H. BS EN 13280:2001 – Specification for GRP Tank.

I. BS 4211:2005 – Specification for Permanently Fixed Ladder

45.4 QUALITY ASSURANCE

A. Components installed within water tanks shall be of corrosion resistant material like stainless steel or dezincification resistant copper alloys.

B. Requirements of Section 22 shall be referred to and complied with in respect of all electrical works.

45.5 SUBMITTALS

A. Section 22 shall be referred to and complied with in this respect.

B. Coordinated positions of water stops, construction joints etc. in water tank walls shall be indicated in the shop drawings.

C. Wiring diagrams, details of components and panel construction and mounting details shall be submitted in respect of water tank level control and indication instrumentation.

D. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

45.6 DELIVERY, STORAGE AND HANDLING

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

B. Factory manufactured products shall be kept in shipping cartons until time of installation.

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

45.7 GUARANTEES AND WARRANTIES

A. The Employer shall be furnished with guarantee and warranty certificates, duly registered with the manufacturer.

PART 46 - PRODUCTS

46.1 MANUFACTURERS

A. Manufacturers are subject to compliance with requirements. Provide products in accordance with the approved manufacturers list or approved similar products.

46.2 PUDDLE FLANGES

A. Puddle flanges shall be used for all connections to water storage tanks, made below the overflow level.

B. Details on the Drawings shall be referred to for minimum dimensions.

C. Puddle flanges fabricated from type K (hard) copper pipes and bronze flanges shall be used for connections to copper piping.

D. Puddle flanges fabricated from schedule 80 black steel pipes and welding neck steel flanges shall be used for connections to steel piping. The assembly shall be hot dip galvanized after fabrication.

E. Integral flanges with studs / cap nuts at wall face and loose, split flanges shall be used to flash tanking membranes at the puddle flange.

F. Synthetic membrane flashing of 900mm diameter shall be provided at puddle flanges installed in the bottom slab of the water tanks and the flashing shall be integrated with the tanking.

46.3 FLOAT VALVES

A. Modulating Float Valves: Angle/Globe pattern, single seated, hydraulically operated, pilot controlled, diaphragm type, normally closed valve of cast iron construction with flanged ends completes with pilot assembly, type K copper capillary lines, mounting plate, plastic float and operating rod, adjustable stops etc. complete.

B. Delayed Action Float Valves: Angle/Globe pattern, single seated, hydraulically operated, pilot controlled, diaphragm type, normally closed valve of cast iron construction with flanged ends completes with pilot assembly, type “K” copper capillary lines, mounting plate, plastic float and operating rod, adjustable stops, etc. complete.

C. Equilibrium Type (for panel type GRP Water Tanks): Bronze construction, angle pattern, equilibrium type float valve with flanged inlet, complete with brass / stainless steel float rod and copper float.

46.4 SUCTION STRAINERS

A. For Copper and UPVC Pipes: These shall be fabricated from line size copper pipes (Type K Hard) and bronze flanges. Minimum total area of perforations (6 mm size) shall be four times the sectional area of the pipe. Straightened pipe fabric shall be brazed to the pipe end as end cap.

B. For Ferrous Pipes: Food grade epoxy coated cast iron body with integral flange and 12mm perforations (Ref: Hattersley Newman Henders fig. No. 2151 G).

C. Fasteners shall be of corrosion resistant material like stainless steel or high tensile brass.

46.5 WATER STORAGE TANK VENTILATION

A. Fabricated goose necks with flanged joints shall be installed on top of overflow pipes to allow for free entry and exit of air during filling or emptying of the tank.

B. Copper shall be used with copper piping and hot dip galvanized black steel with ferrous piping.

C. The end of goose neck shall form a 135-degree arc from the horizontal plane, terminated square to the pipe axis and shall have integral flanged connections to the tank and the overflow pipe.

D. The mouth of the goose neck shall be covered with copper/fine plastic wire mesh net to prevent the entry of flies and pests. The net shall be attached to the pipe with worm driven hose clamps.

46.6 WATER STORAGE TANK LADDERS - INSIDE WATER TANKS

A. These shall be fabricated from austenitic (type 316) stainless steel plates, bars and seamless tubes. Main rail shall be 32mm nominal diameter and rungs shall be 25mm nominal diameter in size. Joints shall be welded and base plates of 100 x 100 x 10 mm size with drilled holes shall be provided for attaching the ladders to walls. These base plates shall be bolted to wall inserts and the ladder welded (at site) to them to attain good alignment.

B. Safety cages made of 25 x 3mm stainless steel flats shall be provided for ladders exceeding 2500mm in height. These shall be attached rigidly to ladders by bolting to specially prepared lugs on the ladder rail (omit on ladders inside tanks).

C. Additional overhead rail made of 25mm nom. diameter stainless steel tubes, bolted to ceiling soffit, shall be provided at the inside and outside of the tank access opening (in case of tanks with side access only).

D. Stainless steel wall inserts (of pipe, puddle and stud plates at wall face) shall be cast-in in the water storage tank walls for attaching ladders. Extra care shall be taken to attain proper alignment and water tightness. Appropriate detail shall be used to flash tanking membranes at ladder support bases.

46.7 WATER STORAGE TANK LADDERS - OUTSIDE WATER TANKS

A. Ladders shall be constructed as detailed above with followings exceptions;

B. With GRP sectional tanks, ladder materials can made of GRP or PVC.

C. With concrete tanks ladders materials can be GRP, heavy duty aluminium or hot dip galvanized.

D. Any section or part of the ladder is in direct contact with water it must comply with construction details of ladders inside water tank or refer to BS4211:2005.

46.8 WATER STORAGE TANK ACCESS DOORS

A. On Side Wall:

1. These shall be fabricated from minimum 1.5mm thick, type 316 stainless steel sheets, boxed to form rigid sections. Corners shall be mitered and all joints welded full length to give a continuous smooth finish. The door frames shall be attached to concrete by nailing / screwing integral purpose made tabs, on the tank side. The joint of the frame with concrete shall be filled with sealant on the visible side.

2. The door shall be constructed with a rectangular box frame with overlapping outer edge, hung with solid hinges welded to the frame. Concealed latch with recessed handle shall be provided to keep the door in closed position.

3. Three 3 mm diameter, wire mesh (25 x 25 mm space) backing welded to the door framework shall be provided to support the air filter. Single piece, viscous impingement type, synthetic air filter shall be provided to cover the opening in the door frame with overlap. The filter shall be held in position by another wire mesh facing, welded to an L-section sheet framing. The wire mesh facing shall be fixed to the door framework by metal screws.

B. On Roof Slabs:

1. Double seal, light duty cast iron cover and frame, painted inside and out white food grade epoxy, of 60 x 60 cm clear openings.

2. The key holes shall be closed type and suitable soft sealing strips shall be used at the grooves to ensure tightness.

46.9 WATER STORAGE TANK LEVEL INDICATORS / CONTROLLERS

A. Water Storage Tanks – Basement and Intermediate Level (DOMESTIC/FIRE)

1. Controller / indicator, Similar to (Sauter), with required Nos. of switch assemblies.

2. Remote indicator panel (common for all the tanks) in the plumbing plant room, containing the following:

   a. Main's isolator interlocked with the door and power on indicator (red).
   b. Remote indicator Sauter model GAN 17 B 10.
   c. High / low level indicators.
   d. Alarm buzzer.
   e. Alarm test and mute facility.
   f. Set of terminals / relays for inter connection with the filtration transfer pump set, Building automation system etc.

3. The following functions shall be accomplished:

   a. Water level indication (dial shall be calibrated in imperial gallons and cubic meters).
   b. High / low water audio-visual alarms.
   c. Low water cut-out of transfer pump set.
   d. On site adjustment of alarm set points.
   e. Provision for hook up with the building automation system for critical alarms.

B. Water Insulated Panel Storage Tanks - Roof Tanks

1. Controller / indicator, with required number, of which assemblies.

2. Remote indicator panel, for all section of the tank.

3. Temperature Controller for cooled water section.

4. The following functions shall be accomplished:

   a. Water level indication.
   b. High / low water audio-visual alarms in the indicator panel.

c. Low water cut-out of domestic booster pump set.

d. On site adjustment of alarm set points.

e. Provision for hook up with the building automation system for critical alarms.

f. Provision for hook up with fire pump control panel

46.10 CONTROL PANELS - GENERAL REQUIREMENTS

A. Requirements shall be referred to and complied with in respect of electrical system components and control panels.

46.11 CONDUITING AND WIRING

A. Heavy duty galvanized iron conduits (surface mounted) and painted sheet steel trucking shall be used for wiring.

B. Stranded copper (1.5mm2), PVC insulated wires with crimped on, sheathed terminal lugs shall be used for all interconnecting wiring. Joints shall not be allowed in a single wire length. Terminals shall be numbered using slip-on ferrules for quick identification.

46.12 MANUFACTURED WATER STORAGE TANKS (GRP TYP.)

A. Water Storage tank panel – Roof

1. Assembled from INSULATED glass fibre reinforced plastic panels of 1000 mm basic size. Half and quarter size panels shall be used as appropriate. The panel shall be hot pressed, opaque and resistant to damaging effects of ultraviolet radiation. The wetted side of the panel shall be smooth and shall not support the growth of algae or similar micro-organisms. The bottom panels shall be of such construction that permits the complete drainage of the tank.

2. The tank assembly shall be complete with structural steel base, ladders, level indicator, vents (two nos. per compartment, hinged and lockable access manhole, overflow and drain fittings etc.

3. The joints shall be sealed with non-toxic; age proof gasket and the tank assembly shall be capable of withstanding a deflection of 5mm of the base slab without leaks or damage.

46.13 CONCRETE TANKS

A. Water St0rage Tank – Basement and Intermediate Level:

1. Above or below ground concrete water storage tanks shall be reinforced concrete construction and shall be of the capacity and dimensions as indicated in the drawings. They shall comply with the relevant standards of the local authority of jurisdiction.

B. Tanks shall be complete with the following:

1. Minimum 600x600 openings (as indicated in drawings) with sealed manhole cover for each valve / accessory.

2. Manholes with double sealed manhole covers.

3. Internal stainless steel or aluminium ladders.

4. Inlets, outlets, over flows, drains and insect proof vent cowls as required on Drawings.

5. High- and low-level controllers, level sensors, level switches and alarms all linked to the BMS.

6. Internal GRP lining or cementitious waterproof lining to the requirements of the local authority of jurisdiction and shall be fully potable guaranteed for 25 years.

7. With watertight hinged cover and locking device.

8. Necessary perforations (including puddle flanges where required) for the inlet and outlet pipes shall be provided. Each storage tank shall be equipped with overflow, warning pipes, and vent pipes, and drain sumps (located directly below the manhole).

PART 47 - EXECUTIONS

47.1 PUDDLE FLANGES

A. Puddle flanges shall be erected in the form work perpendicular to the wall face and rigidly to resist displacement during pouring of concrete.

B. Verticality of the flange faces and alignment of bolt holes with connecting equipment (valves etc.) shall be checked and ensured.

C. The openings in the form work, around puddle flanges, shall be sealed so as to avoid leakage (and resultant honey combing) and undesirable formation of concrete.

D. Alignment of the puddle flanges shall be checked (and adjusted if necessary) immediately after pouring of the concrete.

47.2 SUCTION STRAINERS

A. Suction strainers shall be installed on all supply connections from water storage tanks, with bend down elbows in low level connections.

B. Bronze / fabricated copper suction strainers shall be used for copper piping.

C. Cast iron suction strainers shall be used for steel piping.

47.3 LADDERS AND ACCESS DOORS

A. Inserts shall be installed in the form work for tank walls in a manner similar to that of puddle flanges and good alignment shall be attained.

B. Fasteners and cap nuts of corrosion resistant material shall be used for fixing the ladder to the tank walls.

47.4 LEVEL INDICATION AND CONTROL INSTRUMENTATION AND PANELS

A. The power supply to the system shall be coordinated with the Electrical works and obtained from the standby power supply network, as far as possible. Conduit and wiring to the source shall be included in this Section.

B. Components of the system shall be rated for Dubai, UAE ambient conditions as stipulated by local authorities.

C. The electrical power supply requirements shall be coordinated with the Electrical works and obtained from the emergency power supply network, as far as possible. Conduit and wiring to the source and the controlled equipment shall be included in this Section.

D. The regulations of the local authorities and requirements of the specifications for Electrical works of the projects shall be referred to and complied with in all respects.

E. Relays/volt free contacts in terminal blocks shall be provided for interconnecting with other systems (like BAS).

F. Panels shall be wall mounted with the centre line at 130cm above FFL.

47.5 STRUCTURAL BASE FOR MANUFACTURED WATER STORAGE TANKS

A. The contractor shall coordinate with the building works and ensure the sufficiency of dimensions of the RCC structural base to suit the requirements of the tank manufacturer.

B. Necessary information in respect of the allowable deflections of the tank base shall be furnished to check the integrity of the RCC base to suit the tank.

47.6 TESTING AND COMMISSIONING

A. Blank flanges / plugs shall be temporarily installed on the piping connections to enable the civil works contractor to test the water tightness of concrete tanks.

B. The inside of the tank shall be thoroughly cleaned of all dirt, washed down with water and drained.

C. The tank(s) shall be disinfected along with the disinfection and flushing of the water supply piping.

D. Water samples shall be analyzed and results submitted to the Consultant prior to handing over.

XVII. SANITARY WASTE AND VENT PIPING

PART 48 - GENERAL

48.1 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.

2. Special pipe fittings.

3. Encasement for underground metal piping.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Sewerage Pumps."

48.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CPVC: Chlorinated Polyvinyl chloride plastic.

C. PEX: Cross linked polyethylene.

D. PPR: Polypropylene plastic.

E. HDPE: High-density Polyethylene

F. UPVC: Unplasticized Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

48.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to [ASCE 7, "Minimum Design Loads for Buildings and Other Structures."]

48.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

C. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

2. Sovent Drainage System: Include plans, elevations, sections, and details.

D. Field quality-control inspection and test reports.

48.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency. All pipes to be kite mark certified.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

C. All components and fittings of each pipe work shall be from same supplier.

D. Store fittings in their delivery bags or within protective containers. Do not expose to direct sunlight.

E. Store pipe clear of ground. Do not stack pipes more than 7 layers high. Do not expose to direct sunlight.

PART 49 - PRODUCTS

49.1 PIPING MATERIALS AND SCHEDULE:

A. Refer to Section 22 00 01 Plumbing Services – Particular Specification part 2.2 Piping Material Schedule.

49.2 DRAINAGE PIPES ACOUSTICS

A. All horizontal soil, waste pipes and rain water passing through occupied spaces shall be with silent or acoustical drainage pipes.

49.3 GULLIES

A. All concrete elements of any class for drainage works, whether precast or in-situ, shall be carried out in accordance with relevant civil specifications.

1. Plain cement concrete: This work shall include, but not by way of limitation, supply and casting of sulphate resisting concrete as shown on Drawings and shall be of the following classes (unless specified elsewhere to the contrary):
    a. Class K 140 for bed or haunch or encasement to pipes.
    b. Class K 140 for benching including 2 cm thick, smooth hard finish.
    c. Class K140 for blinding.
2. Reinforced cement concrete: This work shall include, but not by way of limitation, supply and casting of all class K 300 sulphate resisting reinforced concrete elements, whether precast or in-situ, incorporated in the storm water works as shown in the Drawings.

49.4 PRECAST MANHOLE RINGS

A. These shall be of lightly reinforced sulphate resisting cement concrete class K300. Rings shall be of one-meter internal diameter, 15cm thick and of suitable lengths. They shall be boxed on the manhole shaft and jointed with cement and sand mortar (1:3) and the external walls shall be treated with three coats of liquid asphalt to a thickness of not less than 2mm.

49.5 CAST IRON ACCESSORIES FOR MANHOLES

A. Manhole covers and frames: Cast iron/Ductile Iron covers for manholes shall be heavy duty, square, single seal type with closed key holes. They shall be of sound manufacture and free from projections or voids and shall be treated with two coats of an approved tar compound (Inertol thick L or equal). Frames shall be single seal. The covers shall be fixed on to the previously installed frames after filling the seal grooves with a mixture of grease and sand.

B. Step irons shall be of galvanized cast iron conforming to BS 1247. The weight of the step iron shall not be less than 3.20 lbs and shall be 10 inch long and 6 inch wide.

C. Two nos. prising and lifting bar of approved design shall be supplied by the Contractor for the project.

D. Grates and frames for drainage channel shall be made of cast iron and according to the dimensions shown on the Drawings. They shall be treated on both sides with two coats of approved rustproof paint.

PART 50 - EXECUTION

50.1 INSTALLATION - GENERAL

A. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. All pipe work, fittings and accessories shall be installed as per BSEN 12056, to give water tight pipe work installation.

C. Pipe route shall be the shortest possible, with as few bends as possible.

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Plastic pipe work and fittings jointing shall generally be solvent welded with ring seal joints to accommodate expansion

G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping DN 80 and smaller; 1 percent downward in direction of flow for piping DN 100 and larger.

2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

M. 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."

N. Install piping to allow for expansion and contraction without stressing pipe joints or connected equipment.

O. Base of stack shall be formed using 2Nos 45 degree bends connected together by an appropriate length of pipe or a 90 degree large radius support bend to ensure that the formed bend is minimum 2 times the OD of the stack.

P. All branches to be swept in the direction of flow at all times.

Q. Cross vent connections shall be made by a branch pipe being at 45 degrees. All cross connections shall be made above the flood level of any appliance at each floor level.

R. Install exposed piping parallel or at right angles to the building walls, except where otherwise shown on the Contract Drawings.

S. Where changes in pipe sizes occur, install tapered reducer fittings. Use of bushings is not permitted. Install eccentric reducer fittings with level crown.

T. Where changes in pipe direction occur, install factory manufactured fittings. Bending or forming of piping is not permitted without Engineer's written permission.

U. Install test-tees in soil, waste, vent and rainwater pipe risers at minimum 1200mm above the ground floor level, at every alternate level and at other locations as shown on the contract drawings.

V. Provide adequate clearance for installation of insulation and access to valves and fittings.

W. Provide minimum clearances between piping covered by this Section and other services.

X. Expansion joints shall be anchored; the anchor points shall be made utilizing the groove provided on fittings matching engineered bracket. If it is not possible to anchor at the expansion joint, it shall be provided directly onto the pipe; must be within one meter of the proposed point of anchorage.

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

50.2 ACCESS POINTS

A. Provide access points for cleaning purpose at the following:

1. Access shall be at all changes of direction and at each floor level (1200mm from finished floor level) on each soil and waste stack.

2. Locate to allow use of cleaning equipment or the insertion of testing apparatus.

50.3 SETTING OUT AND EXCAVATION OF TRENCHES FOR BELOW GRADE MAINS

A. Trenches shall be excavated only after completion of site development work like backfilling, if any. Care shall be taken to ensure that no heavy equipment shall be worked or moved over piping which is not designed to take up such loads.

B. Clear the existing ground levels along the line of all mains, particularly at all manholes, building connections etc.

C. Where long lengths of piping mains are to be laid in trenches at slight slope, sight rails should be fixed across the trench at intervals of at least 5 meters at a height equal to the length of the boning rod to be used above the required invert level of the drain or sewer at the point where the

sight rail is fixed. There shall be not less than two sight rails in position on each length of the main under construction.

D. The trench shall be excavated to the actual required depth such that the pipe shall bear uniformly on undisturbed ground at every point between joint holes.

E. The Contractor shall examine any unfitting or weak ground material, which may be found below the pipe laying level and report the same in writing to the Engineer, before laying any pipe. In such cases, the unsuitable material shall be removed and made up by backfilling, without any additional cost to the Employer.

50.4 INSTALLATION - PARTICULAR FOR BELOW GRADE MAINS

A. Handle pipes with utmost care so as not to subject the pipes to shocks, which may crack or break the internal lining, if any. Cement lined pipes which are cut to length on site shall be tapered at their spigot ends by a grinder and a fast drying coal tar coat applied at the uncoated areas.

B. The pipes shall be laid directly on the undisturbed bottom of the trench with special recesses made for the joints or placed on a concrete bed. The pipes must be aligned carefully both in line and level. Wooden supports must not be placed under the pipes. Precautions shall be taken to prevent dirt from entering the pipe.

C. Ductile iron pipes shall be wrapped up with polyethylene sleeving before being laid. Adhesive tapes shall be used to secure the sleeving at socket and spigot ends. Plastic coated wire shall be used to secure the encasement at every one third length of the pipe. After jointing is done and testing completed, encasement shall be pulled to close the whole joint and be secured with plastic coated wire strapping. The pipes shall be laid with the folded part of the polyethylene encasement on the crown of the piping.

D. Piping shall be protected against the ingress of foreign material before the pipe is placed in the trench. If the case is such that the pipe cannot be laid, in the trench and in place, without getting earth into it; each end shall be covered with a heavy, tightly woven canvas bag of suitable size before lowering the pipe into the trench. The bag shall be left there until the connection is to be made to the adjacent pipe.

E. When jointing pipes, a mark shall be made to check the position of the end of the barrel. Leave a gap of 5 to 10mm between the ends of the pipes, for piping with flexible joints.

F. The joints shall be left exposed until the line is pressure tested and approved by the Engineer.

G. Deviations from given levels may not be greater than +1cm or -1cm at any point and gradients not greater than 1/20 of the given value.

50.5 BACKFILLING OF PIPE TRENCHES

A. All surplus, suitable and approved excavation material shall be used for backfilling the trenches.

B. All backfill material shall be free of cinders, ashes, refuse, vegetable or organic matter, boulders, stones or other material which are unsuitable for the purpose, in the opinion of the Engineer.

C. Excavations shall be backfilled without unnecessary delay, but not before completion of testing of the piping. The first 30cm fill shall only be compacted by hand tamping; subsequent layers being compacted by power tampers as approved by the Engineer. No heavy mechanical equipment shall be used for backfilling or compaction.

D. The pipe trenches shall be backfilled and compacted to a minimum of 95% of AASHO T -180 density, in layers of not exceeding 15cm and fills shall be brought up simultaneously on the full width of the trench.

50.6 INSTALLATION OF MANHOLE ACCESSORIES

A. Frame of manhole cover shall not be cast in together with roof slab of manhole.

B. Covers and frames shall be fixed in such a way as to match adjacent surface levels with tolerances not exceeding +3mm or -3mm. Before the maintenance period expires, check all manhole covers and readjust them if they are in excess of above mentioned tolerances.

C. Fix all cast iron accessories to concrete manholes using cement and sand mortar (1:3).

50.7 PROTECTION

A. Give the following protective coating/wrapping to piping. All piping above louvered ceilings shall be painted black.

B. Buried plastic piping in areas subjected to traffic loading:

1. Encasement with minimum 10cm thick, class K140, plain concrete.

2. Colored metal coated plastic foil warning grids.

C. Plastic piping buried within/below raft foundation:

1. Monolithic concrete channel enclosing the pipe with water proofing membrane extended under the same when pipe work is below the raft level.

D. Plastic piping exposed to direct sunlight:

1. One layer of self-adhesive, aluminium foil backed kraft tape with 10% overlap.

2. One layer of “Densopol 60” with 50% overlap.

3. Heavy canvas jacketing with Benjamin Foster finish.

E. Insulated plastic piping in technical areas and below grade pipe trenches.

1. Heavy canvas jacketing with Benjamin Foster finish.

F. HDPE storm/drainage piping in areas where the piping is diverting and running horizontally should be acoustically insulated.

50.8 TESTING OF PRESSURIZED PIPING

A. The pipes shall be jointed, plugged and shall have been in position for at least 24 hours, before the tests are carried out.

B. The piping shall be tested for line, gradient and water tightness. The Contractor shall furnish all labour, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer. A minimum of two (2) Nos identical pressure gauges shall be installed at extremities of the piping circuit to be tested.

C. Fill the piping with clean fresh water, leaving all high points open to allow for purging of air. Allow a soaking period of at least 24 hours for cement lined or concrete pipes.

D. Pressurize the system using manual pumps in increments of 25 percent of the test pressure. Allow a standing period of 10 minutes after each pressure increment. Pressure testing using motor driven pump is not permitted.

E. Do not over pressurize the system under any circumstance. If the test pressure is close to the maximum permissible pressure of any of the system components, install calibrated pressure relief valves in the tested circuit.

F. Prior to testing keep all valves and control devices in open position. After completion of pressure test, close each valve one at a time starting from the pressure release end, so as to ensure tightness of the valve.

G. The piping shall be hydrostatically tested at a pressure of 690Kpa (100 psig) or 1.5 times the system working pressure, whichever is greater, but limited to 1379Kpa (200 psig) for copper and steel piping and 1034Kpa (150 psig) for UPVC piping. The pressure shall be maintained for at least 4hours. In metallic piping, allow for pressure fluctuations due to ambient temperature variations. Record the circuit temperature along with the pressure readings.

H. Check for leaks by swabbing with a dry tissue. Drop in pressure to the order of 10Kpa (1.5 psig) per hour shall be considered as acceptable.

I. Do not subject sanitary fixture chrome fittings to the test pressure.

J. Piping shall be tested in segments during the progress of the work. Maintain an official log book for recording the tests carried out on sections of piping, including test pressure, date of test and approval signature of Engineer's representative witnessing the test.

50.9 TESTING OF DRAIN, WASTE AND VENT PIPING

A. The pipes shall be joined, plugged and shall have been in position for at least 24 hours before the tests are carried out.

B. The piping shall be tested for line, gradient and water tightness. Furnish all labour and necessary testing instruments as directed by the Engineer.

C. Install compression type rubber plugs with bleeding caps to plug branch risers in horizontal piping. Install inflatable pneumatic rubber plugs for vertical risers and other inaccessible areas.

D. Open ends of pipe shall be fitted with plugs, one of which shall incorporate a tee-piece for connection to air pump and manometer. Air shall be pumped in till the manometer indicates the required pressure.

E. Pipe shall be tested by air pressure at 100mm wg (988PA) held constant for 5 minutes.

F. Vertical piping shall be tested in sections of two or three floors at a time.

G. Test completed piping by simultaneous flushing of all water closets. Test drainage branches by simultaneous discharge of filled bath tubs, washbasins etc.

50.10 PROTECTION

A. Give the following protective coating / wrapping to piping. All piping above louvered ceilings shall be painted black.

B. Buried plastic piping in areas subjected to traffic loading:

1. Encasement with minimum 10cm thick, class K140, plain concrete.

2. Colored metal coated plastic foil warning grids.

C. Plastic piping buried within/below raft foundation:

1. Monolithic concrete channel enclosing the pipe with water proofing membrane extended under the same when pipe work is below the raft level.

D. Plastic piping exposed to direct sunlight:

1. One layer of self-adhesive, aluminium foil backed kraft tape with 10% overlap.

2. One layer of “Densopol 60” with 50% overlap.

3. Heavy canvas jacketing with Benjamin Foster finish.

E. Insulated plastic piping in technical areas and below grade pipe trenches.

1. Heavy canvas jacketing with Benjamin Foster finish.

F. Drainage piping in areas where the piping is diverting and running horizontally should be acoustically insulated.

50.11 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

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

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install supports for vertical piping every 10 feet (3m).

F. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. DN 40 and DN 50: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.

2. DN 80: 48 inches (1200 mm) with 1/2-inch (13-mm) rod.

3. DN 100 and 125: 48 inches (1200 mm) with 5/8-inch (16-mm) rod.

4. DN 150 and DN 200 mm with 3/4-inch (19-mm) rod.

5. DN 200 to DN 300: 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

G. Install supports for vertical piping every 48 inches (1200mm).

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

50.12 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

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

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

50.13 PROTECTION

A. Exposed Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

XVIII. UNDERGROUND DRAINAGE

PART 51 - GENERAL

51.1 PERFORMANCE OBJECTIVES

A. The completed drainage systems shall meet the performance requirements stated in the building

B. Regulations (England and Wales), including Scotland Building Standards, BS 6031, BS EN 752: 2008, BS EN 1295-1 BS EN 1610-1, Building Drainage and where applicable in England and Wales Sewers for Adoption 6th Edition, Sewers for Scotland 2nd Edition.

C. The Contractor shall provide for the supply and installation of all pipework fittings, and ancillary equipment and is to include for all necessary, jointing, bedding, manhole construction, trenching, supports, etc in order to satisfy the tests and performance requirements detailed within this specification.

D. Notwithstanding the normal testing and inspection procedures, it shall be noted that there is a requirement contained within this specification to carry out a CCTV survey, video and report on the completed below ground drainage installation immediately prior to practical completion for this package (For further details refer to clause 3.21 of this specification).

E. The Contractor shall obtain sewer records from the sewerage undertaker prior to commencement of the contract, in order to confirm all necessary details and levels.

F. The Contractor shall verify, prior to the commencement of the works detailed in this package that the location, size and invert level of all points of connection to sewer outfalls are as indicated on the design drawings.

G. The Contractor is responsible for coordinating all works within the Public Highway with the Local Highway Authority, the Police Authority, the Statutory Authorities and any other bodies or persons that may be affected by the works in progress or by vehicle movements both in and out of the site.

51.2 TEMPORARY CAPS

A. The below ground drainage system shall be capable of withstanding periods of surcharge within the drainage system, and, or sewer, under periods of heavy rainfall. The use of temporary capped ends in all instances shall not be permitted. Mechanical capped ends, capable of withstanding an increased pressure rating under periods of drainage surcharge shall be installed in accordance with the manufacturer instructions, as indicated on the design.

B. Systems under installation shall be capped off appropriately at all times, in accordance with manufacturer's instructions. Provision for a permanent capping arrangement shall be provided as the drainage system enters the building, by the use of a restrained bracketing system in order to prevent movement, refer to detail drawings. Capped drainage end caps must only be removed when the final connections to the above ground installation are to be made. Provisions shall be undertaken for a full risk assessment to ensure a contingency plan has been carried out.

51.3 GROUNDWATER

A. The contractor shall carry out a risk assessment to assess the possibility of ground water ingress. In particular, to ensure water does not affect the integrity of manholes and associated below ground drainage pipe work, bedding and supports.

B. High-performance stainless-steel couplings, capable of resisting the potential external water pressures, shall be installed in the assembly of the installation. Further details of the pipe work installation and manholes construction are further provided within this specification.

C. The system at all times shall be kept drained and clear of water below the lowest level of the system. No water shall be permitted to run over, rise behind, or against brickwork or concrete, in order to ensure the integrity of the system.

D. The contractor may require to pump the surface groundwater from trenches, in order to contend with rising groundwater. Water arising from the construction works shall only be discharged to public sewers and watercourses with the prior written consent of the local Water Authority or the Environment Agency respectively. A risk assessment shall be undertaken by the contractor to ensure no contaminants enter the drainage system. Any associated interception required of such contaminants shall be dealt with in accordance with Building Control and the Local Water Authority.

E. The contractor may deem the installation of temporary drainage system necessary. The contractor shall ensure the installation and construction of temporary drainage shall not undermine the actual drainage installation. Temporary drainage shall be removed upon final connection of the permanent drainage system. Alternatively, the temporary drainage shall be cut and grouted in a manner to permanently seal the temporary drainage system. This will be to the requirements, satisfaction and inspection of Building Control and the Design Engineer.

51.4 CABLE DUCTS

A. All cable ducts shall be formed from 100Ø or 150Ø uPVC piping, as indicated on the drainage detail drawings. Ducts shall be laid in continuous lengths, with integral joints, be of smooth internal bore and shall form a watertight system to prevent the entry of ground water into the duct system (this watertight requirement is not applicable to short ducts for road crossings).

B. Cable ducts shall be uPVC piping to BSEN 1401, complete with vehicle loads, encasement, concrete and draw pits, fittings, etc to make a composite system. All duct routes shall be provided on the as built installation contractor design and agreed on site with the CA prior to installation.

C. Cable ducts shall be installed straight to line, true to gradient or level on an even, continuous 50 mm bed of the specified bedding material, laid over the full width of trench. A minimum clearance of 50 mm between cable ducts in instances where they cross shall be provided. Lay and compact further bedding material to a level not less than 150 mm above crown of duct.

D. Draw lines are be required, these should be threaded through each duct during installation from the chamber or sump to the final location within the building indicated on the design as each duct is connected in sequence. The duct shall be protected from damage and ingress of debris; temporarily seal all exposed ends during construction. Reasonable opportunity should be provided to ensure the local Water Authority, designer and client representative to inspect installation prior to backfilling.

E. Where cable ducts are less than 900mm cover below ground or finished floor level, the duct should be surrounded in 150mm of concrete. Where crown of duct is less than 300mm below slab of draw pit or other construction encase and cast integrally with concrete of same mix as slab. Extend length of concrete to within 150mm of next flexible joint. Excavate trench after hardcore has been laid and compacted. For encased ducts lay 25mm concrete blinding over full width of trench and allow to set. Form vertical construction joints in concrete surround with 18mm compressible board pre-cut to profile of duct. Fill any gap between spigot and socket with resilient material to prevent entry of concrete.

F. Sealing of duct entries to buildings (including service pipes)

G. After all cables have been installed, both duct ends shall be sealed using mastic or expanding foam to form a vermin, gas, water and fire barrier. The fire rating of the seal shall be as necessary to match the fire rating of the local building structure.

H. Spare ducts shall be sealed with end caps and mastic to form a vermin, gas, water and fire barrier.

I. Cables shall be identified where they come into and out of ducts and all labels shall be legible and visible after duct sealing is complete.

51.5 REFERENCE DOCUMENTS

A. Wherever reference is made to a British Standard (BS) a British Standard Institution recognised equivalent European Standard would also apply (see latest BSI Standard Catalogue etc). Each type of equipment/material selected will comply fully with either the latest issue of the BS or the European Standard.

B. All materials used in or upon the works will be to the satisfaction of the Engineer, and where an appropriate Specification issued by the British Standards Institution is current at the date of execution of the works, all goods and materials used will be in accordance with that Specification.

51.6 PIPE SLEEVES

A. Where drain lines pass horizontally through retaining walls the Installer will supply and install a 'Doyma' pipe sleeve and accessories or similar in order to maintain the integrity of the wall at the point of penetration. The pipe sleeve and accessories will prevent the ingress/egress of water and will be installed at a gradient to suit the drain pipe.

B. The pipe sleeves and weathering accessories will be selected to suit the size of drain line penetrating the retaining wall and will be installed in accordance with the manufacturers' instructions. The pipe sleeves will be capped to prevent the ingress/egress of water until the service has been installed and the gaskets are installed.

51.7 SUPPLIERS

A. A list of suppliers from which materials are to be purchased and the materials proposed for installation in the execution of the works will be submitted to the Engineer within 4 weeks of appointment. The information regarding the names of the suppliers may be submitted at different times as may be convenient but no source of supply will be changed without the authority of the Engineer.

51.8 INTERFACES WITH OTHERS

A. It shall be the Contractors responsibility to accurately set out these points in accordance with the above ground drainage designer's requirements. The Contractor shall be responsible for full liaison with the above ground drainage designer to establish the exact locations and dimensions from the structure and/or building fabric.

51.9 PROTECTION AND STORAGE OF MATERIALS

A. All materials shall be stored, stacked and protected in full accordance with the respective Manufacturer's recommendations and accepted good practice.

B. Such measures should include protection against damage arising from ultraviolet attack, exposure to extremes of temperature, wind, rain, superimposed loads, instability of stacking, abuse and damage by vehicular manoeuvres.

51.10 SAMPLES REQUIRED FROM THE CONTRACTOR

A. Engineering bricks and specials.

B. Granolithic concrete aggregate.

C. Type 'A' granular bedding material.

1. Samples of materials approved will be retained at the site office until the completion of the works. Materials rejected by the Engineer will not be used in the works.

2. The cost of all tests on materials required by the Engineer will be borne by the Installer.

51.11 SURFACE REINSTATEMENT

A. As the works proceed, surface soil, kerb stones, paving, concrete, tarmac or other surface finishes shall be replaced and maintained to restore all disturbed surfaces to their original condition, including where necessary the provision of any new materials.

B. Filling of excavations shall not be left proud of the surrounding finish level. Restored finishes shall be properly compacted to prevent settlement.

PART 52 - PRODUCTS

52.1 EXISTING SERVICES

A. Where records of existing services are available, the Contractor shall undertake investigations as necessary to confirm the accuracy and completeness of all information received.

B. Where records of existing services are not available, the Contractor shall determine the precise size, location and level of all sewers and services to which he is required to make a connection or cross the path of.

C. Where such connections are located between manholes, the level shall not be interpolated by known levels upstream and downstream, but shall be verified by trial hole investigation at the point of connection. In the event of an obstruction by other services to the proposed route of sewer outfall or incoming service connections, the Contractor shall report immediately, the prevailing circumstances to the Engineer for his direction.

D. Surveys and investigations into existing services are to be undertaken as soon as practically possible after taking possession of the site in order to verify the information indicated on the contract drawings. Any discrepancies are to be brought to the attention of the CA / Engineer in writing.

E. Protect any existing drains affected by the works and maintain normal operating conditions during construction. The Contractor shall undertake a CCTV survey of all on-site existing drains, which are to be maintained both in order to provide a record of condition prior to works commencing, and to establish if remedial works may be required. The inspection shall be implemented as soon as possible, after commencement of the project.

F. Temporary Drains / Over pumping

1. The Contractor shall allow for all necessary diversions, temporary drains and over pumping in order to complete the works indicated on the drawings.

G. Connections to Existing Drains

1. Where generally indicated on the drawings the Contractor shall make new connections to the existing on-site foul and surface water network at the gradients and depths shown on the drawings and to the satisfaction of the Engineer.

2. The Contractor shall be responsible for establishing the exact location, level, size and material of the existing sewers to which he is to make a connection. Levels for such connections, shall be verified by adequate trial holes formed at the point of connection. Should the connection be obstructed, the Contractor shall notify the Engineer of the problems encountered with an accompanying proposal for overcoming the problem based upon the site conditions for approval by the Engineer.

3. Prior to breaking in to or connecting to the existing sewer, the Contractor shall give a minimum 48 hours notice to the Engineer of their intentions.

4. The Contractor shall ensure that the new connection works do not interrupt the existing flow in the sewer by means of pumping over without the express written permission of the Engineer.

52.2 PIPEWORK AND FITTINGS

A. Pipeline Materials – Clayware

1. Manufacturer: Hepworth Building Products (or equal and approved)
2. All underground drainage pipework outside the building footprint of sizes up to and including 100mm diameter shall be executed in vitrified clayware to BS EN 295:Part 1:1991 as manufactured by Hepworth Building Products from their "Super Sleeve" range of pipes and fittings or equal to be approved.
3. All underground drainage pipework outside the building footprint of sizes 150mm and 225mm diameter, shall be executed in vitrified clayware to BS EN 295: Part 1:1991 as manufactured by Hepworth Building Products from their "Super Seal" range of pipes and fittings or equal to be approved.
4. Flexible pipework and fittings are not permitted for use within this installation; any flexible fittings or lengths of pipework found shall be replaced with standard fittings and pipework at the Contractors own expense.
5. The manufacturers' instructions, requirements and recommendations, shall be fully adhered to in all respects.
6. Jointing between clayware pipework and fittings, shall be achieved by means of polypropylene couplings with elastomeric seals to BS EN 681: Part 1:1996. Each coupling, shall be selected with a sealing ring suitable for the effluent involved.
7. Following the completion of the jointing of pipework due care shall be taken to prevent locating unyielding materials within the free area of the pipe socket or coupling in order to ensure that there is no restrictions in the natural movement of the pipeline under operating conditions.

B. Pipeline Materials – Concrete

1. Manufacturer: CPM Group Limited (or equal and approved)
2. All underground drainage pipework outside the building footprint of sizes 300mm diameter and above shall be executed in concrete pipework and fittings to BS EN 1916:2002, BS 5911:Part 1:2002 and Water Industry Specification (WIS) IGN 4-12-01 as manufactured by the CPM Group Limited from their range of flexible jointed pipes and fittings or equal to be approved.
3. The manufacturers' instructions, requirements and recommendations shall be fully adhered to in all respects.
4. Jointing of concrete pipes and fittings shall be achieved by means of a socketed ended pipe with an integral "G" pattern ring seal carried out in full accordance with the manufacturers' instructions, requirements and recommendations. The Contractor shall ensure that prior to offering each spigot that both jointing surfaces are cleaned and free from dirt and other extraneous material.
5. Following the completion of the jointing of pipework due care shall be taken to prevent locating unyielding materials within the free area of the pipe socket or coupling in order to ensure that there is no restrictions in the natural movement of the pipeline under operating conditions.

C. Pipeline Materials – Cast Iron

1. Manufacturer: Saint Gobain (or equal and approved)

2. Iron Pipes for Internal Drainage Below Buildings to be to BS EN 877 with flexible joints as manufactured by St. Gobain Pipelines reference 'Ensign' or similar approved. Joints to be double spigot with proprietary coupling system. Sealed cast iron access chambers are to be used within internal manholes. BSEN877 with all fittings and couplings supplied by the same manufacturer as the pipe.

D. Pipeline Materials – PP-H

1. Manufacturer: Pipe Thermoplastic Products (or equal to be approved)

2. All underground drainage pipework beneath the building footprint of sizes of 100mm and above shall be executed in PP-H (Homopolymer Polypropylene) to DIN 8077 and DIN 8078 .

3. The manufacturers' instructions, requirements and recommendations shall be fully adhered to in all respects.

4. Jointing between PP-H pipework and fittings shall generally be achieved by means of electrofusion sockets (EFS) carried out by a specialist or trained operative.

5. Where the use of electrofusion sockets is impractical due to site space restrictions the Contractor may, if he so chooses, utilise butt welded joints. Each joint however, as far as practicable shall be prefabricated and tested at the manufacturers works prior to delivery to site. Any on-site jointing shall be carried out by a specialist or trained operative.

E. Pipeline Materials – HDPE

1. Manufacturer: Geberit (or equal and approved)

2. All underground foul and surface water drainage pipe-work and fittings beneath the building footprint up to and including 750mm from the face of the building shall be executed in High Density Polyethylene (HDPE) as manufactured by Geberit Limited or equal to be approved.

3. The Contractor if he so chooses, may utilise pre-fabricated sections of pipe-work and fittings to minimise installation times however, these sections are to be site measured and factory tested prior to delivery with a copy of the factory test being retained on site for approval by the Engineer upon request. Any defects found are to be rectified at the Contractors own expense prior to installation.

4. All Fittings shall be made from injection molded HDPE resins and supplied by manufactured by Geberit Limited or equal to be approved. Fittings shall not reduce or impair the overall integrity or function of the pipeline. Coupling mechanisms shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Fittings shall be soil tight which have leakage at the joint but inhibit soil infiltration.

F. Pipeline Materials - Stainless Steel

1. Manufacturer: Blucher (or equal and approved)

2. Stainless steel non-pressure below ground foul and surface water drainage pipe work and fittings shall comply as manufactured by ACO or equivalent to BS 5955, Part 6: 1980.

3. Stainless steel pipework shall be manufactured to Grade 304 or 316.

4. All fittings shall be Grade 304 or 316 stainless steel or dezincification-resistant copper alloy compression type.

5. Stainless steel bends, up to and including DN 50 (50 mm nominal bore), shall have uniform radii not less than five times the nominal bore of the pipe. Bends, in pipes over DN 50, shall be manufactures using internal plug support.

6. Stainless steel pipes and fittings installed below ground in corrosive areas shall be provided with enhanced corrosion protection.

7. Stainless steel pipes and fittings, when used in concealed locations, shall be subject to further installation precautions as per manufacturer's instructions.

G. Pipeline Material – UPVC

1. Manufacturer: Polypipe Terrain (or equal and approved)

2. Refer to drawings for further detail

52.3 JOINTING

A. General

1. The manufacturer's instructions, requirements and recommendations shall be fully adhered to in all respects.

2. Following the completion of the jointing of pipe-work due care shall be taken to prevent locating unyielding materials within the free area of the pipe socket or coupling in order to ensure that there is no restrictions in the natural movement of the pipeline under operating conditions.

B. PVC-u

1. Jointing between PVC-u structured wall pipe-work and fittings shall be achieved by means of PVC-u couplings with elastomeric seals to BS EN 681: Part 1:1996. Each coupling shall be selected with a sealing ring suitable for the effluent involved.

C. HDPE Pre-Fabricated Pipe-work (Butt Fusion Welding)

1. All joints between HDPE pipe-work and fittings for factory pre-fabricated sections shall be achieved by means of butt fusion welding. Each joint shall be made and tested at the manufacturer's works prior to delivery to site. Test certificates shall be retained on site for inspection by the Engineer upon request. These joints shall be avoided in the drainage system. Due to site condition it is not feasible to use the standard electrofusion welded fitting, contractor shall only be allowed to use such fittings only after the engineers approval with the proper reasoning.

D. HDPE (Electro weld Sleeve Coupling)

1. All joints to be made on site between HDPE pipes and fittings shall be made by means of electro weld sleeve couplings carried out by a specialist Sub-Contractor or trained operative using the appropriate cutting tools and fusion welding machine produced by the manufacturer.

E. HDPE to PVC-u

1. Joints between HDPE and PVC-u pipes shall be made utilising stainless steel mechanical clamps to BS EN 295-4:1995 with EDPM/SBR seals to BS EN 681-1:1996, as manufactured by Polypipe Civils or equal to be approved.

2. The Contractor shall exercise due care so as not to over tighten the clamp leading to damage or distortion of the HDPE or PVC-u pipe. Any damage shall be rectified at the Contractors own expense.

F. Stainless Steel

1. Jointing between Stainless Steel pipe-work and fittings shall be achieved by means of push fit joints with elastomeric seals to BS 2494, BS 7874:1998 & BS EN 681-1:1996. Each joint shall be lubricated with silicon lubricant to both the pipe seal and chamfered stainless steel pipe end. The joint also allows flexibility in terms of thermal expansion.

G. Stainless Steel to Vitrified Clay

1. Jointing between Stainless Steel pipe-work and vitrified clay shall be made using vitrified clay super sleeve connector, as manufactured by Hepworth or equal to be approved.

2. Stainless Steel to Cast Iron

3. Jointing between Stainless Steel pipe-work and cast iron pipe work shall be made using cast iron coupling, as manufactured by Saint Gobain or equal to be approved.

52.4 EXPANSION JOINTS

A. HDPE

1. The Contractor shall include for within his tender whether detailed on the drawings or not, for the provision of an expansion socket with integral SBR/Nitrile “O” ring seal to suit the effluent involved and where required, suitable for encasement within concrete selected from the pipework manufacturers standard range.

2. All expansion joints and anchor points are to be spaced at the manufacturers required

3. intervals and installed in full accordance with the manufacturer’s instructions, requirements and recommendations.

B. Stainless Steel

1. Push fit joints take into account thermal expansion, although expansion joints, are to be spaced at the manufacturers required intervals and installed in full accordance with the manufacturer’s instructions, requirements and recommendations.

C. Connections to Above Ground Pipework

1. Where drainage pop-ups are to terminate within a ground floor or basement slab the correct transitional fitting for connection to the above ground installations shall be provided. The transitional fitting shall terminate flush with the finished floor level unless otherwise described herein.

2. It shall be the Contractors responsibility to accurately set out these points in accordance with the above ground drainage designer’s requirements. The Contractor shall be responsible for full liaison with the above ground drainage designer to establish the exact locations and dimensions from the structure and/or building fabric.

3. All connections between the soil and waste pipe-work and the underground drainage system are to be made using proprietary HDPE to PVC-u/Stainless Steel/Cast Iron "O" ring seal socketed joint of a minimum size diameter to suit the material involved with an integral SBR/Nitrile insert to suit the effluent involved. All reductions are to be supplied and installed by the above ground drainage Contractor.

4. At no point throughout the installation, shall mechanical clamps be used to connect HDPE to PVC-u. Any mechanical clamps found shall be replaced with the appropriate adaptor at the Contractors own expense.

D. Connections to Rainwater Pipework

1. All connections between the rainwater down-pipes and the below ground surface water system shall be formed using proprietary polypropylene adaptors from the manufacturers standard range, to suit the size and pattern of the particular down-pipe involved complete with an integral SBR "O" ring seal to BS EN 681-1:1996.

E. CONNECTIONS TO EXISTING DRAINS

1. Where generally indicated on the drawings the Contractor shall make new connections to the existing sewer network at the gradients and depths shown on the drawings and to the satisfaction of Scottish Water.

2. The Contractor shall be responsible for establishing the exact location, level, size and material of the existing sewers to which he is to make a connection as soon as practicably possible after taking possession of the site. Levels for such connections shall be verified by adequate trial holes formed at the point of connection. Should the connection be obstructed, the Contractor shall notify the Engineer of the problems encountered with an accompanying proposal for overcoming the problem based upon the site conditions for approval by the Engineer and/or Scottish Water.

3. Prior to breaking in to or connecting to the existing sewer, the Contractor shall give a minimum 48 hours notice to the Engineer and Utility Company of their intentions.

4. The Contractor shall ensure that the new connection works do not interrupt the existing flow in the sewer by means of pumping over without the express written permission of Scottish Water.

52.5 PIPE LAYING

A. Handling of Pipes

1. The Contractor will provide apparatus for the off-loading and handling pipes in accordance with manufacturer's requirements/recommendations and good practice. Under no circumstances will a wire sling be permitted through the pipe barrel, and any pipes suffering damage resulting from any means, will be immediately rejected from the site. Making good of damaged pipes will not be permitted.

B. Rocker Pipes

1. Where drains pass through, over or beneath foundations, the Contractor shall supply and install rocker pipes in accordance with the requirements of British Standard BS EN 752 and the Building (Scottish) Regulations latest edition.

2. Rocker pipes shall be formed using two flexible couplings at 150mm and 750mm centres either side of the face of the foundation, which it is to pass through, over or beneath in accordance with the manufacturer's instructions.

C. Granular Bedding to Pipes

1. The granular bedding will be placed and carefully compacted by means of a vibrating plate or other approved apparatus, care being exercised to avoid disturbance of the bedding beneath the pipe, and any disturbance must be made good.

2. The bedding will be dug out under the pipe sockets so that the pipes are supported along the whole length of their barrels. After the pipes have been laid the haunching of the pipes with further granular material can proceed in layers not exceeding 75mm and thoroughly compacted by hand up to half pipe level. This will be carried out on both sides of the pipe in such a manner to prevent lateral or vertical displacement of the pipeline.

D. Pipes Laid in Filling

1. Where pipes are to be laid in the filling the following procedure will be adopted. The topsoil should be stripped along the line of the sewer to form a firm foundation. Concrete grade 20/20 will then be placed between formers and compacted. Width between formers should be at least the pipe diameter plus 450mm. The concrete should be brought up to within 150mm below the pipe barrel. Pipes should then be laid in accordance with the procedure for concrete protected pipelines.

52.6 INSPECTION

A. Pipelines laid upon granular bedding will be inspected after the completion of the placing of the granular bedding material to half pipe full.

B. Concrete Protection to Pipes

1. Concrete protection will be Grade 20/20 concrete to the thickness stated on the drawings. After completion of the excavation, concrete blinding will be laid and will be sufficiently hard to avoid damage, before further operations are carried out. The pipes will then be laid upon precast concrete blocks resting upon this base in the specified manner, whereupon concrete will be placed on one side of the pipe only and vibrated until it appears on the other side of the barrel. Thereafter the remainder of the concrete will be placed evenly on both sides of the pipe and at the same time vibrated and worked into position. No timbering or steel sheeting will be fixed inside the concrete protection, and all timber sheets likely to interfere with the concrete will be withdrawn before concreting is commenced.

2. The concrete will be thoroughly compacted as specified, and suitable precautions taken against flotation of pipes during this operation.

3. Where concrete protection is required to flexibly jointed pipelines the concrete protection is to be interrupted over its full cross section at intervals not exceeding 5m (or as directed by the EA) by a shaped former of bitumen impregnated compressible filler. The interruptions will coincide with pipe joints.

52.7 MARKER TAPES

A. All below ground drainage pipework shall be provided with durable marker tapes suitable worded to identify the pipeline service in lettering no less than 50mm high.

B. The marker tape shall be worded "SURFACE WATER DRAIN BELOW" or "FOUL WATER DRAIN BELOW" located a minimum of 300mm below the finished surface/ground level.

C. All marker tapes shall incorporate a traceable element suitable for monitoring by electronic surveying equipment.

52.8 DRAINAGE ACCESSORIES

A. Petrol Interceptors

1. In the position as generally detailed on the drawing the Contractor shall supply, install, test and set to work a Storm By-Pass Petrol/Oil Interceptor as manufactured by Conder Products Limited from their CNSB range or equal to be approved.

2. The unit shall be manufactured from Glass Reinforced Plastic (GRP) to the requirements of British

3. Standard BS 4994 and be fully compliant with the requirements of BS EN 858 and the Environment Agency Guideline PPG3. The unit shall be capable of retaining oil or petrol collected prior to peak storm flow conditions, during which time the majority of the flow shall be passed directly to drain.

4. The unit is to be positioned onto a minimum 225mm thick concrete base, which shall be designed to the Structural Engineers requirements. A lean mix Grade C20P concrete surround of a minimum thickness is then to be provided up to the level of the access shaft. The Contractor shall ensure that the unit is fully charged with water during this process to maintain a positive down force to prevent floatation or distortion all in accordance with the manufacturer's installation requirements. A concrete cover slab shall then be provided to protect the unit from moving traffic to the Structural Engineers design.

5. A Grade D400Kn ductile iron access cover and frame shall be provided to allow full and unrestricted access to the unit for maintenance and cleaning. The access cover and frame shall be supported and raised upon a Class B engineering brick shaft in English bond of no more than 3 courses bonded with a cement mortar (1:3 mix) taken from the cover slab to a minimum of 100mm below the proposed ground level. The access cover and frame shall then be bedded onto the brick shaft using a 1:3 mix cement mortar.

6. The unit shall be provided with a heavyweight galvanised steel ventilating pipe to BS 1387 with screwed joints to BS 21 to terminate a minimum of 2.4 metres above the finished ground level, no less than 1.0 metre above an openable window or 3.0 metres from either side of a window. Where the ventilating pipe is to be run below ground, it shall be suitably protected and coated using "Denso Tape" to prevent corrosion.

7. In accordance with the Environment Agency's Guidelines (PPG3) the unit shall also be provided with an oil level alarm, silt level alarm, coalescing filter and automatic closure device to prevent the escape of collected pollutants when the maximum storage level is reached. All alarms shall be wired back to the BMS system to give audible and visual warnings.

B. Plantroom Gullies

1. In a positions to be agreed with the Mechanical Sub-Contractor, the Contractor shall supply and install a plantroom floor gullies as manufactured by Wade International or equal to be approved, to facilitate the draining down of the mechanical services plant and to take water from any spillages or leaks.

2. Each gulley shall comprise as a minimum a L2601 cast iron sherardized 300x300mm grating for use in un-finished floors, GC144 cast iron body with 110.2mm diameter vertical outlet and general purpose removable bottle trap with 50mm deep water seal and T1103 cast iron to "SuperSleeve" adaptor.

C. Linear Drainage Channels

1. In the positions as generally detailed on the drawing the, Contractor shall supply and install presloped polymer concrete linear drainage channels as manufactured by Mea UK Limited or equal to be approved selected from their "Supreme Z1000 System" range of channels and fittings.

2. Each run of channel shall consist as a minimum of the required number of 1.0 meter long presloped polymer concrete sections with an integral 50mm fall towards the outlet, integrated galvanised steel edge protection, cast in interlocking joint, ductile iron grade C250Kn slotted "Heelguard" grating with standard locking anti-theft bolts, plain end cap and reference Z1000.EK LG 10 polymer concrete 100mm diameter outlet trapped roddable silt box/es with galvanised steel edge protection and galvanised steel sediment bucket/s.

3. Each channel shall be installed within a minimum 150mm thick grade C20P concrete haunch with the bitumen base courses dressed up to the edge of the channel. The asphalt wearing course shall then be brought up to the edge of the channel protruding 25mm above to allow for settlement of the car park surface under normal operation in accordance with the manufacturer's instructions, requirements and recommendations.

52.9 MANHOLES AND INSPECTION CHAMBERS – PRECAST CONCRETE RING

A. The Contractor shall, where generally indicated on the drawings, supply and install precast concrete ring manholes with tongue and groove joints of the sizes and inverts detailed within the schedules, as manufactured by the CPM Group Limited or equal to be approved. Joints between manhole sections shall be made using a strip of mastic bead in accordance with the manufacturer's instructions, requirements and recommendations, then faced and flush pointed with a cement mortar (1:3 mix).

B. Each manhole shall be constructed in full accordance with the requirements and to the details set down within "Sewers for Adoption" 6th edition. Sewers for Scotland 2nd Edition.

C. Each precast section shall be constructed in accordance with the requirements of "Design Chemical Class 4" tested to the requirements of BS EN 1917:2002 and BS 5911-3:2002 complete with factory fitted polypropylene coated mild steel double step irons at 250mm vertical spacing to BS EN 13101:2004 and precast 50mm diameter holes to accept lifting eyes.

D. All branches and junctions within manholes shall be long radius swept in the direction of flow. The use of square junctions is not permitted at any point in the installation. All penetrations through the manhole rings are to be made watertight prior to commencement of the benching.

E. Benching shall be finished with a cement sand mortar (1:2 mix) troweled to a smooth finish of a minimum thickness no less than 50mm. The gradient of any benching shall not exceed 1:12. All manhole benching shall be undertaken at the time of construction of the manhole.

F. The backfill space between the face of the excavation and the manhole rings shall be filled upon completion with C20P grade concrete to a minimum thickness of 150mm.

G. Where manholes are located adjacent bases or foundations, backfilling shall be undertaken in accordance with the structural Engineers requirements.

H. Manhole cover slabs shall be constructed from C30-P concrete of a minimum thickness prescribed with "Sewers for Adoption" 6th Edition for the appropriate manhole type.

52.10 MANHOLES AND INSPECTION CHAMBERS - BRICKWORK

A. The Contractor shall, where generally indicated on the drawings, provide Class – B Engineering brickwork manholes to BS 3921.

B. All brickwork shall be built in "English Bond" with each frog laid upwards. All joints shall be filled solidly with 1:3 cement mortar as each brick is laid and neatly flush pointed internally as the work proceeds. All external faces shall be provided with weather pointing again as the work proceeds. No bats or broken bricks shall be used except as closers for the purpose of breaking the bond. Joints shall not exceed 7mm in thickness.

C. The manhole base slab shall be constructed from Grade C20P concrete with channels formed using proprietary vitrified clayware as manufactured by Hepworth Building Products Limited or equal to be approved. All concrete manhole bases shall be reinforced and of a minimum thickness of 150mm in full accordance with the Structural Engineers requirements.

D. Each manhole cover slab shall be constructed from reinforced Grade C20P concrete in accordance with the Structural Engineers requirements. All cover slabs shall be provided with a suitably sized opening to allow free and easy access to suit the access cover and frame to be installed.

E. All branches and junctions within manholes shall be long radius swept in the direction of flow. The use of square junctions is not permitted at any point in the installation. All penetrations through manhole walls are to be made watertight prior to commencement of the benching.

F. Benching shall be finished with a sand cement mortar (1:2 mix) troweled to a smooth finish of a minimum thickness no less than 50mm. The gradient of any benching shall not exceed 1:12. All manhole benching shall be undertaken at the time of construction of the manhole.

G. The backfill space between the face of the excavation and the manhole rings shall be filled upon completion with C20P grade concrete to a minimum thickness of 150mm.

H. Where manholes are located adjacent bases or foundations, backfilling shall be undertaken in accordance with the structural Engineers requirements.

52.11 MANHOLES AND INSPECTION CHAMBERS – PREFABRICATED PP-H

A. Beneath the building footprint the Contractor shall supply and install where generally indicated on the drawings prefabricated PP-H (Homopolymer Polypropylene) manholes and inspection chambers to DIN 8077 and DIN 8708, of the types sizes inverts and connection details shown on the drawings.

B. Each manhole or inspection chamber shall be constructed and tested at the manufacturers' works in accordance with the requirements of BS 7158, BS EN 13598-1, BS EN 752 Table NA. 1 and "Sewers for Adoption" 6th Edition (Clause 5.2.31 Plastic Chambers and Rings). Sewers for Scotland 2nd

C. Each prefabricated PP-H manhole shall be complete with the required number of 45° swept branch connections connected to the main channel with a bolted inspection cover, steel core plastic encapsulated access steps to BS EN 13101:2002, prefabricated benching at a slope of between 1:10 and 1:30, top formwork to accept insitu poured concrete cover slab, external PP-H shuttering to accept insitu poured concrete surround and threaded access caps for backdrops where required.

D. Where prefabricated PP-H manholes are to be located adjacent bases or foundations, backfilling shall be undertaken in accordance with the structural Engineers requirements.

52.12 PIPE ENDS IN MANHOLES

A. Where a new pipe end is located at the inside face of a manhole, the Installer will cut the pipe and make good the end. Pipe cutting will be carried out using carborundum saws or other approved methods. Pipes entering manholes will have a flexible joint within 600mm of the inside face of the manhole joining with a short rocker pipe.

52.13 INVERTS AND BENCHINGS

A. In manholes the benching of concrete will be formed with vertical sides brought up to at least the soffit of the outing pipe, a rounded arris formed and carried up obliquely to the side walls at a slope of 1 in 12. All benchings and inverts will be properly compacted by a mechanical vibrator and finished to a perfectly smooth surface.

B. For pipe sizes up to and including 450mm diameter the invert will be formed in half channel pipes, bends and junctions of the appropriate pipe material if manufactured.

52.14 MANHOLE COVERS

A. Covers will generally be ductile iron and comply with the requirements of BS EN 124:1994Bed frames solidly in 1:3 cement/sand mortar over its whole area, centrally over opening, level with surrounding finishes and square with joints in surrounding finishes or with the building or adjacent architectural features.

Places of Installation	Minimum Class
Footways, pedestrian areas and comparable areas, car parks or car parking decks.	B125
Gully tops installed in the area of kerbside channels of roads which when measured from the kerb edge extend a maximum of 0.5 meters into the carriageway and a maximum of 0.2 meters into the footway.	C250
Carriageways of roads (including pedestrian streets) hard shoulders, and parking areas for all types of road vehicles.	D400
Areas imposing high wheel loads e.g. docks and aircraft pavements.	E900

B. Supply and hand-over at practical completion 2 sets of lifting/locking keys to suit each type of manhole cover installed under this package.

1. Manhole Cover – Ductile Iron
    a. Manufacturer: Norinco Ltd or equal to be approved.
    b. Ductile iron access covers and frames to BS EN 124:1994 of the types and sizes detailed within the manhole schedules.
2. Manhole Cover – Cast Iron
    a. Manufacturer: Saint Gobain Pipelines or equal to be approved.
    b. Ductile iron access covers and frames to BS EN 124:1994 of the types and sizes detailed within the manhole schedules.
3. Manhole Cover – Infill Type
    a. Manufacturer: Jones of Oswestry (or equal and approved)
4. Manhole Cover Temporary
    a. Manufacturer: Hepworth Building Products Limited or equal to be approved
    b. During the works the Contractor shall provide proprietary Medium Density Polyethylene high visibility temporary manhole covers with integral twist locking mechanism.
    c. Plywood sheeting, concrete slabs, polystyrene slabs or metal sheet cover plates will not be accepted for this purpose.

52.15 EXCAVATIONS

A. Excavation Generally

1. The Installer will excavate for the works in open cutting in straight lines, and to the levels and gradients as shown on the drawings.
2. During the progress of the works the Installer will ensure that all trenches and shafts are properly supported as necessary in order to ensure the safety of the works.

B. Excavation to Manholes and Trenches

1. The excavations are to be trimmed and finished accurately to the required construction depths, the bottom of the sewer trenches being parallel to the invert gradients of the sewer.

2. All trenches will be of sufficient width at formation level to give the minimum width of bed specified.

3. Adequate trench supports will be provided to ensure stability and safety. Trench support timbers should be withdrawn in stages as the backfilling proceeds. Particular attention should be paid to the compaction at the sides of the trench where the previous layer of backfill is thus disturbed.

4. Trenches will be excavated such that the horizontal width measured at the top of the pipe barrel between the undisturbed trench faces does not exceed the widths required by BS 8000 Pt.14.

C. Trench Widths

1. Trench widths to comply with the requirements of BS 8000 Pt.14.

2. Trench sides will be vertical to at least 300mm above the top of the pipe barrels.

3. Should any of the conditions described below occur, the Engineer may make such modifications to the type and class of pipe bedding or surround material as he will deem necessary:-

4. Where the maximum permitted trench width is exceeded.

5. Where any collapse of the trench side occur.

6. Where the trench sides are not vertical to at least 300mm above the top of the pipe barrel.

7. Where the trench depth varies from that shown on the drawings.

8. Where the backfill or the bedding conditions do not comply with those shown on the drawings.

D. Excavation to Extra Depths and Patches of Bad Ground

1. If, due to an error on the Installer's part or his method of working, the excavations are taken out deeper than required, then the excavated material will be removed and the extra depth filled in with a suitable granular Class S material.

2. If patches of loose, soft or bad ground are encountered at the proper foundation levels, the Installer will excavate to a solid foundation and fill up to the proper level with a suitable granular Class S material.

E. Inspection of Foundations after Excavation

1. Before any concrete or granular bed is deposited, the excavations will be kept drained and any soft mud or slurry removed, and on receiving approval that a satisfactory foundation has been obtained, the placing of the concrete or granular bed may proceed.

2. Dealing with Water

a. The works will at all times be kept drained and clear of water below the lowest level of any part of them, and no water will be allowed to run over or rise behind or

against any brickwork or concrete until this has set or become sufficiently hardened so that it may not be injuriously affected thereby.

b. The Installer will not be permitted to use the finished sewers as an outlet for the water which may

c. be found in trenches, and he may, therefore, be required to pump to keep the trenches, headings and other excavations dry where he may have to contend with water.

d. Should the Installer consider it necessary in order to remove water from the works, he may lay temporary drains in such a manner and of such material as necessary. The Installer will ensure that the construction of such temporary drains does not undermine the works and he will properly stop, close and grout all such temporary drains upon the completion of the works to the satisfaction of the Engineer.

e. The Contractor shall to the best of his ability, within the site constraints, prevent the ingress of water within the excavations.

f. Where water has entered the excavations, the Contractor shall make provision for its removal to a pre-determined discharge point to be agreed with Yorkshire Water Services.

g. Where a drainage sump is to be utilised this shall be located in an area that will not form part of the final installation. Upon completion of the works this area shall be refilled with either DOT Type 1 or Grade C7.5 Concrete to the level of the underside of the adjacent permanent works or, removed in whole if located beneath the building footprint of the subsequent building works.

h. The Contractor shall ensure that the dewatering process does not result in the stability of the adjacent ground being adversely affected by loss and/or migration of the fines.

i. The positions and sizes of all sumps will be to the satisfaction of the Engineer.

j. The disposal of water from the excavations for drainage can only be discharged to water course with the approval of the Environment Agency and with the required interception to ensure river/brook water quality is maintained.

52.16 CONCRETE, MORTAR AND BRICKS

A. Portland Cement

1. Portland Cements will comply in all respects with BS 12 and will be of an approved manufacture.

2. The minimum cement content will be not less than 330kg/m cubed to accommodate Class II sulphates.

B. Fine Aggregate for Concrete

1. The fine aggregate for all concrete will consist of naturally occurring material and will comply with and be graded to BS 882, Zone 2. The aggregate will have an absorption not exceeding 2% in accordance with BS 812 : Part 4.

C. Coarse Aggregate for Concrete

1. The coarse aggregate will consist of naturally occurring materials and will comply with BS 812. The flakiness index when determined by the sieve method described in BS 812 will

not exceed 35, and the absorption will not exceed 2% as measured in accordance with BS 812 : Part 4.

D. Granolithic Aggregate

1. The coarse aggregate for granolithic concrete will be “Ingleton granite” or equal and will conform to the requirements of BS 882.

E. Water

1. Water will comply with the requirements of the Appendix of BS 3148.

F. Concrete Manufacture

1. All concrete will be manufactured from cement, course and fine aggregates and water, without admixture unless otherwise permitted.

2. It may be near the work, at a central mixing point or be obtained from a ready mixed concrete supplier.

3. Grades of concrete to be used in the Works will be as follows, unless otherwise shown on the drawings.

4. The following table lists for the grade of concrete to be used:

	Grade	Nom. Max. Aggregate Size (mm)	Principal Use
30P	30/20	20	Reinforced Concrete
25P	25/20	20	Bedding to Channels
20P	20/10	10 (Ingenous agg.)	Manhole Base and Inverts
0P	10/40	40	Blinding

Note 1) For a typical grade of concrete such as 30/20
30 signifies that the minimum 28 day crushing strength is 30 N/mm2.
20 signifies that the nominal maximum size of aggregate is 20mm, or standard mixes

G. Transportation, Placement and Compaction

1. The method of transporting and placing concrete will be such that contamination, segregation or loss of the constituent materials does not occur. Concrete will not be dropped into place from a height exceeding 1.5 metres.

2. All formwork and reinforcement contained in it, will be clean and free from standing water, snow and ice immediately before the placing of the concrete.

3. The concrete should be placed in its final position as rapidly as possible after being mixed, and not more than 30 minutes elapse between the operations of mixing the concrete and placing it in its final position. No concrete which has developed its initial set will be used under any conditions, and a batch, or part of a batch, or part of a batch, which has commenced to set before being used, will be rejected. Re-tempering of concrete will not be permitted.

4. Concrete will not be placed in standing or running water.

5. All concrete will be fully compacted throughout the full extent of the layer. It will be thoroughly worked against the framework and around any reinforcement and other

embedded items, without displacing them. Successive layers of the same lift will be thoroughly worked together.

6. All concrete with the exception of blinding concrete will be vibrated.

H. Curing and Protection

1. Concrete will be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, cold rain or running water. The protection will be applied as soon as practicable after completion of placing by covering with a layer of sacking, sand, waterproof paper, plastic membrane, etc., until two-thirds of the 28 day cube strength is reached, or by the application by low pressure spray of an approved colourless liquid curing membrane applied at the rate specified by the manufacturer.

I. Remedial Work

1. Any necessary remedial work to concrete will be carried out as directed by the Engineer.

J. Testing of Concrete

1. The testing regime is to be agreed between the Installer and Engineer prior to the commencement of works.

2. Samples of concrete for test will be taken and cubes will be made as and when required by the Engineer. The cubes will be made, cured, stored, transported and tested in compression in accordance with BS 1881. The tests will be carried out in a laboratory approved by the Engineer and reports of all these tests will be supplied to the Engineer within 24 hours of the cubes being tested.

3. If the concrete under test fails to meet the specified minimum crushing strength the Installer may be requested to undertake further tests as directed by the Engineer or he will immediately take such remedial actions as the Engineer may order which may include the breaking out and replacement of such concrete work.

K. Ready Mixed Concrete

1. If the Installer intends to use concrete mixed off site from an independent source it will comply in all respects with BS 328.

2. Where the use of ready mixed concrete is approved by the Engineer it must be obtained from an approved manufacturer and delivered to the site in a lorry fitted with a continuous mixing drum.

3. Each load will be accompanied by a delivery note made out by the weight-batch operator and stating: -

   a. The grade of concrete
   b. Time from the introduction of cement.
   c. The water/cement ratio.
   d. The type and maximum size of aggregate.
   e. The total weight of the load.
   f. Details of any admixtures when permitted.
   g. Vehicle registration number.
   h. Address of plant where materials mixed.

i. The supplier must agree to permit the Engineer or his representative to visit the concrete plant at all times and to discuss any matters arising.

j. Records of concrete tests carried out by the ready mixed concrete supplier will be made available to the Engineer on request.

L. Cement Mortar

1. Cement mortar for use in brickwork will consist of three parts of sand to one part of cement, measured by volume of the materials when dry.

2. Where cement mortar is required for use in jointing cut lengths of pipes or connections, it will be composed of cement and sand in proportions of 1:1 measured by volume of the materials when dry.

3. An impervious hard stage is to be provided for hand mixing and the sand and cement is first to be thoroughly mixed in a dry state, after which water may be added in such amount as is necessary to make the mortar workable. The material is then to be turned over at least twice or until the whole mass is thoroughly mixed and of the proper consistency. It must be used within one hour of mixing and made in small quantities as required from time to time.

4. Machine mixing will be permitted.

5. The sand for cement mortar will comply with Table II of the BS 1200.

6. Any plasticizer used will be free from calcium chloride or similar salts.

M. Bricks

1. All bricks used in the works will be Class 'B' and be new, hard, solid, sound, of true shape, well burnt uniform in colour and size, free from particles and lime pebbles and other imperfections and conform in all respects with BS 3921. The bricks will be without frog or indentation, and will not bear the makers name or other distinguishing marks so placed as to be visible when the bricks are laid in the work. Bullnosed and other special facing bricks will be equal in quality to Class 'B' bricks.

2. Where pallets are employed, off-loading on site will not be taken as approval of bricks on the interior of the load.

52.17 WATERTIGHTNESS

A. All drains, manholes and associated components shall be watertight preventing ingress of groundwater to the drainage system.

52.18 ABANDONMENT

A. General

1. Any drains or sewers which are redundant and to be abandoned shall be permanently plugged within the manhole or inspection chamber and the remainder completely removed. Full grouting-up of the redundant drainage may be acceptable as an alternative upon receipt of a full method statement from the Contractor

B. Private Drains

1. Before any drains are taken out of service ensure that they have been fully traced to ensure there are no live branches serving adjacent properties. Record this process and submit details to the Engineer for approval.

C. Public Sewers

1. Where public sewers are to be abandoned or made redundant the following process shall be followed by the Contractor;
2. Contact the Sewerage Undertaker, in writing, to advise of the proposed works as soon as practical after commencement of the Contract.
3. Undertake investigations, including CCTV camera surveys, as necessary to establish that all sewers are redundant and that there are no unknown connections from neighbouring properties.
4. Produce the necessary sketches and CCTV reports to demonstrate the suitability for abandonment to the Sewerage Undertaker and Engineer.
5. Agree the method for removing / infilling the sewers with the Sewerage Undertaker and Engineer. Inform in writing the Sewerage Undertaker when the abandonment works are complete and invite them to inspect the works. Allow all necessary attend and equipment to facilitate the Sewerage Undertaker's inspections.

D. Chambers and Underground Structures

1. Where manhole chambers, pits or other underground drainage structures are to be removed, the backfilling and compaction methodology shall be submitted to the Structural Engineer and CA for approval.

PART 53 - CLEANING, TESTING AND INSPECTION

53.1 GENERAL

A. The Contractor shall carry out all tests requested by Local and Statutory Authorities and the Engineer / CA on the entire installation and shall supply everything necessary to safely and effectively undertake / demonstrate the tests, i.e. clean water, appliances and equipment and personnel.

B. The Contractor shall be fully aware of the Construction Design and Management Regulations and the requirements of the publication "Safe Working in Sewers and at Sewage Works", published by the National Joint Health and Safety Committee for the Water Service. The Contractor shall provide the necessary protective clothing, safety harnesses, breathing apparatus, gas or oxygen detectors, etc. and shall carry out the recommended safety procedures prior to entry of any personnel to any sewer access shaft or chamber.

C. Mains water only shall be used for the testing of water services pipework.

D. The Contractor is to make available any tests requested within a period of seven days.

E. All tests shall be carried out in accordance with BS EN 752.

53.2 SUMMARY OF REQUIREMENTS

A. All sections and components of the installation are to be covered by the following unless agreed otherwise and agreed in writing with the Engineer.

Test	Timing	Requirement
Interim	As works proceed, prior to backfilling	Visual inspection, Water or Air Test, obstruction test
Final	At completion of the system	Water test or Air Test
Pre-Handover	Just prior to handover of the system	Pressure jet and system clean, CCTV inspection

B. Interim Tests

1. A minimum of 48 hours notice shall be given prior to any backfilling, covering up or Interim Tests to both the Engineer and the building Control officer giving the opportunity to witness the tests.

2. Interim tests shall consist of water or air pressure tests.

C. Final Tests

1. The Engineer and Building Control officer shall be given a minimum of seven days notice of all Final Tests. The Contractor shall have ready for the tests certificates for signature and drawings indicating the as-installed positions and levels of all drainage under test.

D. Pre-Handover Cleaning

1. Immediately prior to handover but as far as possible after all external works are complete, the whole of the drainage system shall be pressure jet cleaned by a specialist company.

The CCTV inspection of the system shall be undertaken as soon as possible after pressure jet cleaning of the system.

2. Thoroughly clean all gullies, channels and other components including frames, walls, benching, step-irons and so on.

3. All interceptors, silt pits and pump stations will be pumped clean of all liquid prior to final inspection and all silt, debris and extraneous material removed.

E. Water Test

1. An air test will be accepted as an alternative to a water test. If the pipework fails the air tests, carry out a water test which will determine acceptability.

2. The procedure for water testing of non-pressure drainage pipes shall be;

   a. Temporarily seal low ends of drains and connections

   b. Fill the system with water to produce 1.2m head at the high end and not more than 2.4m head at the low end.

   c. Allow the pipeline to stand for 2 hours for initial absorption, topping up at intervals before testing commences.

   d. The subsequent loss of water is to be measured over thirty minutes, measured by adding water at ten minute intervals, noting the amount required to maintain the original level in the standpipe. The loss of water(for pipes up to 300mm diameter) shall not be more than;

      1) 0.05 litres per metre run for a 100mm diameter pipe

      2) 0.08 litres per metre run for a 150mm diameter pipe

      3) 0.12 litres per metre run for a 225mm diameter pipe

      4) 0.15 litres per metre run for a 300mm diameter pipe

F. Air Test

1. The procedure for air testing of non-pressure drainage pipes shall be;

   a. Temporarily seal low ends of drains and connections

   b. Connect an appropriate glass 'U' tube gauge to a drain plug in the length to be tested.

   c. If sanitary appliances are connected to the system use a test pressure of 50mm water gauge, alternatively, test to a minimum of 100mm water gauge. Pump air into the system to achieve the desired pressure.

   d. Allow five minutes for stabilisation due to air temperature and then re-adjust to the test pressure if necessary.

   e. Without further pumping, the head of water should not fall by

      1) Using 100mm pressure, maximum fall = 25mm water gauge

      2) Using 50mm pressure, maximum fall = 12mm water gauge

G. Recording of Tests and Inspections

1. A marked-up drawing is to be kept on-site readily available to the Engineer and Building Control officer throughout the works highlighted to show which sections of the installation

have been completed. This should be further highlighted to indicated those sections which have been tested.

2. Records shall be kept of all tests carried out, with copies of the certificates being issued to the Engineer and CA. The test records shall include the following information;

   a. Date
   b. Location and identity of pipeline
   c. Reference to the appropriate installation drawing
   d. Method of test
   e. Name and signature of Contractors' representative
   f. Name and signature of witnessing Engineer
   g. Name and signature of Building Control officer
   h. Result of test

H. Handover CCTV Inspection

1. Prior to Handover all sections of the installation covered by this specification are to inspected internally by employing a specialist CCTV survey company.

2. A minimum of 5 working days notice is to be provided to the Engineer and CA inviting them to witness the inspection. Provision is to be made to allow Engineer to view the monitor screen during the inspection.

3. Two copies of the inspection records are to be provided to the Engineer within ten days of completion of the inspection. The records shall consist;

   a. Colour VHS videotape or DVD recordings
   b. Full interpretative reports
   c. Still photographs / images of significant defects

4. Prior to commencing the CCTV inspection the system is to be flushed with water to identify any backfalls or areas of standing water.

5. Ensure that the intensity of in-pipe illumination is adequate and maintained throughout the inspection. Provide for continual recording and for the camera to be stopped, its position recorded and still images to be taken at any point requested by the CA.

6. Still images are to be taken of all chambers, pits soakaways and other such elements.

7. Obtain instructions for remedying any defects which may be revealed.

I. Defects and Remedial Works

1. If any defects are identified at the interim installation or backfilling stages of the works, remedial works shall be affected immediately and that section of the drainage system satisfactorily re-tested before further drain laying proceeds.

2. If any defects are identified at the time of the final inspection and testing, the Contractor shall endeavour to establish the precise location and nature of the defect without recourse to random trial hole excavations, where this could be avoided by the use of the CCTV inspection.

3. Upon completion of the remedial works, this section of the works shall be re-tested to the entire satisfaction of the Engineer.

4. If, in the course of the Engineer's inspection, it is found that any part of the drainage system is subject to ingress of water, the Contractor shall be held responsible and shall, at his own expense, repair or replace such defective parts of the system to the entire satisfaction of the Engineer.

53.3 CCTV INSPECTIONS

A. General

1. The scope of work includes a full inspection of the new and/or existing pipelines identified on the drawings and shall record all routes, pipe diameters, manhole sizes and condition, levels and final discharge points. A record of the weather conditions will be included for the period of the survey.

2. Redundant connections to the system shall be separately identified.

B. Pre-Cleaning (Sewer Jetting)

1. All manholes and pipelines shall be pressure jet cleaned prior to the CCTV survey. The acceptable standard of cleanliness will occur when obscuration of walls by silt, debris, fat or scaling does not exceed 10%.

2. Linear Measurement

3. The monitor display shall incorporate an automatically updated record of the meterage between manhole centres of the camera position along the pipeline and accurate to 2% of the travel.

4. A suitable metering device shall be supplied which enables the cable length to be accurately measured.

5. Compliance with the above tolerance to be demonstrated by using one or both of the following methods:

   a. Use of calibration device

   b. Tape measurement at the surface between manholes

C. DVD's

   a. Provide two DVD copies of the recordings to be provided on a high density recording tape or DVD, for all pipelines subjected to survey.

   b. Each video tape or DVD shall automatically display on the monitor screen the following information:

      1) Automatic meterage update relating to camera positioning the pipeline

      2) Date of survey

      3) Pipeline diameter

      4) Location reference (MH No. - MH No.)

   c. The recording tape or DVD shall comply with the recording equipment manufacturer's DVD specification.

   d. Camera speed within pipelines shall be limited to 0.10 m/s for diameters less than 200mm, 0.15 m/s for diameters exceeding 200mm but not exceeding 300 mm and 0.20 m/s for those exceeding 300mm. Unless such other speed has been agreed, as will enable all details to be extracted from the video tape recording.

Where faults are located and at the entry to manholes, the camera travel shall be halted, to allow inspection.

e. Photographic Records

f. Photographs to be taken of the following items:

g. Continuous and single point defects

h. Samples of average condition

i. Photographs shall behalf plate size and of durable quality.

2. All photographs shall have clear definition and accurately reflect the monitor display.

D. Final Report

1. Presentation

2. The report shall be presented in accordance with the format laid down in the National Water Council and Department of the Environment 'Manual of Sewer Condition Classification'. Any deviations from this system must be agreed in writing, prior to commencement of work.

E. Manholes

1. The report shall provide a full description of manhole condition and operation efficiency. Evidence of persistent surcharging is to be noted and the following details scheduled for each manhole or access point:

a. Chamber reference and type (F, SW, C or other)

b. Chamber construction materials and internal dimensions (including depth to invert)

c. Channel dimensions and material

d. Benching details including number and size of all right and left hand branch connections

e. Other connections i.e. backdrop or ventilation etc

f. Step irons, type and number

g. Access covers, size, material and load classification (L, M or HD)

2. Key Plan

3. A copy of the key plan showing manhole numbers and pipeline lengths surveyed shall be appended to each copy of this report and must include a key to all abbreviations used.

4. Record Photographs

5. Photographs shall be mounted and inserted in the report at the relevant pages. All photographs and negatives shall be numbered for identification.

6. All negatives shall be submitted with the master copy of the final report and will become the sole property of the CA.

7. Submission of Final Report

8. Unless otherwise stated, two copies of the final report complete with photographs, key plans and video tapes or DVD's, shall be handed to the CA within 7 days of completion of the survey.

9. The Works will not be considered complete until the report and appendages have been received.

F. Conclusions and Recommendations

1. Conclusions Based on Survey Findings

2. Set out the conclusions regarding the current state of the existing drainage installation(s).

3. Particular references shall be made to structural integrity, bore scaling and hydraulic efficiency.

G. Contractors Recommendations

1. Set out the recommendations based on the results of the survey works.

XIX. SANITARY WASTE PIPING SPECIALTIES

PART 54 - GENERAL

54.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Air-admittance valves.
4. Miscellaneous sanitary drainage piping specialties.
5. FOG disposal systems.
6. Central Grease interceptors.
7. Oil interceptors.

B. Related Sections include the following:

1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
2. Division 22 Section "Plumbing Fixtures" for hair interceptors.
3. Division 22 Section "Healthcare Plumbing Fixtures" for plaster sink interceptor

54.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

54.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. FOG disposal systems.
2. Grease interceptors.
3. Grease removal devices.
4. Oil interceptors.

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

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

C. Manufacturer Seismic Qualification Certification: Submit certification that [FOG disposal systems,] [grease interceptors,] [grease removal devices,] [oil interceptors,] accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify centre of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.

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

54.4 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 labelled 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.

54.5 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.

PART 55 - PRODUCTS

55.1 CLEANOUTS

A. Size: Same as connected branch.

B. Type: Adjustable housing.

C. Body or Ferrule: Cast iron or Stainless steel.

D. Frame and Cover Material and Finish: Stainless steel.

E. Frame and Cover Shape: Round/Square, as required by architect.

F. Top Loading Classification: Heavy Duty.

G. Standard: ASME A112.3.1.

H. Size: Same as connected branch.

I. Housing: Stainless steel.

J. Closure: Stainless steel with seal.

K. Riser: Stainless-steel drainage pipe fitting to clean-out.

55.2 FLOOR DRAINS

A. Stainless-Steel Floor Drains

1. Standard: ASME A112.3.1.
2. Outlet: Side or Strainer Material: Stainless steel.
3. Top Shape: Round/Square as required by the architect.
4. Standard: ASME A112.6.3.
5. Seepage Flange: [Required].
6. Material: Stainless steel
7. Top of Body and Strainer Finish: Stainless steel.
8. Top Shape: Round/Square, as required by the architect.

55.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
2. Housing: Plastic.
3. Operation: Mechanical sealing diaphragm.
4. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves

1. Standard: ASSE 1050 for vent stacks.
2. Housing: Plastic.
3. Operation: Mechanical sealing diaphragm.

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

55.4 CENTRAL GREASE SEPARATOR

1. Manufacturer: Kessel (Easy Clean PV + S Auto Mix Pump) (or equal and approved)
2. Separate kitchen waste pipe shall be provided collecting all kitchen waste stub-out from retail and restaurants. All kitchen waste pipe shall pass through a central grease interceptor located at basement 1. A dedicated lifting station adjacent to interceptor shall discharge the treated waste to gravity drainage system at ground floor via a pressure breaking manhole.
3. Grease Separators, manufactured according to EN 1825-1, body to be made of 100% corrosion free polyethylene construction, with integrated sludge trap according to specify norms.
4. Nominal size to be NS 10 i.e. 10 l/s flow rate.
5. Automatic switching between shredding, mixing and disposing via actuator with program-controlled shredder - mix - disposal system.
6. Macerating pump should be able to handle the kitchen sludge/effluent efficiently, including grease and sludge, bones, meats, shells, plastics, etc without the need of any kind of pre filtration of sludge via strainer baskets.
7. Efficient suction of sludge is required for a proper cleaning frequency in the form of wedge-shaped bottom of the separators, wherever possible. A suction coupling shall be provided in loading bay area for disposal truck connection.
8. The macerating pump capacity of 37m3 per hour at 1 bar or higher capacities depending on the site conditions with respect to disposal pipe runs.
9. Isolation valves to be provided for easy removal of macerating pumps for any maintenance purposes.
10. Top mounted water spray nozzle for efficient cleaning of the insides of the separator body. Program controlled solenoid valves of 1" for hot and cold-water connections for the rinsing stage.
11. Disposal flange of PN10 pressure rating to be provided for coupling with disposal truck during the disposal stage.
12. Sonic control level sensing system with ultrasonic sensor technology to measure grease level thickness in real time and emit an alarm for notification of disposal.
13. Control panel should be able to be connected to the BMS system.
14. Sampling chamber to be provided for easy access to the effluent water for the authorities for sample water test.
15. Electronic data log book should be available for a minimum 1 year of activity. Possibility of data transfer by telemetry
16. Remote control for the access of the function of disposal routine to be provided if the grease separator and the terminal point of the disposal flange is far away from each other. This also helps for the personnel with the disposal truck to conduct the disposal operation without accessing the premises.

17. Associated lifting station for grease separator:

a) To provide lifting station with the Grease Separator, shall be located next to grease separator in basement 1

b) Polyethylene storage chamber with 450 ltrs storage volume, pumping volume of 250 ltrs, with screwed cleanout / access opening.

c) Twin Duty standby pumps with non chokable impeller according to DIN EN 12050-1.

d) Pump rating should be IP68

e) To include cast iron backflow preventer, with DN 80 cast iron pressure outlet.

f) Should have 32mm outlet for emergency manual pumping connection.

g) Pumping height of 40m3/hr at 1.8 bar pressure, pump capacity to be 5.5kw

h) Control unit should display current operational parameters, pump settings, hours of operation counter, etc.

i) Control unit should be able to connect to BMS.

j) The whole system should be installed on vibration mat and with floor mounting brackets

55.5 OIL INTERCEPTORS

A. Oil Interceptors:

1. Type: Factory-fabricated interceptor for separating and removing light from wastewater.
2. Body Material: Plastic.
3. Interior Lining: Corrosion-resistant enamel.
4. Exterior Coating: Corrosion-resistant enamel.
5. End Connections: Flanged.
6. Cleanout: Integral.
7. Mounting: Above floor or recessed as required.

55.6 MOTORS

A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

PART 56 - EXECUTION

56.1 INSTALLATION

A. 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.

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

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

D. 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.
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.

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

F. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

G. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

H. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

I. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

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

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

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

M. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

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

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

Q. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

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

S. Assemble components of FOG disposal systems and install on floor. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.

T. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

U. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.

V. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Division 23 Section "Facility Fuel-Oil Piping."

W. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

X. Install wood-blocking reinforcement for wall-mounting-type specialties.

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

56.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. 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.

56.3 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 incomplete piping at end of each day or when work stops.

56.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain FOG disposal systems. Refer to Division 01 Section "Demonstration and Training."

XX. SUMP PUMPS

PART 57 - GENERAL

57.1 SUMMARY

A. Section Includes:

1. Submersible sump pumps.

57.2 SUBMITTALS

A. Product Data: For each type of product indicated, provide from the list of approved manufacturers.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

57.3 QUALITY ASSURANCE

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

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

57.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 58 - PRODUCTS

58.1 SUBMERSIBLE SUMP PUMPS

A. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers.

1. Description: Factory-assembled and -tested sump-pump unit.
2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
3. Pump Casing: Stainless Steel, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
4. Impeller: Statically and dynamically balanced, ASTM B 584, cast bronze, design for clear wastewater/soil handling, and keyed and secured to shaft.
5. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
6. Seals: Mechanical.
7. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
8. Motor: Hermetically sealed capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
9. Controls:
    a. Enclosure: NEMA 250, Type 4X.
    b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
    c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
    e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
10. Control-Interface Features:
    a. Remote Alarm Contacts: For remote alarm interface.
    b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
        1) On-off status of pump.
        2) Alarm status.

58.2 STORMWATER PUMPS

A. Stormwater pumps shall be full bore and shall have solid handling capacity i.e. free passage of minimum 100 mm dia.

B. The stormwater pump sets shall be self-contained fully automatic packaged vertical multistage centrifugal type units, cast iron/stainless steel construction including casing, impeller and pump base. The units shall be complete with duty and standby pumps.

C. The discharge pipe within the pump shall be cast iron and diameter to suit pump or as specified on the drawings with high solids – high build polyamide cured coal tar epoxy coating internally and externally. Dry film thickness of coating to be 300 microns. A flanged connection shall be provided between the cast/ductile iron pipes and the uPVC Class E or GRP pressure pipe work. The gate valves shall be resiliently seated of ductile iron construction with internal and external epoxy paint protection. The non-return valve shall be resilient spring-loaded type of ductile iron construction.

D. The discharge connection size of pumps shall not be less than 150mmØ. The discharge pipe work shall preferably be arranged such that it crosses the slab above sump vertically. The pipe shall be sleeved where it crosses that floor slab and beam. A galvanised steel frame shall be provided around the pipes to protect them from mechanical damage.

E. Each pump is of 100% duty (i.e. one of the pumps is duty pump and other is standby). However, in the event of excessive flow into the chamber, if the duty pump unable to cope the standby pump shall be brought on to assist. Therefore, the panel design shall allow for two pumps working simultaneously.

F. The stormwater pump motor shall be suitable for 415 volts, 3-phase, 50 Hz power supply have Class "F" insulation and IP 68 protection. The pump control panels shall be IP 54 suitable for wall mounting and equipped with anti-condensation heater.

G. The panel shall incorporate the following:

1. Panel shall be equipped for each pump with:
    a. MCB
    b. Starter
    c. Hand / Off / Auto (HOA) switch
    d. Phase Failure Trip
    e. ELS with audio and visual indications
    f. Cyclic relay and 3 position (P1 / P2, P2 / P1 and Auto) duty selector switch shall also be provided.
2. Selected duty pump shall operate independently controlled by float level control switch when (HOA) switch in AUTO position. Duty selection shall be carried out from the duty selector switch. The standby pump shall assist if required. When more than one duty pump is specified for a pump set, the duty pumps shall start with a 15 seconds time delay (adjustable) between each pump.
3. A set of level switches shall be provided to control the operation as under:
    a. Low level switch to stop the pumps
    b. Level 1 switch to start the duty pump
    c. Level 2 switch to start "duty assist" pump

d. Level 3 switch to raise a “high level” alarm.

4. Pumps shall operate as in (2) above except that duty selection shall be carried out by cyclic relay and duty selector switch shall be in Auto position.

5. Pumps shall be capable of operating independently or simultaneously with HOA switch in Hand position and shall override all control circuits (except overload) so that the selected pump can be checked for operation.

6. In the event of duty pump failure, stand by pump shall automatically operate.

7. Panel shall have on front door:

   a. Duty selector switch
   b. Hand off auto switch for each pump
   c. Run and trip lamps for each pump
   d. Panel alive lamp
   e. Control circuit breaker fail lamp
   f. Door interlocked isolator
   g. Labels for above
   h. Earth leakage indication lamp (30mA)
   i. Hours run meter for each pump
   j. High level alarm lamp

8. Where specified, terminals for the following indications to the BMS shall be provided:

   a. Power On
   b. All HOA switches and duty selection switch in auto position
   c. Common fault on panel
   d. High water level alarm

58.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

C. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

D. Motors for submersible pumps shall be hermetically sealed.

PART 59 - EXECUTION

59.1 EARTHWORK

A. Excavation and filling are specified in Division 31 Section "Earth Moving."

59.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

59.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

59.4 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

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

59.5 FIELD QUALITY CONTROL

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

B. 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.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

59.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

59.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points

XXI. ELECTRIC DOMESTIC WATER HEATERS

PART 60 - GENERAL

60.1 SUMMARY

A. Section Includes:

1. Residential, collector-to-tank-coil, solar, electric, domestic-water heaters.
2. Residential, electric, storage, domestic-water heaters.
3. Residential, tabletop, electric, domestic-water heaters.
4. Flow-control, electric, tankless, domestic-water heaters.
5. Thermostat-control, electric, tankless, domestic-water heaters.
6. Domestic-water heater accessories.

60.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7]

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified [and the unit will be fully operational after the seismic event]."

60.3 SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittal:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

D. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify centre of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: from manufacturer.

F. Domestic-Water Heater Labelling: Certified and labelled by UL.

G. Source quality-control reports.

H. Field quality-control reports.

I. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

J. Warranty: Sample of special warranty.

60.4 QUALITY ASSURANCE

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

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

60.5 COORDINATION

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

60.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: 5 years from date of Substantial Completion.

PART 61 - PRODUCTS

61.1 ELECTRIC, DOMESTIC-WATER HEATERS

A. Collector-to-Tank-Coil, Solar, Electric, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers.
2. Standard: UL 174 with integral coil-type heat exchanger.
3. Storage-Tank Construction: Steel.
    a. Tappings: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig (1035 kPa).
    c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
    c. Drain Valve: ASSE 1005.
    d. Insulation: Comply with ASHRAE 90.2.
    e. Jacket: Steel with enamelled finish.
    f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
    g. Heat Exchanger: Corrosion-resistant-metal immersion coil.
    h. Heating Element: One; electric, screw-in immersion type. Limited to 6 kW.
    i. Temperature Control: Adjustable thermostat.
    j. Safety Control: High-temperature-limit cut-off device or system.
    k. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank. The pressure relief valve shall be connected to drainage system.
5. Electric, Storage, Domestic-Water Heaters:
    a. Manufacturers: Subject to compliance with requirements, provide from the list of approved manufacturers.
    b. Standard: UL 174.
    c. Storage-Tank Construction: Steel.
        1) Tappings: ASME B1.20.1 pipe thread.
        2) Pressure Rating: 150 psig (1035 kPa).
        3) Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
    d. Factory-Installed Storage-Tank Appurtenances:
        1) Anode Rod: Replaceable magnesium.
        2) Dip Tube: Required unless cold water inlet is near bottom of tank.
        3) Drain Valve: ASSE 1005.
    e. Insulation: Comply with ASHRAE 90.2.

f. Jacket: Steel, cylindrical, with enamelled finish.

g. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.

h. Heating Elements: Two; electric, screw-in immersion type; wired for non-simultaneous operation unless otherwise indicated. Limited to 12 kW total.

i. Temperature Control: Adjustable thermostat.

j. Safety Control: High-temperature-limit cut-off device or system.

k. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

61.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

B. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting full domestic water heater.

61.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of 1.5 times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for re-testing and re-inspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 62 - EXECUTION

62.1 DOMESTIC-WATER HEATER INSTALLATION

A. Electric, Domestic-Water Heater Mounting: Install electric, domestic-water heaters on domestic-water heater mounting bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."

62.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

62.3 IDENTIFICATION

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

62.4 FIELD QUALITY CONTROL

A. 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.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and re-inspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

62.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

XXII. GAS SERVICES

PART 63 - GENERAL

63.1 STANDARDS AND REGULATIONS

A. Standard and Regulations

1. The Mechanical Sub-Contractor shall be approved by the local Fire Authority.
2. Local Fire Authority Regulations
3. Local Development Control Guidelines
4. Institution of Gas Engineers and Managers (IGE) Standards
5. British Standards
6. National Fire Protection Association (NFPA), USA

63.2 QUALITY ASSURANCE

1. The Mechanical Sub-Contractor must have relevant experience in the design, installation and commissioning of these systems.
2. The Mechanical Sub-Contractor shall provide one-year comprehensive warranty for the complete system as per the relevant clauses of the specification.
3. Risk assessment shall be carried out by an approved assessor. The Mechanical Sub-Contractor shall hire services of a local fire authority approved Risk assessors, to certify the entire gas installation.
4. The manufacturer shall have a quality control and quality assurance program in place. The program shall be certified as complying with the requirements of ISO 9001 and shall:
   a. Be applied continuously throughout the manufacturing process
   b. Be open to inspection before and at any time during manufacture
   c. Include a testing program to prove that the product conforms to the performance requirements.
5. The manufacturer shall provide a copy of its Quality program outlining the above requirements.
6. Prior to acceptance both the manufacturer and the material will be subjected to the ADNOC procurement policy and pre-qualification procedures.

PART 64 - MATERIAL SPECIFICATION

A. Hazardous materials shall be handled and stored according to the manufacturer's instructions and in accordance with the Material Data Sheets.

B. Pipe and Fittings – Above Ground

B.

1. Copper Pipework:

Copper piping shall be used inside kitchens after gas meter at typical floors for the piping system with nominal pressure of 21 mbar. Copper piping shall conform to EN 1057 – R250 (Formerly BS: 2871 table X). Pipe to pipe and pipe to fitting jointing shall be accomplished using end feed capillary fittings. Soft solder in accordance with BS EN 29453 shall be used.

2. Steel Pipework:

Steel piping shall be used inside basements, risers inside shaft and inside corridors up to gas meters inside apartment kitchens. Steel piping shall be seamless carbon steel to API 5L grade B, schedule 80 for high pressure piping and schedule 40 for low pressure piping (75 mbar and 21 mbar). Pipe to pipe and pipe to fitting joints shall be welded in accordance with IGE/UP/2.

PART 65 - METALLIC BALL VALVES

A. Scope

1. This specification details the minimum specification for the design, manufacture and supply of metallic ball valves including above ground valves suitable for pressures up to a maximum operating pressure of 4 bar.

B. Codes and Standards

C.

1. The valves shall as a minimum comply with the following standards:

D.

a. **BS 21** - Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)

b. **BS EN 10226** - Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation.

c. **ASME B16.34** - Valves-flanged, threaded and welding end

d. **BS6891 + A2** - Installation of low-pressure gas pipework of up to 35 mm (R1 1/4) in domestic premises (2nd family gas). Specification)

e. **IGEM/UP/2** - Installation Pipework on Industrial and Commercial Premises

f. **IGE/G/5** - Gas in Flats and Others Multi-Dwelling Buildings

g. **BS EN 331 + A1** - Manually operated ball valves and closed bottom taper plug valves for gas installations for buildings

h. Equivalent alternative codes and standards may be proposed.

E.

C. Technical Details

1. All valves shall be capable of operating with the gas characteristics and temperatures as described in the environmental data as detailed within section 5 of this specification. All valves shall be non- lubricated.

2. All valves shall turn clockwise to close and shall be full bore, and include stops when fully open and closed.

3. All valves shall be metallic and be manufactured from, or coated with corrosion resistant materials.

4. Valves shall be of full-bore type.

5. Appliance Valve – The design pressure of the valve shall be 75 mbar., the end connections shall be female tapered threads to BS 21.

6. Rooftop Valve – The design pressure of the valve shall be 5.5 bar. The end connections shall be tapered threads to BS 21 from the pipe sizes ½" to 1" and the end connections shall be flanged to ASME B16.5 for the pipe sizes from 1 ¼" and above. The valves shall be lever operated, with the lever being capable of being removed.

7. Rooftop Valve with a manual reset – Same as the rooftop valve but shall incorporate a manual reset facility. The manual reset facility shall be designed that once the valve has been closed it can only be turned back on by using a security key.

8. Primary Meter Inlet Valve - The design pressure of the valve shall be at 5.5 bar. The end connections shall be tapered threads to BS 21 from the pipe sizes ½" to 1" and the end connections shall be flanged to ASME B16.5 for the pipe sizes from 1 ¼" and above. A tag shall attach to the body or cast with text in English and Arabic" Gas Valve". The valve shall be lever operated and the lever shall be capable of being removed.

9. Primary Meter Inlet Valve with a manual reset. – Same as above but shall incorporate a manual reset facility. The manual reset facility shall be designed that once the valve has been closed it can only be turned back on by using a security key.

10. Service Riser Valve – The design pressure of the valve shall be 5.5 bar. . The end connections shall be tapered threads to BS 21 from the pipe sizes ½" to 1" and the end connections shall be flanged to ASME B16.5 for the pipe sizes from 1 ¼" and above.

11. In case of MOP is less than 0.5bar, the end connections can be tapered threads to BS 21 from the pipe size ½" to 2" and shall be flanged to ASME B16.5 for the sizes above 2".

D. Data Sheet

F.

1. Screwed Ball Valve (for pressure 4 bar and less)

DESCRIPTION		UNIT	SPECIFICATION
GENERAL	Item		CS threaded ball valve
	Size Range		1/4" to 1"
	Application		4 bar & less pressure
DESIGN & CONSTRUCTION	Service		Natural Gas and LPG
	Type		Two-piece body & blowout proof stem
	Pressure Rating		CWP 600 or higher
	Port		Full Bore
	End Connection		Threaded to BS 21 or Eq
	Maximum System Operating Pressure	bar(g)	4
	Design temperature	0C	`-10 to 60
	Operator		Lever
MATERIAL	Body		A105 or A216 Gr.WCB
	Ball		SS 316
	Seat		PTFE
	Stem		SS 316
	Stem Seal		PTFE or Eq
COD E & S	Face to Face dimension		Manufacturer standard

DESCRIPTION		UNIT	SPECIFICATION
	Design code		ASME B16.34 or Eq
	Testing code		API 598 or Eq
	Fire Safe test		API 607 or Eq

2. Screwed Ball Valve (for 350 mbar and less pressure pipeline)

DESCRIPTION		UNIT	SPECIFICATION
GENERAL	Item		CS threaded ball valve
	Size Range		1/4" to 2"
	Application		350mbar, 75mbar & 21mbar pressure pipeline
DESIGN & CONSTRUCTION	Service		Natural Gas and LPG
	Type		Two piece body & blowout proof stem
	Pressure Rating		CWP 600 or higher
	Port		Full Bore
	End Connection		Threaded to NPT-F
	Maximum System Operating Pressure	bar(g)	0.5
	Design temperature	0C	`-10 to 60
	Operator		Lever
	Locability		As per project BOQ
MATERIAL	Body		A105 or A216 Gr.WCB
	Ball		SS 316
	Seat		PTFE
	Stem		SS 316
	Stem Seal		PTFE or Eq
CODES & STANDARDS	Face to Face dimension		Manufacturer standard
	Design code		ASME B16.34 or Eq
	Testing code		API 598 or Eq
	Fire Safe test		API 607 or Eq

G.

3. Flanged Ball Valve (for MOP less than 350mbar)

	DESCRIPTION	UNIT	SPECIFICATION
GENERAL	Item		CS Flanged valve
	Size Range		2" and above
	Application		350mbar & 75mbar
DESIGN & CONSTRUCTION	Service		Natural Gas and LPG
	Type		Split body & Trunnion mounted
	Pressure Rating		Class 150
	Port		Full Bore
	End Connection		Flanged to ASME B16.5 Class 150, RF
	Maximum Operating Pressure	bar(g)	16
	Design temperature	0C	-10 to 60
	Operator		Lever (Note #1)
MATERIAL	Body		A216 Gr.WCB
	Ball		SS 316
	Seat		PTFE
	Stem		SS 316
	Stem Seal		PTFE or Eq
CODES & STANDARDS	Face to Face dimension		ASME B16.10 (Long pattern)
	Design code		API 6D / ASME B16.34
	Testing code		API 598 or Eq
	Fire Safe test		API 607 or Eq
Notes:			
1	Above 6" (DN 150) size valve shall be supplied with gear operated hand wheel.		

H.

4. Flanged Ball Valve (for MOP less than 4bar)

DESCRIPTION		UNIT	SPECIFICATION
GENERAL	Item		CS Flanged valve
	Size Range		1 ¼" and above
	Application		4bar, 2bar, 350mbar & 75mbar
DESIGN & CONSTRUCTION	Service		Natural Gas and LPG
	Type		Split body & Trunnion mounted
	Pressure Rating		Class 150
	Port		Full Bore
	End Connection		Flanged to ASME B16.5 Class 150, RF
	Maximum Operating Pressure	bar(g)	16
	Design temperature	0C	-10 to 60
	Operator		Lever (Note #1)
MATERIAL	Body		A216 Gr.WCB
	Ball		SS 316
	Seat		PTFE
	Stem		SS 316
	Stem Seal		PTFE or Eq
CODES & STANDARDS	Face to Face dimension		ASME B16.10 (Long pattern)
	Design code		API 6D / ASME B16.34
	Testing code		API 598 or Eq
	Fire Safe test		API 607 or Eq
Notes:			
1	Above 6" (DN 150) size valve shall be supplied with gear operated hand wheel.		

I.

PART 66 - GAS PRESSURE REGULATORS

A. Scope

1. This specification details the minimum requirements for the manufacture and supply of gas pressure regulators for use in multi-occupancy, non-domestic applications (4 bar to 2 bar, 350mbar, 75mbar or 21 mbar, 2 bar to 350 mbar).

J.

B. Codes and Standards

K.

1. The gas pressure regulators shall as a minimum, comply with the following standards:

L.

a. BS EN 334 - Gas pressure regulators for inlet pressures up to 100 bar.
b. BS 21 - Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
c. BS EN 10226 - Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
d. BS EN 12279 - Gas supply systems. Gas pressure regulating installations on service lines. Functional requirements
e. ASA 49 - Colour – Gray Industrial Metal Paint
f. IGE/TD/13 - Pressure regulating installations for Natural Gas and LPG, Liquefied Petroleum Gas and Liquefied Petroleum Gas/Air

M.

2. Alternative equivalent standards may be submitted for approval.

N.

C. Technical Details

1. Inlet Pressure 4bar Maximum
2. Outlet Pressure 350 mbar, 75mbar or 21 mbar
3. Regulators supplied shall have sufficient capacity to meet the demand and typical capacities are, but not limited to; 2.5scm/h, 6scm/h, 10scm/h, 16scm/h, 25scm/h and 40scm/h.
4. Internal domestic regulators shall be provided without relief.

O.

5. Pressure Protection

a. Regulators shall have limited capacity internal relief. The relief port of the primary service regulator (when installed in a meter box) shall be piped to the bottom edge of the meter box. The pipe shall be manufactured in nylon, or an approved alternative material. The pipe shall be connected to a tank fitting fitted through the edge of the box.
b. Regulators shall also have over pressure slam shut valves.

P.

6. Material

c. Spring Casing: Aluminum

d. Body: Ductile Iron, or aluminium

7. Exterior Finish

e. The exterior of the regulator shall be coated with a finish of suitable epoxy based coating. The coating shall be capable of meeting or exceeding the corrosion and chemical resistance test requirements as set out in ANSI B109-2 or equivalent.

8. Identification

a. All regulators shall have an identification label showing maximum inlet pressure, outlet pressure, under pressure cut off setting and capacity.

9. Threads

a. Inlet and outlet threads shall be to BS 21.

10. Spring

a. The spring shall be of stainless steel

11. Pressure Test Nipple

a. All regulators shall have a suitably positioned pressure test point on the outlet of the regulator.

12. Filter

a. A removable filter shall be fitted to the inlet of the regulator. The size of the filter mesh shall be 50 microns.

13. Security

a. The regulator shall include a tamper proof seal/mechanism locked by a wire or similar device.

14. Installation and Maintenance Instruction

a. A copy of the manufacturer's installation and maintenance instructions shall be supplied with each regulator.

D. Data Sheet

DESCRIPTION		UNIT	SPECIFICATION
GENERAL	Item		Pressure Regulator
	Location		To be specified
	Qty		As per project BOQ
DESIGN & CONSTRUCTION	Service		Natural Gas and LPG
	Type		Direct Operated
	Design Code		BS EN 334 or Eq.
	Inlet Pressure (Min)	bar(g)	0.021
	Inlet Pressure (Max)	bar(g)	4
	Outlet Pressure	bar(g)	To be specified
	Capacity	SCM/H	To be specified

	MOP	bar(g)	4	
	Outlet Pressure Range	bar(g)	0.35 to .021	
	Design Temperature	0C	-10 to 60	
	OPSO Set Pressure	mbar(g)	To be specified	
	UPSO Set Pressure	mbar(g)	To be specified	
	Orifice Size	mm	To be specified	
OPTIONS	OPSO		Yes	
	UPSO		Yes	
	Relief Valve		Yes	
	Excess flow shutoff		Yes	
MATERIAL	Body		Die cast Aluminium	
	Diaphragm		Buna / Nitrile synthetic rubber with clouth reinforcement / Eq.	
	Spring		SS	
CONNECTIONS	Connections		Size	End Connections
	Inlet		To be specified	
	Outlet		To be specified	
	Sensing line		To be specified	
	Relief valve outlet		To be specified	

NOTES:	
1	Regulators shall be suitable for use with fuel gases, with temperatures as described above and pressures according particular application.
2	Complete set of relevant documents shall be provided at the time of delivery.
3	Flow direction shall be marked on the body of the regulator.

PART 67 - GAS METER ASSEMBLY

A. Scope

1. This specification details the requirements for the manufacture and supply of diaphragm RPD and Turbine meters for use in multi-occupancy (primary {customer} meters), villas, domestic & non-domestic applications including volume conversion.

B. Codes and Standards

1. IGE/GM/6 non-domestic meter installations. Standard designs
2. IGE/GM/8/ Parts 1 – 5 Non-domestic meter installations. Flow rate exceeding 6 m3h-1 and inlet pressure not exceeding 38 bar. Part 1: Design
3. IGE/GM/5 Selection, installation and use of electronic gas meter volume conversion systems
4. BS EN 1359 Gas meters. Diaphragm gas meters
5. BS EN 12480 Gas meters. Rotary displacement gas meters
6. BS EN 12405-1+ A2 Gas meters. Conversion devices. Volume conversion
7. BS EN 12405-2 Gas Meters. Conversion devices. Energy Conversion
8. BS 6400 :1 and 2 Specification for installation, exchange, relocation and removal of gas meters with a maximum capacity not exceeding 6 m3/h. Medium pressure (2nd family gases)
9. BS EN 61000-6-3+ A1 Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments
10. BS EN 60079-0 Explosive atmospheres. Equipment. General requirements
11. BS 21 Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
12. BS EN 10226 Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation

C. Types of Meter

Meter type	Typical capacity range
Diaphragm	Up to G16 (25 m3h-1)>
Rotary Positive Displacement(RPD)	> G16 (25m3h-1) to G160 (250 m3h-1)
Turbine	G40 (65m3h-1) to G 4000 (6,500 m3h-1)

D. Technical Details

1. Capacity

- Meters shall have sufficient capacity to meet the demand and be capable of operating in the pressure range 4 bar to 21 mbar depending on the supply pressure.

2. Dimensions

- The meters shall be sized to be as compact as possible. For Primary (Customer) Meters for multi occupancy apartment blocks, rotary displacement meters will be the preferred meter due to their compact construction, and include where appropriate electronic volume conversion for pressure and temperature.

3. Exterior Finish and Lead Free

- The exterior finish of the meters shall consist of a lead-free primer and a finish coat which are capable of meeting or exceeding the corrosion and chemical resistance test requirements as set out in ANSI B 109-2.

4. Identification

- An identification label shall be affixed by the manufacturer on each meter such that it will not interfere with the meter dial sealing or bar code reading. Details of the label and wording shall be in both English and Arabic and the layout of the lettering and wording shall be approved by engineer. The manufacturer shall submit a sample of the proposed label for approval. The gas flow direction shall be marked on the meter.

5. Diaphragm

- Diaphragms shall be manufactured from Buna or an equivalent approved material.

    a. Case

    b. Meters shall have a steel/aluminum case.

    c. Screws

    d. All screws securing meter casing flanges shall be steel with zinc plating or aluminum dipped.

    e. Pressure Test Point

    f. All diaphragm meters shall have a suitably positioned pressure test point on the outlet pillar. For rotary meters this shall be on the outlet flange connection.

    g. Index

    h. The Mechanical Index should be in unit of Cubic Meter with metering accuracy up to 3 decimal units.

    i. Tamper Proofing

    j. All meters shall have anti-reverse flow mechanism, and the index window shall have a mechanism to prevent unauthorized access to the index and its drive. The index mechanism including gear wheels shall be non-metallic. All meters shall be sealed (sometimes referred to as “badged” or “stamped”) by a recognized metrological authority. The manufacturer shall provide proof of the accuracy confirmed in the process.

6. PTZ Volume Correction

    a. For meters operating at pressures in excess of 75 mbar consideration shall be given to the installation of a suitable volume corrector in accordance with IGE/GM/5 and BS EN 12405. The consumer’s load profile and usage pattern shall be evaluated in order to establish the need to fit such a converter.

7. Caps

    a. All meters shall have suitable dust caps to protect the inlet and outlet threads.

8. Mounting Brackets

    a. Mounting brackets should accompany diaphragm meters to facilitate the fixing of meters to walls and boxes where appropriate.

9. Pulse Generating Device

a. The meters shall be fitted with a device that produces a pulse proportional to flow that is capable of interfacing with a remote hard wired totalizer

10. Packaging

a. Meters shall be packaged to protect them from damage during shipping and handling.

11. Installation and Maintenance Instructions

a. A copy of the manufacturer's installation and maintenance instructions shall be supplied with each meter.

E. Data Sheet

	DESCRIPTION	UNIT	SPECIFICATION
GENERAL	Item		Gas Meter
	Location		To be specified
	Qty		As per Project BOQ
DESIGN & CONSTRUCTION	Service		2nd & 3rd Family Gases
	Type		To be specified
	Design Code		To be specified
	Operating Pressure	bar(g)	To be specified
	Pressure Rating / MOP	bar(g)	4
	G rating		To be specified
	Flow Rate	SCM/H	To be specified
	Design Temperature	^{0}C	60
	Rangeability		To be specified
	Accuracy	%	To be specified
	Index unit		m3
	Nos. of reading numbers		To be specified
	LF pulse rate	m3/pulse	To be specified
OPTIONS	OFGEM or Metrological Authority Approval		Yes
	Communication port		To be specified
	EVC		To be specified
	Direct reading		To be specified
	Remote reading		To be specified
	Pressure Sensor		To be specified
	Temperature Sensor		To be specified

	DESCRIPTION	UNIT	SPECIFICATION	
MATERIAL	Body		Aluminum case with resistant case treatment	
CONNECTIONS	Connections		Size	End Connections
	Inlet		To be specified	
	Outlet		To be specified	
	Pressure Sensor		To be specified	
	Temperature Sensor		To be specified	

NOTES:

1	Meters shall be suitable for use with fuel gases, with temperatures as described above and pressures according particular application.
2	Complete set of relevant documents shall be provided at the time of delivery.
3	Flow direction through gas meter should be left to right when viewing the index end and the flow direction shall be marked on the body of the meter.

PART 68 - METER BOXES

A. Scope

1. This specification details the requirement for the manufacture and supply of consumable materials for use with meter and regulator installations

B. Codes and Standards

1. ANSI 316 - American Iron and Steel Institute grade 316 stainless steel
2. BS 21 - Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
3. BS EN 10226 - Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
4. BS 746+ A1 - Gas meter unions and adaptors
5. BS EN 1254-1 - Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
6. BS EN 1254-2 - Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
7. Alternative equivalent codes and standards may be submitted for approval.

C. Materials

1. Meter Box

    a. The design of the meter box shall allow ready removal of the assembly and components from the box. The box shall be designed so as to minimize its size.

    b. The box shall meet the following requirements:

    c. Include a back plate arrangement to which the detachable main body of the box is securely fastened from inside the box.

    d. The back plate shall have a pre drilled hole for the exit of the outlet pipe, alternatively an exit slot may be provided at the base of the back plate.

    e. The back plate shall include an entry slot on the base to facilitate the entry of the inlet piping. The entry and exit slot shall be fitted with seals that prevent the ingress of airborne sand and dust.

    f. Meter boxes for use in Multi occupancy (master meter sets) or Commercial applications shall have the facility to allow the outlet PEX or steel piping to exit via the top of the meter box and as such the meter box back plate and lid shall have a slot to accommodate same, and shall have a seal that prevents the ingress of airborne sand, dust and water.

    g. To accommodate the relief port piping of the regulators (that shall be piped to the bottom edge of the meter box) a slot shall exist in the base of the meter box lid to facilitate a tank fitting connection.

    h. Include an access door which is hinged and locked with a security type locking mechanism. Hinges and locking mechanism are to be manufactured from high grade plastic/nylon.

    i. Be supplied with a suitably labeled key and labeling on the inside of the door describing the actions to be taken in the event of a gas escape.

    j. Have a seal that prevents the ingress of airborne sand and dust.

2. Meter Bracket

a. The meter bracket shall be manufactured from corrosion resistant material and shall have two slots in order to fit the meter connecting unions.

3. Primary Service Regulator Connections

a. The connections to the primary service regulator shall be such that the regulator can be removed / exchanged without the need to excavate or remove the meter box back plate and /or connecting pipe work. The connections shall be manufactured from corrosion resistant materials and shall comply with an appropriate international standard.

4. Connecting Pipework

a. The connecting pipe work between the primary service regulator and the meter shall be manufactured from corrosion resistant material and shall comply with an appropriate international standard. The pipe work shall have a minimum fire resistance of 30 minutes.

5. Meter Connecting Unions

a. Unions for connecting diaphragm meters shall be made of brass, bronze or gun metal. The meter inlet union shall be threaded to BS 746 for connection to the meter. The meter outlet union shall be threaded to BS 746 for connection to the meter and have a capillary socket to BS EN 1254-2 and /or BSEN 1254-1 for connection to the outlet piping. Neoprene washers shall be provided for each union.

6. Inlet Fitting for Meter Boxes

a. The inlet fitting shall be securely mounted to the bottom surface of the meter box back plate, the design of the mounting arrangement shall allow the fitting to be removed and replaced if necessary. The fitting end connections shall be threaded to BS 21, installed internally within the box for connection to the meter inlet connection piping; and suitable for connection to PE 100 inlet service pipe.

7. Outlet Fitting for Meter Boxes

a. The outlet fitting shall be securely mounted to the top surface of the meter box back plate. The design of the mounting arrangement shall allow the fitting to be removed or replaced if necessary.

b. The fitting end connections shall be threaded to BS 21, installed internally within the box for connection to the meter outlet connection piping.

PART 69 - CARBON STEEL PIPES AND FITTINGS

A. Steel piping shall comply with the following specifications in addition to the latest specifications: When an edition date is not indicated for a Code or standard, the latest edition in force at the time of Contract award shall apply.

1. API 5L Specification for line pipe
2. ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
3. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
4. IGE/TD/3 Recommendations on Transmission and Distribution Practice –Steel & PE Pipelines pipelines for gas distribution.
5. IGE/TD/4 Recommendations on Transmission and Distribution Practice -PE and Steel gas services and service pipework.
6. ASME B31.8 Gas Transmission & Distribution Piping Systems

B. Pipe Grade

1. The pipe material shall be either anyone of API 5L, ASTM A106 or A53 and the grade shall be Grade. B.

C. Pipe Wall Thickness

Size (NPS)	Schedule
½"	Sch.40
¾"	Sch.40
1"	Sch.40
1 ¼"	Sch.40
1 ½"	Sch.40
2"	Sch.40
2 ½"	Sch.40
3"	Sch.40
4"	Sch.40
6" and above	Sch.40

D. Mill Test Certificates

1. The supplier shall provide the purchaser with the pipe mill certificates for the purchaser's acceptance prior to the pipe being shipped to the purchaser. The pipe mill certificate shall contain, at minimum, all mechanical and chemical properties, heat number, and production test results.

E. Pipe End Preparation

1. Pipe ends shall be beveled for welding in accordance with ASME B16.25.
2. Pipes ends shall be fitted with a protective dust cap prior to shipping.

F. Pipe Marking

1. The following markings shall be clearly visible on the pipe and it shall be as per Para. 10 of API 5L or as per A530 for ASTM A106 and ASTM A53.
2. Steel Fittings
3. Fittings such as elbows, tees, reducers & flanges etc shall comply with the following specifications:
    a. ASTM A 234 WPB Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
    b. ASTM A105 Forging, Carbon steel for piping components including flanges, fittings and valves

c. ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

d. ASME B16.9 Factory made wrought steel butt welded fittings

e. ASME B16.11 Forged fittings – Socket welding and threaded

f. ASME B16.25 Butt welding ends

g. MSS SP-44 Steel Pipeline Flanges

h. MSS SP-97 Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Butt-welding Ends

G. Butt welding Fittings:

1. Fittings shall be manufactured from material with strength equal to or greater than that of the pipe and shall be suitable for welding to the line pipe. The wall thickness of the fittings shall match that of the pipe to which they will be welded. Fittings with greater wall thickness will be acceptable provided the ends are counter bored to produce a wall thickness matching that of the pipe. Ends will be beveled for welding in accordance with ASME B16.25.

H. Flanges:

1. The flange material shall be compatible with the pipe material for the intended service. The selected flange material specifications shall have pressure/temperate rating according to the flange dimensional standards as applicable.
2. Flanges shall be welding neck with 1/16" raised face (Class 150 flanges). The bore of welding neck flanges shall be according to the applicable ASME standards. The flange bore shall be equal to the pipe bore.

I. Marking

1. Fittings and flanges shall be clearly and permanently marked with the following information:

a. Manufacturer's name or trademark

b. Size and wall thickness

c. Schedule number or weight

d. Material type number

e. Gaskets, Bolts and Nuts

2. Gaskets, bolts and nuts shall comply with the following specifications;

a. BS 3381: 1989 Specification for spiral wound gaskets for steel flanges to BS 1560

b. ASME B16.20 Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.

c. ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges

d. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

e. ASTM A194 Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

f. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

J. Gasket:

1. Gaskets shall be suitable for the intended service and compatible with the flange facing, rating and bolting.
2. ASME B16.20 spiral wound gaskets with 316 stainless steel winding and high purity flexible graphite filler shall be used for raised face flanges.

3. Outer rings are required for all the pipe sizes.

K. Jointing

1. Pipe to pipe and pipe to fitting joints will be either threaded or welded depending on operating pressure and pipe diameter in accordance with IGEM/UP/2 as follows.
2. Pipe ≤ 2" diameter may be screwed or welded for the MOP less than 0.5 bar.
3. Pipe ≤ 1" diameter may be screwed or welded for the MOP greater than 0.5 bar.
4. Pipe diameter more than 1" for MOP greater than 0.5 bar, it shall be welded joint.

PART 70 - COPPER TUBE

A. Scope

1. This specification details the minimum requirements for the manufacture and supply of copper tubing and fittings.
2. The copper tube and fittings shall be used to carry Natural Gas and LPG as part of the supply downstream of the primary (customer) meter to the inlet of the customer's appliance or connection and may also be used as part of a dropper system in multi occupancy buildings.

B. Codes and Standards

1. BS EN 1057+ A1 Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications.
2. BS EN 1254-2 Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
3. BS EN 1254-1 Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
4. BS 21 Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
5. BS EN 10226 Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
6. BS EN ISO 9453 Soft solder alloys. Chemical compositions and forms
7. BS EN ISO 17672 Brazing. Filler metals
8. Alternative equivalent standards may be submitted for approval.

C. Technical Details

3. Copper tube and fittings shall be supplied in accordance with the codes and standards as specified above.
4. Use of copper tube will be limited to a maximum diameter of 28mm. The following table identifies the wall thickness requirements for the copper tube:
5. Pre solder fittings are preferable.

Nominal Tube Diameter	Wall Thickness
15mm	0.7mm
22mm	0.9mm
28mm	0.9mm

6. All copper tubes shall be marked in accordance with BS EN 1057. For example, 15mm OD tube, 0.7mm wall thickness, half hard condition (R250), shall be marked every 600mm as follows:
7. Copper tube EN 1057 – R 15 x 0.7
8. The above marking shall be followed by the maker's mark and the date of production.
9. All fittings shall be of the end feed capillary type.

PART 71 - COOKER CONNECTION

A. Scope

1. This material specification details the minimum requirements for the manufacture and supply of cooker kits.
2. The cooker kits shall consist of the following components:
    a. Flexible hose
    b. Automatic closing valve
    c. Back plate elbow
3. The detailed requirements for each of these components are specified in the technical detail section below.

B. Codes and Standards

- The flexible hose assembly shall, as a minimum, comply with the latest edition of the following codes:

1. BS 669-1Part 1 Flexible hoses, end fittings and sockets for gas burning appliances. Specification for strip-wound metallic flexible hoses, covers, end fittings and sockets for domestic appliances burning 1st and 2nd family gases
2. BS 669-2Part 2 Flexible hoses, end fittings and sockets for gas burning appliances. Specification for corrugated metallic flexible hoses, covers, end fittings and sockets for catering appliances burning 1st, 2nd and 3rd family gases
3. BS EN 1254-1 Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
4. BS EN 1254-2 Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
5. BS 21 Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
6. BS EN 10226 Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
7. Alternative equivalent standards may be submitted for approval.

C. Technical Details

1. Flexible Hose
    a. The flexible hose shall be supplied in accordance with the requirements of BS 669 Part 1 and Part 2 as appropriate. The hose shall be steel reinforced structure. The table below specifies the required nominal bore, length and fittings for each flexible hose assembly for domestic cookers. All fittings shall be manufactured from corrosion resistant materials.
    b. Hoses for use in Non Domestic applications such as restaurants shall be fit for purpose for the environment in which they will be used.

2. Flexible Hose Details

Nominal Bore	Length	End Details
¾	600mm	¼ or ½ BS21 tapered Bayonet
½	900mm	¼ or ½ BS21 tapered Bayonet

3. Automatic Closing Valve

a. The automatic closing valve shall be designed to house the bayonet end of the hose using a quick release mechanism. The valve shall provide a gas tight seal without the bayonet installed. The valve shall be of an elbow design, and shall include a 15mm BS 21 male tapered thread at 90 degrees to the bayonet housing.

b. The fittings shall be manufactured from corrosion resistant materials.

4. Back Plate Elbow

a. The back plate adaptor shall be capable of being mounted to walled surfaces, and shall incorporate the following ends:

Tapered thread to BS 21,

Capillary socket to BS EN 1254-2, for connection to copper fittings

b. The fittings shall be manufactured from corrosion resistant materials.

D. Installation and Operating Instructions

1. A copy of the manufacturer's installation and operation instructions shall be supplied with each cooker connection kit.

PART 72 - CONVERSION KITS

A. Scope

1. This material specification details the minimum requirements for the manufacture and supply of conversion kits to convert LPG appliances to operate on Natural Gas and LPG.
2. For the residential market, the majority of these appliances will be cookers and small hotplates. The commercial market is generally food production, and therefore mainly comprises catering appliances.
3. Reference should be made to ADNGD-SYD-561 – Appliance Conversion

B. General Requirements

1. The preferred method of appliance conversions is by use of manufacturer approved conversion kits.
2. The use of other methods of appliance conversion will be the subject of formal approval in cases where it can be demonstrated that manufacturers approved conversion kits are not available.
3. Conversions kits shall be designed to accept Natural Gas and LPG at the inlet to the appliance at 20mbar for both domestic and residential appliances.

C. Specific Requirements

1. Conversion kits obtained from the manufacturer shall bear the manufacturers stamp and shall be obtained direct from the manufacturer or from nominated approved agents.

PART 73 - GAS DETECTION

A. Scope and System Requirements

1. The installation of gas leakage detection is mandatory in the UAE and the principle of operation is identical in domestic, commercial and industrial installations. Leakage detectors are strategically placed throughout the installations and are connected either directly or indirectly as defined below to a solenoid valve located immediately downstream of the consumer's Emergency Control Valve. Gas leakage will trigger the detector, which will signal the solenoid valve closed in the event of a leak.

B. Domestic Premises

1. The supplies to domestic premises, whether in single storey or multi storey buildings are equipped with a solenoid valve located immediately downstream of the Emergency Control Valve. The solenoid is normally open and is linked to a dedicated leakage detector located at a suitable point in the kitchen. On detection of a leak, the detector signals the solenoid closed. The point of isolation is only within the premise which has the leak. The supplies to all other consumers remain unaffected.

2. In multi storey buildings, detectors are strategically placed at relevant points of the distribution system, e.g., within the OTS. Where there is more than one OTS, each will carry its own dedicated detector(s). All of the detectors are connected to a gas panel which indicates the status of the detectors on an annunciator screen, such that the caretaker of the building can assess the status at any time. The gas panel is also linked into the fire panel, which itself is connected to a solenoid valve located in the customer primary meter set. In the event of leakage, the detector will signal the solenoid valve closed indirectly, via the gas and fire panels. Closure of the solenoid valve will close off the supply to the entire building.

C. Commercial and Industrial Premises

1. Gas detectors are placed strategically throughout the installation and are connected to a gas panel. The gas panel is linked into the fire panel, which itself is connected to a solenoid valve or a motorized valve located immediately downstream of the Emergency Control Valve. Should any of the detectors indicate gas leakage, the solenoid valve will be signaled closed via the gas and fire panels, closing off the supply to the premises.

D. Existing Systems Requiring Conversion

1. The existing gas detection system fitted within the Multi Unit Buildings and Commercial Installations shall be retained and calibrated for Natural Gas and LPG or replaced where calibration is not possible. Similar systems may be installed in new buildings where Natural Gas and LPG piping is fitted;

2. The existing gas detection system is a PC based fully addressable system. Gas detectors will typically be installed in kitchens. Gas detectors within Open to Sky areas (OTS) are deemed unnecessary and shall be disconnected from the existing gas detection system.

3. Gas detectors shall be cabled to the control panel, and in the event of leakage the gas detector shall send a data signal to the control panel and shut off the gas supply by shutting off the solenoid valve.

4. The system will monitor the gas sensors via a real time communication cable loop providing alarm status, sensor failure, sensor activation, sensor calibration and servicing identification. The sensors can be identified by the address system and a graphic layout which indicates the identification number of the device and its location.

5. Sensors will have an estimated life expectancy of ten years and are explosion protected to meet 1 Division 1 Group D requirements as per NFPA 58 & 70, and shall normally be wall mounted.

6. The operation of solenoid valves shall be controlled via the solenoid switching interface units. On detection of a leak the system shall close the solenoid valve via the interface unit. The detection system shall have the capability of shutting off the gas supply via a solenoid valve from the control panel.

7. The gas sensors shall be calibrated for Natural Gas and LPG, powered by 12v/5v DC, sensor housing IP68, power consumption typical 120ma, audio visual alarms, manual reset, Explosion protected and can automatically shut off solenoid valve in case of a leak.

8. Solenoid switching interface units shall have a power input of 220-240V AC (fused), be fully fuse protected, sensor input optically isolated. Separate N/C output for fire/BMS service optically isolated. Outlet relay contact solenoid 12VDC-24VDC, selectable N/O-N/C dry contact for fire/BMS, power consumption 600ma for 24V system. Power requirements for a 12volt system shall also be considered.

9. An audio-visual alarm unit shall be installed in the vicinity of the control panel.

10. Cabling shall be MICC or fire proof cables of at least 1.5sq.mm area shall be used to interconnect between each detector and the control panel.

E. Codes and Standards

1. National Fire Protection Association NFPA 58, 54, 56
2. National Fire Protection Association NFPA 70

PART 74 - SOLENOID VALVE

A. Scope

1. This material specification details the minimum requirements for the manufacture and supply of solenoid valves.
2. The detailed requirement is specified in the technical detail section below.

B. Codes and Standards

- The solenoid valve shall, as a minimum, comply with the latest edition of the following codes:

1. BS EN 161+ A3 Automatic Shut off valves for Gas Burners and Gas Appliances
2. IEC 335 Electrical Safety
3. ISO 4400 Fluid power systems and components – Three-pin electrical plug connectors with earth contact – Characteristics and requirements
4. BS EN 1254-1 Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes
5. BS EN 1254-2 Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
6. BS 21 Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)
7. BS EN 10226 Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
8. Alternative equivalent standards may be submitted for approval.

XXIII. SEWAGE WATER TREATMENT EQUIPMENT

PART 75 - GENERAL

75.1 SCOPE

This guide specification covers the requirements for packaged SEWAGE Treatment Equipment that can be used for human waste treatment.

75.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced.

- AWPA P5 (2015) Standard for Waterborne Preservatives
- ASM 06118G (1993) ASM Metals Reference Book (3rd Ed) ASTM INTERNATIONAL (ASTM)
- ASTM D638 (2014) Standard Test Method for Tensile Properties of Plastics
- ASTM D746 (2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
- ASTM D790 (2017) Standard TeBBst Methods for Flexural Properties of Unreinforced and Reinforced
- Plastics and Electrical Insulating Materials
- ASTM D883 (2020a) Standard Terminology Relating to Plastics
- ASTM D1248 (2016) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
- ASTM D1505 (2018) Standard Test Method for Density of Plastics by the Density-Gradient Technique
- ASTM D1525 (2017) Standard Test Method for Vicat Softening Temperature of Plastics
- ASTM D1593 (2009) Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting
- ASTM D2765 (2016) Standard Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics

75.3 SUBMITTALS

Submit the following documents and drawings for review and approval prior to installations and procurement.

Shop Drawings

- Detail Drawings;
- Installation details;

Product Data

- Composting Tank;
- Spare Parts list

Test Reports AcceptanceTests Factory Testing and

Operation and Maintenance Data Manuals

75.4 DELIVERY, STORAGE, AND HANDLING

Protect from the weather, humidity and temperature variations, dirt, dust, and other contaminants equipment delivered and placed in storage.

PART 76 - PRODUCTS

76.1 SYSTEM DESCRIPTION

Provide the large, continuous composting type tank. Add wastes at the top of the pile so that the composting material will eventually flow by gravity to the finished compost area as the underlying finished compost is removed. The composting toilet includes the composting chamber, ventilation fan and vent stack, stool with chute, and urinal with piping. Supply these elements and necessary related appurtenances and pieces by a single composting toilet manufacturer.
Note that it is intended that the composting tank shall be coupled with the vacuum drainage system. Refer to Section 22 40 00 “Vacuum Drainage System”
Submit detail drawings of equipment and material to be provided. Detail drawings containing complete wiring and schematic diagrams and other details required to demonstrate that the system is coordinated and will function properly as a unit.

76.2 DESIGN

Provide composting chamber that holds a minimum of [_] cubic meter of composting material. The composting chamber must receive wastes from [_] stools, and from [_] urinals. Design the vents, air ducts, and air inlets to the composting chamber so that air can flow from the user compartment into the composting chamber but not in the reverse direction, and so that no air can reach the vent without first passing through the composting material. Design the toilet so that all liquid entering the composting chamber will drain over and through the composting pile, and not along the chamber walls. Collect all excess liquid to an easily accessible liquid holding area. The toilet must [contain a pump for removing excess liquid] [be equipped with a drainage port in the bottom of the liquid holding area that can be connected to a liquid disposal system]. Depending on liquid volume, expected usage, and if a pump is used, permanently install [automatic] [manual] variety pump with automatic control. Design and construct the toilet so that liquids can enter the composting chamber only through the waste ports. Provide materials and joints in the toilet that are impermeable to liquids and not subject to biological, chemical, or physical corrosion.

76.3 PERFORMANCE

The composting tank must produce an inert, odor-free compost with a moisture content less than 60 percent. The finished compost must not produce enough gas to inflate a plastic bag which is 80 percent full of compost after being sealed in the bag for 24 hours at an ambient temperature. The toilet must prevent the entry of insects in the user compartment and surrounding area through the use of noncorrosive screens over all air and ventilation inlets. Assure that the composting toilet is installed properly and demonstrate that it will operate properly.

76.4 JOINT SEALANTS

Provide joint sealants that are resistant to water and biological decomposition.

76.5 LUMBER

Use pressure-treated or preserved sanded, two sided (S2S)
construction-grade pine or fir without excess crown lumber for the tank support. Treat lumber for preservation in accordance with AWPA P5.

76.6 DRAIN PIPE

Provide drain pipe from the urinal to the composting tank at least 32 mm inside diameter (ID) and sloped continuously toward the tank. Provide pipe made of a corrosion-resistant material. Locate the pipe outlet to the composting tank such that the urine flows onto or close to the center of the compost pile, to ensure that the urine flows through the pile and does not short-circuit down the tank walls.

76.7 STOOL, CHUTE, SEAT, AND LID

Construct the toilet stool in two pieces, consisting of an exterior piece that is permanently connected to the floor of the user compartment and an interior piece that is mounted inside the exterior piece and conveys wastes into the toilet chute. Construct the interior piece of

high-density polyethylene, fiberglass, or stainless steel (Type 304). Construct the exterior piece of [high-density polyethylene] [fiberglass] [oak] [stainless steel]. The top of the installed toilet stool must be a minimum of 360 to a maximum of 460 mm (14 to a maximum of 18 inches) above the user compartment floor. The minimum diameter of the interior piece opening into the chute must be 300 mm (12 inches). Fabricate the toilet chute from stainless steel (0.4775 to 0.6350 mm 24 to 26 gauge), high-density polyethylene, or fiberglass, and may be fabricated in one piece or in several pieces that are assembled in the field. Attach the chute to the composting toilet with a chute/tank connector fabricated from the same material as the chute. Fabricate the seat and lid from high-density polyethylene, ABS plastic, hardwood, or stainless steel. Provide toilet, chute, chute/tank connector, seat, and lid by the composting toilet manufacturer and certified by the manufacturer to be compatible with the manufacturer's composting toilet.

76.8 COMPOSTING VENTILATION SYSTEM

Install a ventilation system to draw air through the composting tank to provide a continuous supply of oxygen to the compost pile, ensuring that aerobic decomposition and dehydration occur. The ventilation system must also draw off odors or gases generated by the pile. Provide a system with the following components:

Electrically Powered Exhaust Fan

An electrically powered exhaust fan, installed and sized to provide a minimum flow of 0.042 to 0.057 cubic meters/second (90 to 120 cfm of air). Place the fan as high as possible in the building, but easily accessible for maintenance or replacement. The fan must not be closer than 760 mm 30 inches to the roof and a maximum of 1.8 m (6 feet) from a power disconnect. If ac power is not available, a 12-volt direct current (dc) fan may be substituted and powered by a solar power generating system.

Interior Vent Pipe

At least 150 mm (6 inches) in diameter, extending from the composting tank to support box just under the exterior roof. If elbows are used, they must have minimal bend and frequency of occurrence. Vent pipe must be made of a corrosion-resistant material. Install pipes with the bell down to prevent the entry of water. Tape joints using duct tape.

Exterior Pipe

An exterior pipe extending from the support box to the rain cap. Surround the pipe with insulation (fiberglass or equivalent R-1.23 (7). Extend the exterior pipe at least 600 mm (2 feet) above the peak or highest point of the roof. Install pipes with the bell down to prevent the entry of water. Do not use elbows greater than 45 degrees. Provide elbows made of, or coated with, a corrosion-resistant material.

Vent Pipe Roof Sleeves

Made of, or coated with, a corrosion-resistant material.

Slip Joint

A slip joint installed above the fan for the easy removal of the fan. The sleeve of the slip joint must be long enough to slide down and close the gap left by the fan when the fan is removed.

Support Box

A support box installed under the roof to connect the interior and exterior vent pipes. Provide support box made of, or coated with, a corrosion-resistant material.

Roof Jack and Rain Collar

These components must be made of, or coated with, a corrosion-resistant material.

Rain Cap

Mounted on the top of the exterior vent pipe. The rain cap must be made of, or coated with, a corrosion-resistant material.

Braces

Braces installed on the exterior vent pipe if winds greater than 80 km/hour (50 mph) or snow load greater than 900 mm (3 feet) can be expected, or if the exterior pipe extends more than 1.2 m (4 feet) above the peak of the roof.

76.9 URINALS

Install one trough urinal for each composting unit. This trough must be made of stainless steel or corrosion-resistant material. The trough must be at least 660 mm (26 inches) long and 200 mm (8 inches) deep; extend the back at least 890 mm (35 inches) above the bottom of the trough to protect the wall in back of the urinal. Mount the urinal at a height of approximately 400 mm (16 inches).

76.10 COMPOST BAFFLES

Provide two baffles, front and back, to form a compartment to contain the compost pile. Attach the front baffle securely; however, sealing is not required.

76.11 LIQUID BAFFLE, DRAIN PORTS, AND SCREENS

Install a liquid baffle with a screen at the front of the compost tank to retain the compost, and permit the passage of water seeping from the compost pile. Provide screen openings at least 6 mm (1/4 inch) to minimize plugging. The screen must be easily accessible so that it can be checked for plugging and can be cleaned. Provide a drain port in front of the liquid baffle to drain any seepage to a wastewater collection or treatment system. Place the drain port as low as possible in front of the liquid baffle so that no water stands in the bottom of the tank. Provide an overflow drain to permit the drainage of water should the drain plug become clogged. Place the overflow port just below the level of the top of the liquid baffle. Provide drain line at least 32 mm (1-1/4 inches) ID.

76.12 LIQUID DRAIN FITTINGS

Provide fittings made of corrosion-resistant or impervious material such as polyvinyl chloride, polyethylene, or stainless steel.

76.13 AIR DUCTS

Provide at least 2 air ducts to carry air beneath the compost pile. Construct the air ducts of a material impervious to corrosion and to biological decomposition.

76.14 AIR INTAKES

Provide air intakes at the front of the compost tank that are at least 5800 square mm (9 square inches) in cross section.

76.15 SIGNS

Affix signs to the major components of the composting toilet that identify those components. Provide names on the signs consistent with the identifying names in the operating instructions. Place other signs securely in the user compartment telling users that trash, cigarettes and matches thrown into the toilet can interfere with the composting process or set the compost pile on fire.

76.16 FIRE EXTINGUISHER

If fire extinguishers are used, furnish the type that will not interfere with the composting process (ammonium phosphate type is acceptable).

76.17 COMPOST HOLDING TANK

Design

Design the tank that receives and holds the human wastes during composting (the compost holding tank) so that wastes enter from the top of the tank, and the composting material and excess liquid are removed from the bottom of the composting pile. The tank may be supplied in one, two, or three pieces; bolt tanks supplied in more than one piece together in place.

Construct the tank of [plastic] [layered polyester fiberglass] [stainless steel] or an equivalent material that is impermeable to water and is corrosion-resistant. Construct the inner surfaces of the tank of material that is not susceptible to chemical or biological decomposition and is impervious to the absorption of waste and chemical derivatives. Slope the tank bottom towards the compost removal and liquid removal areas of the tank. Design the tank walls and floor to resist forces equal to or greater than the hydrostatic forces that would occur if the tank were filled with water with a maximum deflection in the walls or floor of 13 mm (1/2 inch). The tank roof must resist a 445 N (100-pound load), with a maximum deflection of 13 mm (1/2 inch). Equip the tank with a door that provides access to the bottom of the composting pile and an inspection door opening into the area above the composting pile as specified. The composting tank selected for installation is subject to the approval of the Client, and is based on the detail drawings.

Polyethylene Tank

Alternative Standards

ASTM D1248, Type 1, Class M, Grade 2, Category 3, with the following additional requirements:

R. Provide resin containing [stabilizers] [pigmentation] to resist ultraviolet degradation (for occasional exposure).

S. Provide [uncolored] [unfilled] resin density range of 0.938 to 0.942 grams per mL 0.938 to 0.942 grams per mL.

T. Provide resin with a maximum melt index of 5.

Alternative Standards II Alternatively, the following standards apply.

U. Unless otherwise indicated, use the plastics technology in accordance with the definitions given in ASTM D883.

V. The molding resin must not contain any fillers. Provide plastics that contain a minimum of 0.25 percent ultraviolet stabilizer and a maximum of 0.50 percent. Pigments may be added but do not exceed 1.0 percent of the weight of the molded compost shell.

W. The minimum mechanical properties of the materials are as follows based on molded parts:

Property	ASTM	Value
Density	ASTM D1505	0.935 - 0.940 gm/cc59 lb/cu ft
ESCR spec. thickness 125 mils F50	ASTM D1593	900-1000 hr
Tensile strength ultimate 2 in./min.	ASTM D638 Type IV Spec.	17,925 kPa2600 psi
Elongation at break 2 in./min.	ASTM D638 Type IV Spec.	400 percent
Vicat softening temp.	ASTM D1525	116 degrees C240 degrees F
Brittleness temp.	ASTM D746	minus 118 degrees Cminus 180 degrees F
Flexural modulus	ASTM D790	690.5-758.4 MN/square meter 100,000-110,000 psi

X. The finished surface of the molded part must be as free as possible through commercial processing from visual defects such as foreign inclusions, air bubbles, pinholes, and craters. Trim and smooth cut edges.

Y. Mold composting tank shells to a nominal 10 mm 3/8 inch thickness. Take physical dimensions externally and must fall within plus or minus 1 percent of the required dimensions.

76.18 COMPOST ACCESS DOOR

Design and Construction

Equip the compost holding tank with a door mounted above the finished compost holding area to remove compost and to detect and remove excess liquid. Provide minimum door opening of 0.339 square meters (525 square inches). Construct the door of material that is impermeable to water, corrosion-resistant, and not susceptible to attack by composting organisms. Provide door that supports a minimum of 1.33 kN (300 pounds) with a maximum deflection of 13 mm (1/2 inch). Position the door opening such that personnel can see all of the finished compost and liquid storage excess liquid without requiring their heads or torsos to enter the composting tank. Attach the door to the compost holding tank with stainless steel hinges meeting the standards of ANSI/BHMA A156.1, or a full-length stainless steel piano hinge, or with plastic hinges. Maintain the door in any open position, when required, without braces or other external support or restraint. Normally, keep the door closed, and equip with a stainless-steel latch that is easily operated by personnel but that prevents animals from entering the composting chamber.

Surrounding Area

Design the area around the compost access door so that maintenance personnel can remove compost while in a standing position. Provide a dry, stable work platform with adequate area for personnel movement and placement of the buckets or bags receiving the removed compost or liquids. Design stairs or ramps to the compost removal area to allow easy access to the area and safe transportation of compost and liquid containers from the area.

76.19 INSPECTION DOOR

Design and Construction

Equip the compost holding tank with a door near the top of the tank that is used to remove debris, to rake the top of the compost pile, to observe the pile surface, to add water, and to perform other necessary operation and maintenance activities on the pile surface. Provide minimum door opening of 0.186 square meters (288 square inches). Construct the door opening of material that is impermeable to water, corrosion-resistant, and not susceptible to attack by composting organisms. Position the door opening so that personnel can see all of the pile surface from outside the tank and can reach all of the pile surface without requiring their head or torsos to enter the composting tank. Attach the door to the compost holding tank with aluminum or stainless-steel piano hinge, or with plastic hinges. Design the door to stay in an open position when required, without braces or other external support or restraint. Normally, keep the door closed, and equip with a stainless-steel latch that is easily operated by personnel but that prevents animals from entering the composting chamber.

Maintenance Provisions

Design the area in front of the inspection door so that maintenance personnel will have a stable, level platform to stand upon while inspecting the top of the compost pile. Construct the platform surface at an elevation that puts the center of the inspection door at eye level of maintenance personnel using the platform. Keep an area in front of the inspection door clear of obstructions that would interfere with inserting a 1.8 m (6 foot) long rake through the inspection door.

76.20 SOURCE QUALITY CONTROL

Molded Unit Inspection

Visually inspect each molded unit to ensure that it is as free as possible from defects. In addition, take test samples from a "cut-away" section of the compost tank shell and the following tests performed:

Impact Test

Use ASTM D746 for this test. Sample must not shatter at 162.7 J (120 foot pounds) at minus 29 degrees C (minus 20 degrees F) (minimum).

Degree of Cross-Linking Test

Using ASTM D2765, a minimum gel of 70 percent must be reported on the inside half of the sample.

1.1.1 Factory Testing

Submit factory test results attesting to manufacturing quality control of the proposed system, at least [____] days before the Contracting Officer approves or disapproves the composting toilet proposed for installation. Document [.] installations of composting toilets, essentially identical to the composting toilet installed under this specification, and that those installations have at least [__] consecutive years of operating experience. Include available operating data for each of the [___] installations, along with the names, addresses, and telephone numbers of personnel at the [__] installations that will furnish information upon request regarding questions of interest to the Client.

PART 77 - EXECUTION

77.1 INSTALLATION

Submit drawings showing proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearances for maintenance and operation. Install toilet in accordance with the manufacturer's installation instructions and in accordance with the approved submittals. Install the toilet using craftsmen and laborers with demonstrable experience and, where appropriate, certification or license in the required skills. Ensure that composting toilet is in working order.

77.2 CLEANING

Thoroughly clean the installed composting toilet, enclosure, and appurtenances.

77.3 FRAMED INSTRUCTIONS

Post framed operating instructions, under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, where directed. Prepare condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal, safe operation, and procedures for starting and maintaining the system safely in typed form, frame as specified for the wiring and control instructions and post beside the diagrams. Submit proposed diagrams, instructions and other sheets for framed instructions.

77.4 CLOSEOUT ACTIVITIES

Spare Parts

Submit spare parts data, including a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service, after approval of the detail drawing and not later than 2 months prior to the date of beneficial occupancy.

Operation and Maintenance Manuals

Submit operation manual outlining step-by-step procedures required for system operation. Include with the instructions the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. Include with the manual diagrams for the system as installed.

Training Course

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total of 16 hours of normal working time, and must start after the system is functionally completed but prior to final acceptance tests. Cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations. Notify the Client at least 14 days in advance of proposed beginning of the training course.

XXIV. COMMON WORKS RESULTS FOR FIRE PROTECTION

PART 78 - GENERAL

78.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and the following sections of this specification:

1. Section 104400 – Fire Protection Specialties
2. Section 210548 – Vibration Controls for Fire Suppression Piping and Equipment
3. Section 211200 – Fire Suppression Standpipes
4. Section 211313 – Wet Pipe Fire Suppression Sprinklers
5. Section 211339 – Foam Water Sprinklers
6. Section 212200 – Clean Agent Extinguishing Systems
7. Section 213113 – Electric Drive Centrifugal Fire Pumps
8. Section 213116 – Diesel Drive Centrifugal Fire Pumps
9. Section 213400 – Pressure Maintenance Pumps

78.2 SUMMARY

A. This section includes the following:

1. Piping materials and installation instructions common to most piping systems
2. Mechanical sleeve seals
3. Sleeves
4. Escutcheons
5. Grout
6. Fire-suppression equipment and piping demolition
7. Equipment installation requirements common to equipment sections
8. Painting and finishing
9. Concrete bases
10. Supports and anchorages

78.3 DEFINITIONS

A. Finished Spaces:

1. Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated space immediately below roof, space above ceilings, unexcavated spaces, crawlspaces and tunnels.

B. Exposed, interior installations:

1. Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations:

1. Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations:

1. Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations:

1. Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber

2. NBR: Acrylonitrile-butadiene rubber

78.4 SUBMITTALS

A. Product Data for the following:

1. Mechanical sleeve seals

2. Escutcheons

B. Welding certificates

C. Submit clause by clause specification compliance statement to confirm specified parameters are met.

78.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1 "Structural Welding Code – Steel".

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Bracing Qualifications".

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping".

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

78.6 DELIVERY, STORAGE AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

78.7 COORDINATION

A. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to allow for fire suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames".

PART 79 - PRODUCTS

79.1 MANUFACTURERS

A. Subject to compliance with requirements and/or as per Section 230010 "Approved Manufacturer's List" or comparable product.

79.2 PIPE, TUBE AND FITTINGS

A. Refer to individual Division 21 Piping Sections for pipe, tube and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings

79.3 JOINING MATERIALS

A. Refer to individual Division 21 Piping Sections for special joining materials not listed below.

B. Galvanized schedule 30 pipes and threaded fitting for pipe sizes up to 2" (50 mm).

C. Grooved-End, Ductile-Iron Pipe Appurtenances sizes 2-1/2" (65 mm) and above.

1. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

2. Grooved-End, Ductile-Iron Piping Couplings: AWWA C606, for ductile-iron pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

79.4 MECHANICAL SLEEVE SEALS

A. Description:

1. Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

2. Sealing Elements:

a. Fire rated UL Listed sealant. The sealant shall completely fill the space around the pipe sleeve and all the way at both ends of the sleeve.

3. Pressure Plates:

a. Carbon steel or stainless steel subject to engineer direction. Include two for each sealant element.

4. Connecting Bolts and Nuts:

a. Stainless steel of length required to secure pressure plates to sealing elements. Include on for each sealing element.

79.5 SLEEVES

A. Galvanized Steel Sheet: 0.0239 inch (0.6 mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

79.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. Once-Piece, Stamped Steel Type: With set screw or spring clips and chrome plated finish.

C. Split Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips and chrome plated finish.

D. One Piece, Floor Plate Type: Cast iron floor plate.

79.7 PIPE HANGERS

A. The components of hanger assembly that directly attach to the pipe or the structure shall be UL Listed and FM Approved.

B. All hangers shall be made of steel. Hangers shall be galvanized and UL/FM approved. The spacing of the hanger supports shall be complying with NFPA requirements

C. Piping shall be hung with hangers and supports independent of any other hangers, supports system or devices. Non-related materials may not be suspended from or attached to standpipe piping or components

D. Powder driven or anchor shall not be used. Do not mix piping materials and hangers of dissimilar metals.

79.8 GROUT

A. Description: ASTM C 1107, Grade B, Non-shrink and non-metallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi (34.5 MPA), 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

PART 80 - EXECUTION

80.1 PIPING SYSTEMS – COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service area.

D. 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.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes

H. Install piping free of sags and bends

I. Install fittings for changes in direction and branch connections

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install escutcheons for penetrations of walls, ceiling and floors according to the following:

1. New Piping:
    a. Piping with fitting or sleeve protruding from wall: One piece, deep pattern type.
    b. Chrome Plated Piping: One-piece, cast brass type with polished chrome plated finish
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel type
    d. Bare Piping at ceiling Penetrations in Finished Spaces: One piece, stamped steel type or split plate, stamped steel type with concealed hinge and set screw.
    e. Bare Piping in Unfinished Service Spaces: One-piece, stamped steel type with concealed or exposed rivet hinge and set screw or spring clips.
    f. Bare Piping in Equipment Rooms: One-piece, stamped steel type with set screw or spring clips.
    g. Bare Piping at Floor Penetrations in Equipment Rooms: One piece floor plate type.
2. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
3. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions and concrete floor and roof slabs.
    a. Cut sleeves to length for mounting flush with both surfaces.

b. Exception: Extend sleeves installed in floors of mechanical equipment areas pr other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

c. Install sleeves in new walls and slabs as new walls and slabs are constructed.

d. Install sleeves that are large enough to provide ¼ inch (6.4 mm) annular clear space between sleeve and pipe or insulation. Use the following sleeve materials:

e. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150)

f. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum board partitions.

g. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

h. Seal space outside of sleeve fittings with grout.

i. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

4. Aboveground, Exterior Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   a. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.

   b. Install cast iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

   c. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

5. Underground, Exterior Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

   a. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

6. Fire-Barrier Penetration: Maintain indicated fire rating of walls, partitions, ceilings and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 Section "Penetration Fire Stopping" for materials.

7. Verify final equipment locations for roughing-in.

8. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

80.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. 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 unless dry seal threading is specified.

2. Damaged Threads. Do not use pipe sections that have cracked or open welds.

80.3 PAINTING

A. Painting of fire-suppression systems, equipment and components is specified in Division 09 Section "Interior Painting" and "Exterior Painting".

B. Damage and Touch up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

80.4 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions that supported unit.

2. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch (450 mm) centers around the full perimeter of the base.

3. Install epoxy coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachments to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000 psi (20.7 MPa). 28-day compressive strength concrete and reinforcement as specified in Division 03 Section "Cast-in Place Concrete or Miscellaneous Cast-in Place Concrete".

80.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

80.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut fit, and place wood grounds, nailers, blocking and anchorages to support and anchor fire suppression materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

80.7 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

XXV. VIBRATION CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 81 - GENERAL

81.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and the following sections of the specification:

1. Section 104400 – Fire Protection Specialties
2. Section 210500 – Common Work Results for Fire Suppression
3. Section 211200 – Fire Suppression Standpipes
4. Section 211313 – Wet Pipe Fire Suppression Sprinklers
5. Section 211339 – Foam Water Sprinklers
6. Section 212200 – Clean Agent Extinguishing Systems
7. Section 213113 – Electric Drive Centrifugal Fire Pumps
8. Section 213116 – Diesel Drive Centrifugal Fire Pumps
9. Section 213400 – Pressure Maintenance Pumps
10. Section 283112 – Digital Addressable Fire Alarm System "not specified in this section"

81.2 SUMMARY

A. This Section includes the following:

1. Isolation pads
2. Isolation mounts
3. Restrained elastomeric isolation mounts
4. Restraining braces

81.3 DEFINITIONS

A. UBC: Uniform Building Code

B. ICC-ES: ICC-Evaluation Service

81.4 SUBMITTALS

A. Product Data: For the following

1. Include rated load, rated deflection and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision and finish for each type and size of component used.
    a. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegate Design Submittal: For vibration isolation details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation required to select vibration isolators, and for designing vibration isolation bases.

C. Welding Certificates

D. Qualification Data: For installer vender and testing agency

E. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

81.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7 and that is acceptable to Authorities Having Jurisdiction.

B. Welding: Quality procedures and personnel according to AWS D1.1/D1/1M, "Structural Welding Code Steel".

PART 82 - PRODUCT

82.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements and or as per Section 230010, "Approved Manufacturer's List" or comparable products.

B. Pads arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non slip pattern and galvanized steel base plates, and factory cut to sizes that match requirements of supported equipment.

C. Resilient material: Oil and water resistant neoprene or rubber.

D. Channel Support System: MFMA-3, shop or field fabricated support assembly made of slotted steel channels with accessories for attachment to braced components at one end to building structure at the other end and other matching components and with corrosion resistant coating and rated in tension, compression, and torsion forces.

E. Hanger Rod Stiffener: Steel tube or steel slotted support system sleeve with internally bolted connection to hanger rod.

F. Bushings for Floor Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size anchor bolts and studs.

G. Bushing Assemblies for Wall Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil and water resistant neoprene with a flat washer face.

I. Mechanical Anchor Bolts: Drilled in and stud wedge of female wedge type in zinc coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of 8 times diameter.

J. Adhesive Anchor Bolts: Drilled in and capsule anchor system containing polyvinyl or urethane, methacrylate-based resin and accelerator or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

82.2 FACTORY FINISHES

A. Finish: Manufacturer's standard prime coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory assembled and tested equipment before shipping.

C. Powder coating on springs and housings

D. All hardware shall be galvanized. Hot dipped galvanize metal components for exterior use.

E. Baked enamel or powder coat for metal components on isolators for internal use.

F. Color code or otherwise mark vibration isolation and seismic control devices to indicate capacity range.

PART 83 - EXECUTION

83.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing in of reinforcement and cast-in place anchors to verify actual locations before installation.

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

83.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on drawings to receive them and where required to prevent buckling of hanger rods.

C. Strength of Support and Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

83.3 VIBRATION CONTROL DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13

2. Space lateral supports a maximum of 40 feet (12m) o.c and longitudinal supports a maximum of 80 feet (24 m) o.c.

3. Brace a change of direction longer than 12 feet (3.7 m)

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolts and mounting hole in concrete base.

E. Install bushing assemblies for mounting bolts for wall mounted equipment, arranged to provide resilient media where equipment or equipment mounting channels are attached to wall.

F. Attachment to Structure: If specified attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joist, or at concrete members.

G. Drilled Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Structural engineer if reinforcing steel or other embedded items are encountered during drilling. Located and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Ste anchors to manufacturer's recommended torque, using torque wrench.

6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

83.4 FIRE SUPPRESSION VIBRATION CONTROL SCHEDULE

A. Supported or Suspended Equipment:

1. Equipment Location: Fire Pump Room

2. Thickness: 25 mm thick

3. Number of Pads: Shall be as recommended by equipment supplier

XXVI. FIRE HYDRANT

PART 84 - DRY BARREL FIRE HYDRANT

84.1 GENERAL

A. AWWA C502 HYDRANT SPECIFICATIONS

1. Fire hydrants shall be rated for a minimum working pressure of 10.3 Bar (1034 kPa) and manufactured to comply UL/FM and AWWA C502 standard.
2. Fire hydrants shall have a main valve which shall provide complete closing of the drains after 4 to 5 turns of the operating nut in the opening direction.
3. The drain ring assembly shall be replaceable without removing the hydrant from the connecting pipe or having to dig.
4. Fire hydrants shall be three-way in design, having one pumper nozzle (size as specified) and two 2-1/2" hose nozzle (side outlet). Nozzle thread type shall be as specified by the end user.
5. The operating nut shall be a one piece design, manufactured of Bronze. It shall be pentagon in shape and the nut dimensions shall be as specified by the end user.
6. An arrow shall be cast on the bonnet flange to indicate the specified opening direction.
7. Hydrants shall be a "traffic-model" having upper and lower barrels joined at the ground line by a separate and breakable "swivel" flange providing 3600 rotation of upper barrel for proper nozzle facing.
8. The lower barrel shall be an integrally cast unit. The use of threaded on or mechanically attached flanges is deemed unacceptable.
9. All ferrous part shall be epoxy coated, the lower barrel shall be bitumen coated.
10. Hydrants shall be internally coated by Epoxy to avoid corrosion.
11. A bury line shall be marked on the lower barrel below the break flange to indicate proper installation depth.
12. Hydrant Inlet shall flanged and the size shall be minimum 6"

84.2 BS EN 14384 HYDRANT SPECIFICATIONS

1. Fire hydrants shall be suitable for maximum working pressure of 16bar and manufactured to comply BSEN 14384:2005 standard.
2. The design of obturator (base valve) in hydrant is made in such a way that it can be replaced at site.
3. The material of base valve shall be High Tensile Brass.
4. The drain system shall start automatically when hydrant is closed.
5. Fire hydrants shall be three-way in design, having one pumper connection 1X4" Male/Female BSRT to BS 336 and 2X2-1/2" St. thro' landing valve with female Inst. Outlet to BS 336 or 2 x 2-1/2" adaptor having female Inst. Outlet to BS 336.
6. The operating nut shall be a one piece design, manufactured of Bronze. It shall be pentagon in shape.
7. An arrow shall be cast on the bonnet flange to indicate the specified opening direction.
8. Hydrants shall be a either Breakable or Non-breakable models.
9. All ferrous part shall be epoxy coated, the lower barrel shall be bitumen coated.
10. Hydrants shall be internally coated by Epoxy to avoid corrosion.
11. Hydrants shall be compatible against resistance to disinfection products.
12. A bury line shall be marked on the lower barrel below the break flange to indicate proper installation depth.
13. Hydrant Inlet shall flanged and the size shall be either 4" or 6"

PART 85 - WET BARREL FIRE HYDRANT

85.1 GENERAL

- Fire hydrants shall be manufactured to comply with AWWA Standard C503. Fire hydrants shall meet all requirements UL/FM. Coupling must be quick coupling as per Civil Defense requirements where coupling must be Listed & Certified.
- Fire hydrants shall be rated for a working pressure of 200 Psig.
- Hydrant Body shall be Ductile Iron, Stainless Steel, or Bronze as specified.
- All ferrous part shall be Internally & Externally Epoxy coated.

85.2 UNDERGROUND HYDRANTS

Underground fire hydrant valves shall be of screw down type and are suitable for a maximum working pressure of 16 bar. The Inlet shall be flange type and the Outlet of this hydrant shall be round threaded 2 ½" size to BS 336 Standard.

Underground fire hydrants are manufactured to comply BS 750:2006 & EN14339:2005 and shall be **BSI KITE Mark Approved**.

85.3 MATERIALS

1. Body material shall be made of Grey cast iron or Ductile Iron as per BS standard
2. Material of spindle shall be made of Stainless steel to BS EN 10088-1
3. Material for the screwed outlet is made of High tensile brass to BS 12163
4. Spindle sealing (two seals) is of the toroidal sealing ring ('O' ring) type
5. Design of the spindle cap in accordance with BS 5163
6. A Wiper ring is positioned above the spindle sealing to prevent the ingress of foreign matter.

85.4 DESIGN FEATURES

A. The Hydrant shall be compactable against resistance to disinfection products.

85.5 RESISTANCE TO OPERATING LOADS

A. Maximum operating torque value (MOT) 105 N-m
B. Minimum strength torque value (mST) 210 N-m

85.6 CORROSION PROTECTION

A. All Ferrous components liable to corrosion shall be shot blasted (inside & outside) to SA 2-1/2 standard
B. Each hydrant should be painted from inside a 3 Coat epoxy paint system including primer, intermediate & Top coat

85.7 DRAINING

A. Hydrant draining system is by self-operating frost valve
B. Volume of retained water 80ml
C. Time of draining~3 min. 20 Sec.

85.8 HYDRAULIC CHARACTERISTICS

A. Flow co-efficient Ky equal 120 m3/hr @ 1.7 bar

XXVII. FIRE SUPPRESSION STAND PIPES

PART 86 - GENERAL

86.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and the following sections of the specification:

1. Section 104400 – Fire Protection Specialties
2. Section 210500 – Common Work Results for Fire Suppression
3. Section 210548 – Vibration Controls for Fire Suppression Piping and Equipment
4. Section 211313 – Wet Pipe Fire Suppression Sprinklers
5. Section 211339 – Foam Water Sprinklers
6. Section 212200 – Clean Agent Extinguishing Systems
7. Section 213113 – Electric Drive Centrifugal Fire Pumps
8. Section 213116 – Diesel Drive Centrifugal Fire Pumps
9. Section 213400 – Pressure Maintenance Pumps
10. Section 283112 - Digital Addressable Fire Alarm System “not specified in this section”

86.2 SUMMARY

A. This section in conjunction with the contract documents and drawings indicated the design, materials, equipment, installation, inspection and testing and operations requirement of the fire protection systems.

B. Requirements are included but not to limited to:

1. Pipes, fittings and specialties.
2. Fire protection valves
3. Hose connections
4. Hose stations
5. Monitors
6. Fire department connections
7. Alarm Devices
8. Manual control stations
9. Control panels
10. Pressure gages

86.3 DEFINITIONS

A. High-Pressure Standpipe Piping: Fire suppression standpipe piping designed to operate at working pressure higher than standard 175 psig (1200 KPa).

B. Standard-Pressure Standpipe Piping: Fire Suppression standpipe piping designed to operate at working pressure 175 psig (1200 KPa) maximum.

86.4 SYSTEM DESCRIPTION

A. General: The design of fire protection system shall be complete with all necessary equipment, materials and accessories for proper operation. System design and installation shall reflect high quality professional work that properly account for practical maintenance concerns and aesthetic concerns, as well as meets the design requirement of NFPA and the Authority Having Jurisdiction. Deviation from the standard including inefficient designs, unnecessary materials and special system modification to meet criteria shall be avoided.

B. Standpipe, where shown on the drawings shall be installed as Class I, Class II and Class III system per NFPA 14. Hydraulic calculations are required for all wet standpipes serving two or more hose stations.

C. Automatic Wet-Type, Class I Standpipe System: Include NPS 2-1/2 (DN 65) hose connections.

D. Automatic Wet-type Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose station.

E. Automatic Wet-type Class III Standpipe System: Include NPS 2-1/2 (DN 65) hose connection and NPS 1-1/2 (DN 40) hose station.

F. Has open water supply valve with pressure maintained and is capable of supplying water demand.

G. Provide the entire standpipe systems as required by local or state agencies, or by Owner's insurance company. The entire system shall be hydraulically designed unless otherwise noted.

H. Additional fire protection required by Authority having Jurisdiction or fire code requirement for the building not mentioned or referred in these specification shall be foreseen and provided by the fire protection specialist contractor without any additional cost to the Owner.

86.5 PERFORMANCE REQUIREMENTS

A. Standard Pressure, Fire Suppression Standpipe System Component: Listed for 175 psig (1200 KPa) minimum working pressure.

B. High Pressure, Fire Suppression Standpipe System Component: Listed for 300 psi (2070 Kpa) working pressure as per system requirement.

C. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria as per NFPA requirements.

D. Fire suppression standpipe design shall be approved by Authorities Having Jurisdiction.

1. Minimum residual pressure at each hose connection outlet is as follows:
    a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig (450 KPa)
    b. NPS 2-1/2 (DN 65) Hose Connections: 100 psig (690 Kpa)
2. Maximum residual pressure at required flow at each hose connection outlet is as follows unless otherwise indicated:
    a. NPS 1-1/2 (DN 40) Hose Connections: 100 psig (690 KPa)
    b. NPS 2-1/2 (DN 65) Hose Connections: 175 psig (1200 Kpa)

86.6 SUBMITTALS

A. After award of contract and prior to fabrication, Fire protection system contractor shall submit to the engineer for approval, complete design submittals. Design submittal package shall include:

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.

2. Standpipe and Hose system cabinets, include size, type and finish; hose connection; type and length or fire hoses; finish of fire hose coupling; type, material and finish of nozzle and finish of hose reel/hose rack.

3. Shop Drawings: For fire suppression standpipes. Include places, elevations, sections, details and attachments to other work.

4. Wiring diagrams: For power, signal and control wiring.

5. Details of anchorage and attachments to structure and to supported equipment.

6. Delegated Design Submittal: Fore standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

7. Coordination Drawings: Fire Suppression Standpipes, drawn to scale on which items are shown and coordinated with each other using inputs from installer of the items involved:

   a. Domestic Water Piping
   b. Drainage Piping
   c. Compressed Air Piping
   d. HVAC Ducts and Piping
   e. Sprinkler System Piping
   f. Electrical Wirings

8. Qualification Data: For qualified installer and professional engineer

9. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by Authorities Having Jurisdiction, including hydraulic calculations if applicable.

10. Welding certificates

11. Fire hydrant flow test report

12. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping".

13. Field quality control reports.

14. Operation and Maintenance data: For fire suppression standpipes specialties to include operation and maintenance manual fully describing schedules, replacement parts, and other operation requirements.

15. As-Built Drawings:

a. Upon completion of the installation, the contractor shall revise all Fire protection design files, calculations, manuals, operating instructions to agree with construction as actually accomplished. The notation "As-Built" shall be entered in the revision block, dated and initiated.

b. As-Built submittals shall be submitted prior to the final acceptance testing. This delivery shall include both electronic and hard copy.

16. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

86.7 QUALITY ASSURANCE

A. Installer Qualifications:

B. Installer's responsibilities include designing, fabricating, and installing fire suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire hydrant flow test.

C. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer. Obtain design and installation approval from Authority having Jurisdiction.

D. Specialist Subcontractor shall arrange inspection by the Local Civil Defense Authority and to obtain approval after installation.

E. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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

G. NFPA Standards: Fire suppression standpipe equipment, specialties, accessories, installation and testing shall comply with NFPA 14. "Installation of Standpipe and Hose System".

H. Use only those products specifically listed and approved for fire protection services by UL, Underwriters Laboratories Inc., FM-Factory Mutual Testing Laboratories, BSI, Kite Mark, LPCB or other approved agencies of international repute, where stipulated.

I. Conform to the requirements of the following:

1. Dubai Civil Defense

2. NFPA – National Fire Protection Association

3. BS-EN – British Standard Specification

4. Local Authority, International Electro Technical Commission, IEC, IEE Standards in the selection and installation of electrical components and systems.

86.8 PROJECT CONDITIONS

A. Interruption of existing fire suppression standpipe service: Do not interrupt fire suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire suppression standpipe service according to requirements indicated:

1. Notify Architect, Construction manager, & Owner no fewer than two (2) days in advance of proposed interruption of fire suppression standpipe service.

2. Do not precede with interruption of fire suppression standpipe service without Architect's Construction Manager's, Owner's written permission.

86.9 EXTRA MATERIALS

A. Provide Fire Blankets in Kitchens where indicated in the drawings. It should have BS KITE mark and should be LPCB approved. Fire blanket shall be manufactured from 430 gm/sq.m glass fiber material which shall withstand temperature up to 550 deg. C. The size shall be 4 feet x 4 feet x 6 feet.

86.10 TRAINING REQUIREMENTS

A. Prior to final acceptance, the installing fire fighting specialist contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include system operation, manual and functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

86.11 WARRANTY

A. All fire fighting and sprinkler system including fire pump set components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

PART 87 - PRODUCTS

87.1 MATERIALS, GENERAL

A. Materials and equipment used in the installation of Fire Suppression Standpipe System shall be new and listed by UL Fire Protection Equipment Directory or FM Approved Guide, latest edition. The standard products and the latest design of the manufacturer shall be used and installed per their listing, approval or manufacturer recommendations.

B. Where two or more units of the same class of equipment are required, these units shall be of the same manufacturer (e.g. couplings shall be from one manufacturer). All materials shall be installed per their listing or approval and per the manufacturer's recommendation and specification.

C. Manufacturers: Subject to compliance with requirements and/or as per Section 230010 "Approved Manufacturer's List" or comparable product.

87.2 PIPING MATERIALS

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

87.3 STEEL PIPE AND FITTINGS

A. All pipes shall be galvanized steel seamless to ASTM A-53, Sch. 40 Grade B.

B. Fire fighting specialty fittings shall be UL Listed and FM approved with 300 psi (2070 KPa) minimum working pressure rating, and made of material compatible with piping. Specialty fittings shall have 300 psi (2070 KPa) or depending on system pressure requirements.

C. Threaded fittings: Fittings for 50 mm diameter and below shall be 300 psi (2070 KPa) ductile iron threaded type. All fittings shall be UL/Fm approved.

D. Fittings 65 mm diameter and above shall be mechanical grooved type. Grooved fittings shall be UL/FM approved. Use 300 psi (2070 KPa) rated fittings as per system pressure.

E. When pipes are assembled by screwed fittings or by "cut grooved" groove, the minimum thickness for pressure up to 2070 Kpa.

F. All piping and fittings shall be painted for fire protection red as per NFPA requirement.

G. All painting of standpipe system shall be complete and as specified under painting section.

H. Grooved-Joint, Steel Pipe Appurtenances:

1. Pressure rating: 300 psi (2070 KPa) minimum depending on system requirements.

2. Galvanized and uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile iron casting; with dimensions matching steel pipe.

3. Grooved End Pipe Couplings for Steel Piping: AWA C606 and UL 213, rigid pattern, unless otherwise indicated for steel pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

87.4 PIPING JOINING MATERIALS

A. Pipe flange gasket materials: AWWA C110, rubber, flat face. 1/8 inch (3.2 mm) thick or ASME B16.21, non-metallic and asbestos free

B. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full face gaskets

C. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

D. Metal, Pipe Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCup Series, copper-phosphorous alloys for general duty brazing unless otherwise indicated.

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

87.5 PAINTING

A. All painting and fittings for fire protection shall be painted red per NFPA requirements.

B. All painting for fire suppression standpipe system shall be completed as specified under painting section.

87.6 PIPE HANGERS

A. The components of hanger assembly that directly attached to the pipe or the structure shall be UL Listed and FM approved.

B. All hangers shall be made of steel. Hangers shall be galvanized and UL/FM approved. The spacing of the hanger supports shall be complying with NFPA requirements.

C. Piping shall be hung with hangers and supports independent of any other hangers, support systems, or devices. Non related materials may not be suspended from or attached to sprinkler piping components.

D. Power driven supports or anchor shall not be used. Do not mix piping material and hanger material of dissimilar metals.

87.7 LISTED FIRE PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL Listed and FM Approved
2. Minimum Pressure rating for Standard-Pressure Piping: 175 psi (1200 Kpa)
3. Minimum Pressure Rating for High-Pressure Piping: 300 psi (2070 KPa).
4. Valves controlling water flow in fire protection piping shall be OS&Y – Outside Screw and Yoke Type, except as noted.
5. All fire protection valves (Gate valves, Check Valves and Butterfly Valves) shall be from one source.

B. Ball valves:

1. Standard: UL 1091 except with ball instead of disc.
2. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends

3. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body threaded ends or ductile iron body with grooved ends.

4. Valves NPS 3 (DN 80): Ductile iron body with grooved ends.

C. Bronze Butterfly valves:

1. Standard: UL 1091

2. Pressure rating: 300 psi (2070 KPa)

3. Body Material: Bronze

4. End Connection: Threaded

D. Iron Butterfly Valves:

1. Standard: UL 1091

2. Pressure rating: 300 psi (2070 KPa)

3. Body Material: Ductile iron coated with nylon 11

4. Style: Wafer or Grooved type with Tamper Switch

5. End Connection: Grooved

E. Check Valves

1. Standard: UL 312

2. Pressure rating: 300 psig (2070 KPa)

3. Type: Swing check

4. Body Material: Cast Iron

5. End Connections: Flanged or grooved

F. Bronze OS&Y gate valves:

1. Standard: UL 262

2. Pressure rating: 300 psi (2070 KPa)

3. Body Material: Bronze

4. End Connection: Threaded

G. Iron OS&Y gate valves:

1. Standard: UL 262

2. Pressure rating: 300 psi (2070 KPa)

3. Body material: Cast or ductile iron

4. End Connections: Threaded

H. Indicating-Type Butterfly valves:

1. Standard: UL 1091

2. Pressure Rating: 300 psi (2070 Kpa)

3. Valves NPS 2 (DN 50) and smaller:

a. Valve Type: Ball or Butterfly

b. Body Material: Bronze

c. End Connections: Threaded

I. Valves NPS 2-1/2 (DN 65) and larger:

1. Valve Type: Butterfly

2. Body Material: Cast or Ductile Iron

3. End Connections: Flanged, grooved or wafer

J. Valve Operation: Integral electrical, 115-V ac, pre-wired, single circuit, supervisory switch, supervisory switch indicating device.

K. NRS Gate Valves:

1. Standard: UL 262.B

2. Pressure rating: 300 psi (2070 Kpa)

3. Body Material: Cast iron indicator post flange

4. Stem: Non-rising

5. End Connections: Flanged or grooved

L. Indicator Posts:

1. Standard: UL 789

2. Type: Horizontal for wall mounting

3. Body Material: Cast Iron with extension rod and locking device

4. Operation: Wrench

M. Y-Type Strainer

1. Pressure rating: 300 psi (2070 Kpa)

2. Body Material: Ductile Iron ASTM A-536 grade 65-45-12

3. Type: 304 Stainless Steel cylindrical removable baskets

4. 2-3" Strainer: 1/16" perforations and 41% open area

5. 4"-12" Strainer: 40% open area

N. Suction Diffuser

1. Pressure rating: 300 psi (2070 Kpa)

2. Body Material: Ductile iron body AST< A-395 grade 65-45-15 body with base support

3. Diffuser: 304 Stainless steel with 5/32" dia. holes for 3"-12"

4. Removal start up pre-filter: 20 mesh 304 Stainless steel screen

5. Access coupling: Flange ANSI Class 150 Standard

6. End Connection: Grooved

O. Riser Check Valves

1. Pressure Rating: 300 psi (2070 Kpa)
2. Body Material: Black Enamel painted ductile iron body to ASTM A536 grade 65-45-12 4"-8"
3. Disc: Grade E EPDM encapsulated Ductile iron disc.
4. Spring and Shaft: Stainless Steel
5. End Connection: Grooved
6. Suitability: Suitable for Anti-Hammer service and horizontal and vertical installation
7. Ancillaries: Drilled, tapped and plugged stream for 2" drainage outlet and ½" pressure taps both upstream and downstream of disc.

P. Building Expansion Joints: Flexible couplings shall be used to accommodate any movement in the pipe due to building expansion or contraction. A proper study and calculation needs to be provided by the manufacturer.

87.8 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide" published by FM Global, listing.
2. Pressure rating: 300 psi (2070 Kpa)

87.9 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide" published by FM Global. Listing.
2. Pressure Rating:
   a. Standard Pressure Piping Specialty Valves: 175 psi (1200 KPa) minimum
   b. High Pressure Piping Specialty Valves: 300 psi (2070 Kpa)
   c. Body Material: Cast or ductile iron
   d. Size: Same as connected piping
   e. End Connections: Flanged or grooved

B. Alarm valves

1. Manufacturers: Refer to "Approved Manufacturer's List"
2. Standard: UL 193
3. Design: For horizontal or vertical installation
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping

C. Pressure Reducing Valves

1. Body Materials: Cast iron and/or Cast Steel
2. Pressure rating: 300 psi (2070 Kpa)
3. Disc Seat/main Disc Piston: Stainless Steel

87.10 HOSE CONNECTIONS

A. Adjustable-Valve Hose Connections

1. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure control device for connecting fire hose.
2. Pressure rating: 300 psi (2070 Kpa)
3. Material: Brass or bronze
4. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65) as indicated
5. Inlet: Female pipe threads
6. Outlet: Male hose threads with lugged cap, gasket and chain. Include hose valve threads according to NFPA 1963 and matching local fire department threads.
7. Pressure Control Device Type: Pressure reducing.
8. Design Outlet Pressure Setting: 65 psi (450 KPa) for NPS 1-1/2 and 100 psi (690 Kpa) for NPS 2-1/2
9. Finish: Polished chrome plated/Rough brass or bronze/rough chrome plated.

B. Non-adjustable Valve Hose Connections

1. Standard: UL 668 hose valve for connecting fire hose
2. Pressure rating: 300 psi (2070 Kpa)
3. material: Brass or bronze
4. Size NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated
5. Inlet: Female pipe threads
6. Outlet: Male hose threads with lugged cap, gasket and chain. Include hose valve threads according to NFPA 1963 and matching local fire department threads.
7. Finish: Polished chrome plated/Rough brass or bronze/Rough chrome plated.

87.11 NPS 1-1/2 (DN 40) RACK TYPE HOSE STATIONS

A. Hose Rack:

1. Standard: UL 47
2. material: Steel with red enamel
3. Type: Swivel type with water retention device
4. Operation: Semi-automatic
5. Size: Size to hold fire hose
6. Ancillaries: Escutcheon, Rack Nipple, Hose coupling and Hose pins

B. Hose Valve

1. Standard: UL 668 NPS 1-1/2 (DN 40) for connecting fire hose
2. Type: Adjustable
3. Pressure Control Device: Pressure reducing
4. Design Outlet Pressure Setting: 65 psi
5. Hose Valve and trim Finish: Polished chrome plated
6. Pressure rating: 300 psi (2070 Kpa) minimum
7. Pattern: Angle
8. Material: Brass or bronze
9. Pressure Control Device: UL 1468 integral or for field installation if indicated.
10. Size: NPS 1-1/2 (DN 40)
11. Inlet: Female pipe threads
12. Outlet: male hose threads according to NFPA 1963 and matching local fire department threads.

C. Hose:

1. Standards: NFPA 1961 and UL 219 lined fire hose with swivel inlet, coupling, gaskets and nozzle
2. Size: NPS 1-1/2 (DN 40)
3. Length: 100 feet (30 m)
4. Jacket: 100% polyester double jacket
   a. Inner jacket: Twill weave
   b. Outer jacket: Plain weave
5. Lining: synthetic rubber
6. Cover: Rubber, plastic or combination or rubber and plastic compounds
7. Nozzle: UL 401
8. Material: Polished chrome plated brass
9. Type: Spray, adjustable from shutoff to fog spray or straight stream.

87.12 NPS 1" (DN 25) REEL TYPE HOSE STATIONS

A. Hose Reel:

1. Standard: UL 47
2. Hose Reel and Bracket Material: Stainless Steel
3. Support Arm: Chrome plated and swing through 180 degrees
4. Type: Hose reel assembly. Include hose valve, wall bracket, hose reel, water retention device , hose pins and hose
5. Operation: Automatic

6. Size to hold fire hose

7. Finish: Stainless Steel

B. Hose Valve

1. Standard: UL 668, NPS 1" (DN 25) for connecting fire hose

2. Type: Adjustable

3. Pressure –Control Device: Pressure reducing

4. Design Outlet: 65 psi

5. Hose valve and trim finish: Polished chrome plated

6. Pattern: Angle

7. Material: Brass or bronze

8. Pressure Control Device: UL 1468, integral or for field installation if indicated

9. Size: NPS 1 (DN 25)

10. Inlet: Female pipe threads

11. Outlet: Male hose threads according to NFPA 1963 and matching local fire department threads.

C. Hose:

1. Standards: NFPA 1961 and UL 219 lined fire hose with swivel inlet, coupling gaskets and nozzle.

2. Size: NPS 1" (DN 25)

3. Length: 100 feet (30 m)

4. Jacket: Synthetic Thread

5. Rubber: Non-kink, three ply with two synthetic rubber layers

6. Lining: Rubber compound.

7. Cover: Rubber, plastic or combination of rubber and plastic compounds.

8. Nozzle: Jet spray

a. Material: Polished chrome plated brass

b. Type: Jet Spray

87.13 FIRE HOSE

A. Size: 2-1/2"

B. Length: 100 feet (30 m)

C. Jacket: 100% polyester double jacket

1. Inner jacket: 100% virgin polyester yarn in both wrap

2. Outlet jacket: Twill weave plain weave

87.14 FIRE DEPARTMENT CONNECTIONS

A. Flush Type, Fire Department Connection:

1. Standard: UL 405
2. Type: Flush for wall mounting
3. Pressure Rating: 175 psi (1200 KPa) minimum
4. Body Material: Corrosion-resistant metal
5. Inlets: Brass with threads according to NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass swivel connections, and check devices or clappers.
6. Caps: Brass, lugged type, with gasket and chain
7. Escutcheon Plate: Rectangular, brass wall type
8. Outlet: With pipe threads
9. Body Style: Square
10. Number of Inlets: Four (4)
11. Escutcheon Plate marking: Similar to "STANDPIPE"
12. Finish: Polished chrome plated
13. Outlet Size: NPS 6 (DN 150)
14. Inlet Size: 65 mm Male complete with blank caps and chains
15. Coupling: BS 336

87.15 AIR RELEASE VALVE

A. Body Material: Copper alloy to BS 1400

B. Size: 100 mm

C. Tested Pressure: 2415 KPa

87.16 ALARM DEVICES

A. Alarm Device types shall match piping and equipment connections

B. Water Motor Operated Alarm:

1. Standard: UL 753
2. Type: Mechanically operated with Pelton Wheel
3. Alarm Gong: Cast aluminium with red-enamel factory finish
4. Size: 8-inch (200 mm) diameter
5. Components: Shaft length, bearings and sleeve to suit wall construction
6. Inlet|: NPS ¾ (DN 20)
7. Outlet: NPS 1 (DN 25) drain collection

C. Electrically Operated Alarm Bell:

1. Standard: UL 464
2. Type: Vibrating, Metal Alarm bell
3. Size: 8-inch (200 mm) minimum diameter
4. Finish: Red-enamel factory finish, suitable for outdoor use

D. Water flow indicators

1. Standard: UL 346
2. Water Flow Detector: Electrically supervised
3. Components: Two single pole, double throw circuit switches for isolated alarm and auxiliary contacts, 7A, 125 V ac and 0.25 V-dc, complete with factory set, field adjustable retard chamber to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated
5. Pressure Rating: 300 psi (2070 KPa
6. Design Installation: Horizontal or vertical

E. Pressure Switches

1. Standard: UL 346
2. Type: Electrically supervised water-flow with retard feature
3. Components: Single pole, double throw switch with normally closed contacts
4. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches

1. Standard: UL 346
2. Type: Electrically supervised
3. Components: Single-pole, double throw switch with normally closed contacts
4. Design: Signals that controlled valves is in other than fully open position

G. Indicator Post Supervisory Switches:

1. Standard: UL 346
2. Type: Electrically supervised
3. Components: Single-pole, double throw switch with normally closed contacts
4. Design: Signals that controlled indicator post valve is in other than fully open position.

87.17 PRESSURE GAUGES

A. Standard: UL 393

B. Dial Size: 3-1/2 to 4-1/2 inch (90 to 115 mm) diameter

C. Pressure Gage Range: 0 to 300 psi (2070 KPa)

D. Water System Piping gage: Include "WATER" or "AIR/WATER" label on dial face

E. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 88 - EXECUTION

88.1 RESPONSIBILITIES

A. The Contractor is responsible for the installation of the fire protection system in accordance with these specifications and contract drawings. The Contractor shall coordinate with architectural, mechanical and electrical, design and construction documents, to ascertain the required information, to affect a properly designed and installed fire suppression system for the building construction and occupancy classification. The installation shall reflect high quality professional work that properly accounts for practical maintenance concerns and aesthetics.

B. The installation of the fire protection systems shall be complete with all necessary accessories for proper operation and shall be accomplished by a specialist fire fighting contractor or licensed company regularly engaged in this type of work and in accordance with requirements of the National Fire Protection Association Standards (NFPA) and the Authority Having Jurisdiction (Dubai Civil Defense).

C. The fire protection system installation shall be coordinated with the other trades (mechanical, electrical, architectural and structural, etc.)

D. The installation shall comply with all mandatory, advisory interpretations, and recommended applicable rules of the latest editions of the NFPA standards and the Authority Having Jurisdiction (Dubai Civil Defense).

88.2 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" article.

B. Report test results promptly and in writing.

88.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connection before installation.

B. Examine walls and partitions for suitable thickness, fire and smoke rated construction, framing for hose station cabinets and other conditions where hose connections and stations are to be installed.

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

88.4 WATER SUPPLY CONNECTIONS

A. Connect fire suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping".

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to water distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

88.5 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated as far as practical.

B. Deviations from approved working plans for piping require written approval from Authorities Having Jurisdiction. File written approval with Architectural before deviating from approved working plans.

C. Piping Standard: Comply with requirements in NFPA 14 for installation of fire suppression standpipe piping.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install drain valves on standpipes. Extend drain piping to floor drain or outside the building.

F. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or outside the building.

G. Install alarm devices in piping systems.

H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS ¼ (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

J. Fill wet type standpipe system piping with water.

88.6 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples and transition and special fittings that have finish and pressure ratings same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and removes burrs. Bevel plain ends of steel pipe.

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

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant and bolts. Join steel pipe and grooved end fittings according to AWWA C606 for steel pipe joints.

I. Steel-Piping, Roll Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel pipe grooved joints.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

K. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube handbook" "Brazed Joints" Chapter.

L. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemblies coupling with housing, gasket, lubricant and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

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

88.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls and specialties according to NFPA 14 and Authorities Having Jurisdiction.

B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow in main supply to system.

2. Alarm Valves: Install bypass check valve and retarding chamber drain line connection.

3. Landing Valves:

a. Schematic riser diagrams, clearly indicating the identification number of each landing valve, their elevations with respect to the pump center line and the maximum pump discharge etc. shall be furnished to the manufacturer of pressure reducing type valves for the purpose of calibrating these landing valves.

b. Pressure reducing type landing valves installed at site, shall be calibrated at the factory and sealed and tagged to this effect.

88.8 AIR RELEASE VALVE

A. Provide access doors in shaft walls, where installed in inaccessible places. Provide drain pipe to convenient location.

88.9 HOSE CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 1-1/2 (DN 40) hose connection valves with flow restricting device.

D. Install NPS 2-1/2 (DN 65) hose connections with quick disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow restricting device.

E. Install wall mounted type hose connections in cabinet. Include pipe escutcheons, with finish matching valves, inside cabinet where water supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Cabinet shall be as per Architect's requirements.

F. Install hose reel hose stations on wall with bracket or in cabinets.

88.10 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall type, fire department connections

B. Install automatic (ball drip) drain valve at each check valve for fire department connection.

88.11 IDENTIFICATION

A. Install labelling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling and terminals. Comply with requirements for identification specified in Section 206553 "Electrical Identification".

88.12 PAINTING AND LABELLING

A. The above ground steel piping system including valves, piping in finish area, miscellaneous metal works shall be clean, pre-treated, primed and painted.

B. Coating shall only apply on clean dry surfaces using clean brushes. Surfaces shall be cleaned to remove all dust, dirt, rust and mill scale.

C. Galvanized pipe shall be primed with proper material before painting. Application shall be as per the manufacturer recommendation for pipe surface corrosion protection.

D. Contractor shall paint those portions of fire protection as required.

E. Standpipe system (e.g. inspector tests, drain valves) shall be labelled with all information required by NFPA 14 Standard.

F. Labelling shall be accomplished with the use of permanently marked weatherproof metal or rigid plastic identification signs. The signs shall be secured with corrosion-resistant wire, chain, or other approved means. These signs shall be provided by the manufacturer, manufacturer's representative or installer of the sprinkler system.

G. Standpipe riser shall be labelled with building and standpipe system riser number. Labelling shall be accomplished with the use of approved self-sticking labels. The color and size shall be contrast the surface that it is applied to.

88.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems 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. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance' Chapter.

4. Energize circuits to electrical equipment and devices.

5. Start and run air compressor where applicable.

6. Coordinate with fire alarm tests. Operate as required.

7. Coordinate with fire pump tests. Operate as required.

8. Verify that equipment hose threads are same as local fire department equipment.

C. Fire suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

88.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

88.15 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard weight steel pipe with grooved ends; grooved end fittings; grooved end pipe couplings and grooved joints.

B. Standard and High pressure, wet type, fire suppression standpipe piping shall be galvanized steel, seamless to ASTM A-53, Sch. 40 Grade B.

XXVIII. FIRE SUPPRESSION SPRINKLER & GASEOUS EXTINGUISHING SYSTEMS

PART 89 - GENERAL

89.1 SUMMARY

A. This Section includes piping, valves, and sprinkler heads for fire sprinkler systems.

89.2 SUBMITTALS

A. Submit shop drawings of entire sprinkler system, signed by a professional engineer registered in the UAE, to the Local Fire Marshal for approval.

B. After review/acceptance by the Local Fire Marshal, comply with provisions of Division 01.

C. Submit system test verification.

D. Submit record drawings in accordance with Division 01.

89.3 QUALITY ASSURANCE

A. Provide sprinkler equipment and installation in accordance with recommendations of the Employer and as approved by Local Authority.

B. Equipment and installation shall meet requirements of NFPA 13 – Standard for the Installation of Sprinkler Systems, and NFPA 24 - Private Service Mains and their Appurtenances.

C. The system shall be hydraulically designed wet system and subsequently installed in accordance with the hazard classification involved.

1. Submit calculations to Employer for approval prior to start of installation.

2. Drawings and calculations shall be signed by a professional engineer registered in the UAE.

3. Where portions of the sprinkler system are located within unheated areas, i.e., soffits, canopies, chases, or are exposed to the weather subject to freezing temperatures, include adequate measures in the system design to protect those portions from the weather.

D. Computer rooms, electrical switchgear rooms, and telephone/communication equipment rooms shall be protected by a preaction water system designed for the hazard classification of the area, unless specified to be protected by another approved suppression system.

E. All fire suppression systems must not contain any ozone depleting substances (CFCs, HCFCs or Halons).

PART 90 - PRODUCTS

90.1 ACCEPTABLE MANUFACTURERS

A. Sprinkler Heads; Pressure Switches, Flow Switches, Pre- Action Systems

1. Grinnell
2. Reliable
3. Kennedy Valves
4. Angus Fire armour
5. Tyco
6. Or approved substitute

B. Pipework and Grooved Fittings:

1. Grinnell
2. Tyco
3. Gruvlock
4. Victaulic
5. Or approved substitute

C. Fire Department Connection:

1. NAFFCO
2. Kennedy Valves
3. Stockham Valves and Fittings
4. Tyco
5. Or approved substitute

D. Tamper Switches:

1. Edwards
2. Gamewell
3. A.D.T.
4. Potter
5. Or approved substitute

E. Flow Switches; Pressure Switches, PRV Valves.

1. Grinnell
2. Reliable Sprinklers USA.
3. Kennedy Valves
4. Tyco
5. Or approved substitute

F. Supervising Valves; Zone Control Valves; Supervising Valves

1. Sprinkler Alarm Valves; Flow Valves
2. Grinnell
3. Reliable Sprinklers USA.
4. Kennedy
5. Stockam Valves and Fittings
6. Tyco
7. Or approved substitute

G. Foam Sprinkler Systems, Nozzles,Bladder Tanks,and Foam Protection System Accessories.

1. Grinnell
2. Reliable Sprinklers USA.
3. Tyco
4. Zener
5. Or approved substitute

90.2 SPRINKLER HEADS

A. Link Temperature Ratings:.

1. Select to suit specific hazard area in accordance with NFPA 13, or as identified on the drawings.
2. Place sprinklers in upright or pendant position as required, with the deflector parallel to the ceiling.
3. Maintain clearances between the deflectors or other obstructions in accordance with NFPA Standard No. 13.

B. Suspended Ceilings: Pendant type with brass finish and escutcheon.

C. Suspended Ceilings: Grinnell Cleanline F946 concealed pendant type with chrome-plated finish and closures plate with pure white enamel finish. Solder closure plate to the head enclosure at 3 points and shall drop off when temperature reaches 57 deg C.

D. Exposed Areas and Ceiling Voids: Standard upright type with brass finish. For sidewall application, provide sidewall type with chrome-plated finish and escutcheon.

E. Window Sprinklers

1. Provide horizontal side wall type sprinkler heads at the inner face of the double curtain wall system. Tyco Fire Products, Model WS-5.6K factor, specific application window sprinklers, horizontal sidewall type or approved substitute.
2. The model WS specific application window sprinklers shall be installed in accordance with the manufacturer's instruction, as well as with the applicable standards of the NFPA and in addition to the standards of any other authorities having jurisdiction.

F. Spare Automatic Sprinklers:

1. Provide in accordance with NFPA Standard No. 13, representative of head types installed.

2. House in a suitable lockable metal cabinet.

3. Provide no fewer than 2 special sprinkler head wrenches, or at least 1 head wrench for each cabinet or sprinkler type, whichever is greater.

90.3 SPRINKLER RISER

A. Provide smoke/sprinkler zone control valves, flow switches, test valves, sight glasses, and sectional drain valves as shown on Drawings.

B. Where system static pressure is in excess of pressure indicated within NFPA 13, provide listed PRV with associated pressure relief valve on the branch pipe prior to the zone valve assembly

C. Provide listed pressure gauge complete with isolation valve onto each riser pipe prior to the floor zone valve.

D. Provide listed automatic air valve to the top of each sprinkler riser.

90.4 FIRE DEPARTMENT CONNECTION

A. Inlet(s)

1. Polished chrome-plated free standing type, fire department connection with six-way clapper body, in accordance with local fire protection service, with matching caps and chains.

2. Escutcheon shall have integral raised letters "AUTOMATIC SPRINKLER."

3. Provide connection with swing check valve.

4. Install an automatic ball drip between fire department connection and check valve to drain connection.

B. Automatic Ball Drips:

1. Cast brass in-line with both ends threaded with iron pipe threads.

2. Pipe drain to spill through building wall to grade or to drain.

90.5 VALVES AND TAMPER SWITCHES

A. Valves:

1. Provide enamel on metal identification sign on all valves in accordance with NFPA Standard No. 13.

2. All valves shall be padlocked and strapped open.

B. Gate Valves: OS&Y, UAE Authority approved.

C. Butterfly Valves: Gear operated, indicating type.

D. Check Valves: 2070 kPa WWP.

E. Tamper Switches: Provide on all service entrance and service riser valves and zone valves. Switch shall close contacts when valve tampering occurs.

F. Air Compressor: Provide an air compressor, sized for system volume and pressure, for dry or pre-action sprinkler systems, or connect to reliable instrument air source if available.

90.6 SUPPORTS, HANGERS AND SEISMIC BRACING

A. Supports, hangers and seismic bracing shall be in accordance with NFPA standard.

B. Contractor shall provide support details in conformance with the building structure, complete with calculation signed and stamped by a structural engineer registered in the United Arab Emirates.

90.7 AFF FIRE – SUPPRESSSION SYSTEM

A. Contractor shall provide all materials, labor, equipment, and services to provide and install complete and properly functioning AFFF System for helipad. The actuation of the deluge valves via ultra-violet infrared flame detection system and pull stations for each zone and for the hose reel located at each access.

B. The Foam Solution: The foam solution shall be produced by introducing foam concentrate into the water stream by the balanced pressure proportioning method using a bladder pressure tank and modified venture proportioner.

C. Bladder Tank: Tank shall be vertical cylindrical steel ASME coded pressure vessel with a nylon reinforced Buna-N bladder shaped to conform to the inner pressure vessel configuration. Tank shall be designed for working pressure of 1207 kPa and hydrostatically tested to at least 1806 kPa. The tank interior shall be coated with a coal tar epoxy sealer for additional corrosion resistance. The bladder tank shall be UL listed or FM approved together with the type of foam concentrate and proprotioner(s) being used in the system. The bladder tank is to have a minimum of 190-liters capacity to provide sufficient foam concentrate for the time specified when the system is discharging foam solution at total maximum system flow. The bladder tank is to be complete with all necessary outlets and supports such as a continuous welded skirt equip to tank diameter or two saddle supports as appropriate. Associated trim on the bladder tank shall include bronze pipe and fittings, four 1 in. bronze ball valves with secured nameplate depicting the valve name and operating position, and a break-resistant polycarbonate sight gauge. The tank exterior shall be primed and painted red (enamel) epoxy) for corrosion protection. The bladder tank, proportioner, and foam concentrate shall all be the products of single manufacturer. The bladder tank shall be an Ansul, or equal. type designed to accurately proportion and control the mixing of pressurized foam concentrate into a water stream. Proportioners shall be sized for the specified flow rates and either be Local Authority or FM approved with the type of foam concentrate and bladder tank being used together in the system. A fixed metering orifice, secured with a stainless steel retaining ring, shall be sized according to the type and percentage of foam concentrate used. The proportioner shall be an Ansul or Equal.

D. Fixed Nozzle: 20mm fixed constant flow nozzle, delivers 4.2 – 33igpm at 689kPa. Fog capabilities up to 49 deg C, rugged brass construction, finish satin brass. Elkhart NTS-C Fixed Fog Nozzle or equal.

E. AFFF: 208 liters of Ansulite 3% (AFC- #A) AFFF concentrate.

F. Bladder Tank Sight Gauge: The sight gauge shall be a device for estimating the quantity of foam concentrate in a bladder tank, and shall be self-draining. The gauge tube shall be 13mm. polycarbonate and tested for compatibility with the agent used. It shall be fastened to the tank near the tube top and the bottom shall terminate in a 13mm full port bronze body ball valve. The valve shall have a chromium-plated bronze ball, bronze stem, stainless steel handle and locking nut, and high performance reinforced Teflon seats and stuffing box ring with a 4137 kPa W.O.G.

rating. The valve shall have clearly legible nameplate including the necessary steps to safely use the site gauge. The valve handle shall be drilled so that it may be pinned in the position that allows operation of the bladder tank. The pin shall be attached to the valve by a chain to avoid loss. The gauge assembly shall be designed for connection to a 13mm F.N.P.T. fitting. Ansul part No. 48427, or equal.

G. Hydraulic Concentrate Control Valves: The hydraulic concentrate control valve shall consist of a factory assembled and tested threaded bronze body ball valve, with mounting pad, designed for a minimum 2758 kPa WOG. Valve shall be fitted with stainless steel ball, stem, and packing nut. Valve seats shall be of glass reinforced Teflon material.

H. All piping exposed to weather shall be provided with heat tape and insulation.

I. Hose Reel: Red glossy polyester coated steel drum, rims, and universal mounting stand N.P.T. inlet with male hose thread outlet, Potter-Roemer.

J. Fire Extinguishers: Yellow-green glossy polyester coated steel cylinder, carriage and hose hanger assembly, quick release, non-kink hose with positive grip nozzle, semi-pneumatic tires. Rating 10A: 120-B.

K. Ultra-violet/Infrared flame Detectors: Omniguard model 850 fire chief ultraviolet/ Infrared flame detector certified to Mil-Std-461C, EC-801-2ESD and IEC- 801-5.

L. Pull Stations: Manually activated input signal on supervised alarms systems, weather proof enclosure, 10 Amp snap action switch “T” pull handle, Harrington HSPS Series, or equal.

90.8 SPRINKLER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A135 or ASTM 795; UL listed, having Corrosion Resistance Rating (CRR) 1.00 or greater; FM approved.

1. Coating: Hot-dip galvanized to meet ASTM A795 where used in dry systems; black carbon steel elsewhere.

2. Steel Fittings: ANSI/ASME B16.25, buttweld ends.

3. Cast Iron Fittings: ANSI/ASME B16.4, screwed fittings.

4. Malleable Iron Fittings: ANSI/ASME B16.3, screwed type.

5. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

6. 75mm and smaller Schedule 40 seamless steel pipe, 100mm and over Schedule 10 steel roll-grooved.

7. Exception: Stand pipes 100mm and smaller schedule 40.

90.9 PRE ACTION SYSTEM

A. The preaction fire suppression system shall be Viking “TOTALPAC”, double interlocked electric/pneumatic system, Grinnell or approved substitute.

B. The unit shall be pre-trimmed, pre-wired and factory tested for easy installation requiring connections only for 75mm water supply inlet, water discharge outlet, main drain, the detection

and alarm connections and the electrical power supply. Components for the release control panel and the electrical junction box shall be manufactured to NEMA 12 Standards.

C. The unit shall come with a direct/tankless automatic air compressor combined with an air pressure maintenance device kit.

D. Sprinkler heads for preaction system shall be per NFPA 13, and shall be constructed of non-ferrous metal, Viking "Mirage" or approved substitute.

E. Smoke Detectors:

1. The pre-action system shall include the installation of ceiling mounted smoke detectors wired to the "TOTALPAC" unit.

2. Smoke detectors shall be System Sensor Models 1400 and 2400, Notifier, or approved substitute.

F. The pre-action control panel shall include contacts for connection to building fire alarm system.

G. System Operations:

1. Actuation of one detector or loss of pressure:

a. Illuminate the respective zone (circuit) lamp on the control unit.

b. Energize a pre-alarm audible and visual signal associated with that area in which the detector was operated.

c. Transmit a signal to the building's fire alarm system.

2. Activation of one or more detectors and loss of pressure:

a. Illuminate the respective zone (circuit) lamp on the control unit.

b. Energize a pre-alarm audible and visual signal associated with that area in which the detector was operated.

c. Light an individual lamp on an annunciator.

d. Open deluge valve.

e. Transmit a signal to the building's fire alarm system.

f. Transmit a signal to shut off all power to zone.

90.10 GASEOUS EXTINGUISHING SYSTEMS

A. The design and installation of all gaseous extinguishing systems shall be undertaken by a specialist contractor. These should be non-ozone depleting in accordance with local regulations.

B. Gaseous extinguishing systems shall be provided in areas as indicated on the G.A. plans.

C. See drawing titled "FIRE PROTECTION DETAILS" for the particular type of extinguishing system to be provided.

PART 91 - EXECUTION

91.1 INSTALLATION

A. Position sprinkler heads at center of tile unless specifically indicated to the contrary on reflected ceiling plans.

B. Position ceiling void sprinkler heads away from obstruction or other building elements that may inhibit the sprinkler head spray pattern.

C. Coordinate sprinkler piping routing with ductwork, pipes, structure, conduit, and other building components.

1. Provide auxiliary drains and pipe offsets required to clear other work.

D. Arrange, phase, and perform work to assure adequate services for the Employer at all times.

E. Protect sprinkler heads against mechanical damage with standard guards.

F. Locate outside alarms on wall of building adjacent to siamese fire department connection. Outside alarms shall be provided under Division 28.

G. Provide tamper switches for each sprinkler zone control valve and main entrance service valve and service riser valves. Connect switches to fire alarm system in accordance with Division 28.

H. Provide flow switches, UAE Authority approved, which close contact when flow is detected, in sprinkler lines where noted.

1. Install flow switches and adjacent valves to be easily accessible and behind access panels when located above plaster ceilings.

2. Locate flow switch minimum of 305mm from a fitting that changes the direction of flow and not less than 610mm from a drain connection or 10 pipe diameters from a gate, check, or alarm valve.

3. Connect switches to fire alarm system in accordance with Division 28.

I. Provide brace and clamp bends, plugs, tees, and installation in accordance with the requirements of NFPA Standard No. 24. Anchor connection between underground piping and base or riser with tie rods and pipe clamps.

J. Provide drains at base of risers, on valve sections, and at other locations for complete drainage of system. Drains may be valve and connected to central drain riser, or may spill outside over splash block, or into a floor drain capable of handling full flow of drain line.

K. Provide valve test pipes in accordance with NFPA Standard No. 13 and extend to discharge through proper orifice as specified above.

L. Flush system before connecting sprinkler to underground supply connection in accordance with requirements of NFPA Standard No. 13.

91.2 INSTRUCTIONS

A. Furnish the Engineer with 1 bound copy of complete instructions, including catalog cuts, diagrams, drawings, hydraulic calculations and other descriptive data covering the proper testing, operation, and maintenance of each type of system installed, and the necessary

information for ordering replacement parts. In addition, post 1 copy of complete instructions at the alarm check valve location.

B. Provide Employer's maintenance personnel with detailed instructions covering the necessary and recommended testing, operating, and maintenance procedures for each type of system.

91.3 TESTS

A. Upon completion and prior to acceptance of the installation, subject the system, including the underground supply connection, to all tests per NFPA Standard No. 13 and furnish the Engineer with a certificate thereof.

XXIX. WET PIPE FIRE SUPPRESSION SPRINKLERS

PART 92 - GENERAL

92.1 SUMMARY

A. This section in conjunction with the contract documents and drawings indicates the design, materials and equipment, installation, testing and operations requirements of the fire protection systems.

B. Requirements are included but not limited to:

1. Pipes, fittings, supports, accessories and specialties
2. Fire protection valves
3. Fire department connections
4. Sprinklers
5. Fire Pump and fire pump controllers
6. Excess pressure pumps
7. Alarm devices
8. Manual control stations
9. Control panels
10. Pressure gauges

92.2 DEFINITIONS

A. High Pressure Sprinkler Piping: Wet pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psi (1200 KPa), but not higher than 300 psi (2070 KPa).

B. Standard Pressure Sprinkler Piping: Wet pipe sprinkler system piping designed to operate at working pressure of 175 psi (1200 KPa) minimum.

92.3 SYSTEM DESCRIPTIONS

A. The design of fire protection system shall be complete with all necessary equipment, material and accessories for proper operation. System design and installation shall reflect high quality professional work that properly account for practical maintenance concerns and aesthetic concerns, as well as meets the design requirements of NFPA and Authority having Jurisdiction (Dubai Civil Defense). Deviation from the standards including in efficient designs, unnecessary materials, and special system modification to meet criteria shall be avoided.

B. Provide the entire sprinkler including sprinkler heads, piping valves, tamper switch, flow alarms and other appurtenances required by local or state agencies or by the Owner's insurance company. The entire sprinkler system shall be hydraulically designed unless otherwise needed.

92.4 PERFORMANCE REQUIREMENTS

A. Standard Pressure Piping System Component: Listed for 175 psi (1200 KPa) minimum working pressure.

B. High Pressure Piping System Components: Listed for 300 psi (2070 KPa) working pressure.

C. Delegated Design: design sprinkler system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Margin of Safety for available water flow and pressure: 10%, including losses through water-service piping, valves and backflow preventers.

E. Design criteria: Minimum density for automatic sprinkler piping design

F. Light Hazard Occupancy: 4.10 lpm over the most remote 139 sq.m. Using quick response fire sprinkler heads with head temperature complying with NFPA 13-2007, Table 6.2.5.1.

G. Ordinary Hazard Group I Occupancy: 6.10 lpm over the most remote 139 sq.m. Fire sprinkler heads temperature ratings complying with NFPA 13-2007, table 6.2.5.1.

H. Ordinary Hazard Group II Occupancy: 8.10 lpm over the most remote 139 sq.m. Fire sprinkler heads temperature ratings complying with NFPA 13-2007, Table 6.2.5.1.

I. Special Hazard Occupancy: As determined by Authorities Having Jurisdiction

J. Maximum Protection Area per Sprinkler: Per UL Listing

1. Residential Area: 400 sq.ft. (37 sq.m)
2. Light Hazard Occupancies: 225 sq.ft. (20.9 sq.m)
3. Ordinary Hazard Occupancies: 130. sq.ft. (12.1 sq.m)
4. Extra-Hazard Occupancies: 100 sq.ft. (9.3 sq.m)
5. Total Combine Hose Stream demand Requirement: According to NFPA 13 unless otherwise indicated:
    a. Light Hazard Occupancies: 100 Gpm (6.3 L/s) for 30 minutes
    b. Ordinary Hazard Occupancies: 250 Gpm (15.75 L/s) for 60 to 90 minutes
    c. Extra Hazard Occupancies: 500 Gpm (31.5 L/s) for 90 to 120 minutes

K. Standard Pressure Piping System Component: Listed for 175 psi (1200 KPa) minimum working pressure.

L. Maximum water flow velocity shall not exceed 5 meter per second in any system piping of hydraulically design.

M. Hydraulic calculation shall be performed using an approved computer software generated calculation. Hand calculation programs or calculation on spreadsheet will not be accepted. All calculation programs shall use Hazen William's calculation method.

N. Provide Balance Pressure (Bladder Tank) Foam Sprinkler System where shown on the drawing. System shall be in conformance to NFPA 16.

O. LPG Gas storage shall be protected by deluge water spray system, with water application rate in accordance to NFPA 15 requirements. System operation shall be wet pilot actuation using quartzoid bulb detector.

1. Provide Pre-action sprinkler system a complete double interlock, automatically controlled pre-action type sprinkler system for Lift Machine Rooms and delicate room where risk of water damage. System shall be complete with:
2. Deluge Valve
3. Trimmings, piping and components including check valve

4. Supervised electric actuator (Solenoid Valve)

5. Diaphragm bypass and release line

6. Manual override release

7. Low pressure alarm switch and electric alarm pressure switch

8. Air compressor

9. System operation shall conform to the following sequence:

    a. A detector operated to its trip point by a smoke or fire, causes a normally closed detector circuit to open

    b. Open solenoid valve allow release of water in the chamber of the deluge valve and clapper opens to relieve air and fill system with water.

10. Additional fire protection required by the Authority having Jurisdiction of fire code requirement for the building not mentioned or referred in this specification shall be foreseen and provided by the fire specialist subcontractor without any additional cost to the owner.

92.5 SUBMITTALS

A. After award of contract and prior to fabrication, Fire Protection System Contractor shall submit to the engineer for approval, complete design submittals. Design submittals package shall include:

1. Product Data: Manufacturer's catalogue data, system and component operating instructions for the following:

    a. Sprinkler heads, escutcheon, and guards. Include sprinkler flow characteristics, finish and mounting orientation.

    b. Fire fighting listed valves, system control and specialty valves; includes size, pressure rating and type.

    c. Piping, fitting, support and accessories; pressure rating and class, load, etc.

B. LEED Submittal:

1. Product Data for credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content and chemical components.

C. Shop Drawings: Submit shop drawings and calculations for the system and shall include the following:

1. Approved sprinkler and fire fighting piping drawings: Working plans according to NFPA 13 and 14, that have been approved by Authorities Having Jurisdiction, including hydraulic calculation.

2. Fire fighting, sprinkler system and pump room arrangement plans, elevations, sections and details.

3. Details of anchorages and attachments to structure and to supported equipment.

4. Power, signal, and control wiring diagrams. Differentiate between manufacturer installed and field installed wiring.

5. Equipment schedules to include rated capacities; shipping, installed and operating weights; furnished specialties; and accessories.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Coordination Drawings:

1. Sprinkler systems, drawn to scale, in which the following items are shown and coordinated with each other, using input from installers of the items involved:

2. Domestic water piping

3. Compressed air piping

4. HVAC hydronic piping

5. Fire suppression standpipe system

6. Electrical cabling

F. Coordinate layout and installation of fire fighting, sprinkler system and specialties with other construction that penetrates ceilings, including other services.

G. Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling mounted items. Show the following:

1. Ceiling suspension assembly members

2. Method of attaching hangers to building structure

3. Size and location of initial access modules of acoustical tile

4. Size and location of access panels in hard ceiling to provide access to concealed valves, tamper switch, etc.

5. Ceiling-mounted items, including lighting fixtures, diffusers, grilles, speaker, sprinklers and access panels, and special mouldings.

H. Qualification Data: For qualified installer and professional engineer

I. Welding certificates

J. Hydraulic calculation

1. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and test Certificate for Aboveground Piping".

2. Operation and Maintenance Data: Submit operation and maintenance manual fully describing maintenance schedules, replacement parts and other operation requirements; for sprinkler system control and specialty valves.

3. Samples for Initial Selection: Manufacturer's charts showing the full range of sprinkler covers available, valves, fittings and valves.

4. As-Built Drawings:

a. Upon completion of the installation, the contractor shall revise all fire protection design files, calculations, manuals, operating instructions to agree with

construction as actually accomplished. The notation "As-Built" shall be entered in the revision block, dated and initiated.

b. As-built submittals shall be submitted prior to the final acceptance testing. This delivery shall include both electronic and hard copies.

c. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

92.6 QUALITY ASSURANCE

A. Installer Qualifications

B. The contractor shall at his cost, appoint a Specialist Subcontractor for Fire protection systems. The Specialist Subcontractor shall be approved by the local Civil Defense Authority and subject to Engineer's approval. The Specialist Subcontractor shall be entirely responsible for the design, supply, installation, testing and commissioning of the fire protection system in line with the specification, drawings and to Engineer's and local Civil Defense Authorities approval. After preparation of Shop Drawings and their approval by the Engineer, The Specialist Subcontractor shall obtain their approval from the local Civil Defense Authority. After installation, testing and commissioning of the sprinkler system, the Specialist subcontractor shall arrange inspection by the local Civil Defense Authority and obtain their approval of the installation.

C. Installer responsibilities include designing, fabricating and installing fire fighting systems and providing professional engineering services needed to assume engineering responsibility.

D. Use only those products specifically listed and approved for fire protection services by UL-Underwriters Laboratories Inc., FM-Factory Mutual testing Laboratories, BSI KITE mark, LPCB or other approved agencies of international repute, where stipulated.

E. Conform to the requirements of the following:

1. Dubai Civil Defense

2. NFPA – National Fire Protection Association of USA

3. BS-EN – British Standard Specification

4. Local Authority, International Electro technical Commission, IEC, IEE Standards in the selection and installation of electrical components and systems

F. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code or equivalent BS-EN Standard.

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

H. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation and testing shall comply with the following:

1. NFPA 13 "Standard for the Installation of Sprinkler System"

2. NFPA 25 "Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection System"

92.7 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilitate occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than two (2) days in advance of proposed interruption of sprinkler service.

2. Do not proceed with interruption of sprinkler service without Architect's/Construction manager's/Owner written permission.

92.8 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.

B. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space and minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on project.

92.9 SPARES

A. The installing fire protection specialist contractor shall supply the owner with quantities of spare parts listed below as replacement part utilized in this installation.

1. 24 Nos. conventional (68 deg. C) sprinklers used in plant areas

2. 24 Nos. spray (57 deg. C) concealed sprinkler used in corridors

3. 24 Nos. spray (57 deg. C) recessed pendent sprinkler used in areas with ceiling

4. 24 Nos. spray (57 deg. C) sidewall sprinkler used in residential areas

5. 12 nos. Spray (57 deg. C) (K=115) extended coverage sidewall sprinkler used in areas where room length is more than 6.3 m

92.10 TRAINING REQUIREMENTS

A. Prior to final acceptance, the installing fire fighting specialist contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include system operation, manual and functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

92.11 WARRANTY

A. All fire fighting and sprinkler system including fire pump set components furnished and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with manufacturer, but in no case less than one (1) year from date of system acceptance.

PART 93 - PRODUCTS

93.1 MATERIAL GENERAL

A. Materials and equipment used in the installation of the fire fighting and sprinkler system shall be new and listed by the UL Fire Protection Equipment Directory or the FM Approval Guide, latest edition. The standard products and the latest design of the manufacturer shall be used, and install per their listing, approval, or manufacturer recommendations.

B. Where two or more units of the same class of equipment are required, these units shall be of the same manufacturer (e.g. couplings shall be of one manufacturer). All materials shall be installed per their listing or approval and per manufacturer's recommendation and specification.

C. Manufacturers: Subject to compliance with requirements and/or as per Approved Manufacturer's list in Section 230010 or comparable products.

93.2 PIPING MATERIALS

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

93.3 STEEL PIPE AND FITTINGS

A. All pipes shall be galvanized steel, seamless to ASTM A-53, Sch. 40 Grade B.

B. Fire fighting specialty fittings shall be UL Listed and FM approved with 300 psig (2070 KPa) minimum working pressure rating, and made of material compatible with piping.

C. When pipes are assembled by screw fittings or by "cut grooved" the minimum thickness for pressure up to 2070 KPa.

D. Threaded Fittings: Fittings of 50 mm diameter and below shall be 2070 KPa. Ductile iron type threaded. All fittings shall be UL/FM approved.

E. Fittings 65 mm diameter and above shall be mechanical grooved type. Grooved fittings shall be UL/FM approved. Use 300 psig (2070 KPa) rated fittings as per system pressure. Grooved joint, steel pipe appurtenances:

1. Pressure rating: 175 psi (1200 KPa) minimum, 300 psig (2070 KPa) for high pressure.

2. Galvanized and Uncoated, Grooved End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile iron casting; with dimensions matching steel pipe.

3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern unless otherwise indicated, for steel pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

F. Steel Pressure-Seal Fittings: UL 213, FM approved, 175 psi (1200 KPa) pressure rating with steel housing, rubber O-rings and pipe stop; for use with fitting manufacturer's pressure-seal tools.

93.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2mm) thick or ASME B16.21, non-metallic and asbestos free.

B. Class 125, Cast Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full face gaskets

C. Class 250, Cast Iron Flanges and Class 300, Steel raised Face Flanges: Ring Type gaskets.

D. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Brazing Filler Materials: AWS A5.8/A5.8M, BCup Series, copper-phosphorous alloys for general duty brazing unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D/10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

93.5 COVER SYSTEM FOR SPRINKLER PIPING

A. Description: System of support brackets and covers made to protect sprinkler piping.

B. Brackets: Glass reinforced nylon.

93.6 PAINTING

A. All piping and fittings for fire protection shall be painted red per NFPA requirements.

B. All painting for sprinkler system shall be complete and as specified under painting section.

93.7 PIPE HANGERS

A. The components of hanger assembly that directly attached to the pipe or the structure shall be UL listed and FM approved.

B. All hangers shall be made of steel. Hangers shall be galvanized and UL/FM approved. The spacing of the hanger supports shall be complying with NFPA requirement.

C. Piping shall be hung with hangers and supports independent of any other hangers, support systems, or devices. Non-related materials may not be suspended from or attached to sprinkler piping or components.

D. Power driven supports or anchor shall not be used. Do not mix piping material and hanger material of dissimilar metals.

93.8 LISTED FIRE PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL Listed or FM approved
2. Minimum Pressure rating for Standard Pressure Piping: 175 psi (1200 KPa)
3. Minimum Pressure rating for High Pressure Piping: 300 psig (2070 KPa)
4. All fire protection service valves shall be from one source
5. Valves controlling water flow in fire protection shall be OS&Y-Outside Screw and Yoke type, except as noted.

B. Ball Valves

1. Standard: UL 1091 except with ball instead of disc.
2. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
3. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile iron body with grooved ends.
    A. Valves NPS 3 (DN 80): Ductile iron body with grooved ends.

C. Butterfly Valves:

1. Bronze Butterfly Valves

a. Standard: UL 1091

b. Pressure rating: 175 psig (1200 KPa)

c. Body Material: Bronze

d. End Connections: Threaded

D. Iron Butterfly Valves

1. Standard: UL 1091

2. Pressure rating: 300 psig (2070 KPa)

3. Body Material: Cast or ductile iron coated with nylon-11

4. Style: Grooved or wafer with tamper switch

5. End Connections: Grooved

E. Check Valves:

1. Standard: UL 312

2. Pressure rating: 300 psig (2070 KPa)

3. Type: Swing check or split clapper type

4. Body Material: Cast steel designed and manufactured according to AWWA standards.

5. End Connections: Flanged or grooved

F. OS&Y Gate Valves

1. Bronze OS&Y Gate Valves

a. Standard: UL 262

b. Pressure rating: 175 psig (1200 KPa)

c. Body Material: Bronze

d. End Connections: Threaded

2. Iron OS&Y Gate Valves

a. Standard: UL 262

b. Pressure rating: 300 psig (2070 KPa)

c. Body Material: Cast or ductile iron

d. End Connections: Flanged or Grooved

G. Indicating-Type Butterfly Valves:

1. Standard: UL 1091

2. Pressure rating: 300 psig (2070 KPa)

3. Valves NPS 2 (DN 50) and Smaller:

a. Valve Type: Ball or butterfly

b. Body Material: Bronze

c. End Connections: Threaded

4. Valves NPS 2-1/2 (DN 65) and Larger:

a. Valve Type: Butterfly

b. Body Material: Cast or ductile iron

c. End Connections: Flanged, grooved or wafer

5. Valve Operation: Integral electrical, 115-V ac, pre-wired, single circuit, supervisory switch or electrical, 115 V ac, pre-wired, two circuit, supervisory switch indicating device.

H. NRS Gate Valves:

1. Standard: UL 262

2. Pressure rating: 300 psig (2070 KPa)

3. Body Material: Cast iron with indicator post flange

4. Stem: Non-rising

5. End Connections: Flanged or grooved

I. Indicator Posts:

1. Standard: UL 789

2. Type: Horizontal for wall mounting

3. Body Material: Cast iron with extension rod and locking device

4. Operation: Wrench

J. Riser Check Valves

1. Pressure Rating: 300 psig (2070 KPa)

2. Body Material: Ductile Iron, ASTM A-53 grade 65-45-12 4"-8 with base supports boss.

3. Spring and Shaft: Stainless Steel

4. End Connections: Grooved

5. Design: Suitable for Anti Hammer service and horizontal and vertical installation

6. Provide drilled, tapped and plugged stream for 2" drainage outlet and ½" pressure taps both upstream and downstream of disc.

7. Building Expansion Joint: Flexible couplings shall be used to accommodate any movement in the pipe due to Building expansion or contraction. A proper study and calculation needs to provide by the Manufacturer.

8. Pressure Reducing Valves

a. Pressure rating: 300 psig (2070 KPa) where required

b. Body Material: Cast Iron/Cast steel as applicable

c. Valve shall be extremely site adjustable

d. Disc seat/main disc piston shall be stainless steel

9. Suction Diffuser – Grooved End rated 300 psi, ductile iron body, ASTM A-395 grade 65-45-15 body with base support boss. Diffuser of 304 Stainless Steel with 5/32" (4mm) diameter holes for 3"-12". Removable starts up pre-filter 20 mesh 304 Stainless Steel screen. Provide connections for pressure measurement and drain. Access coupling style 07, flange ANSI class 150 standard.

10. Flexible Joints: 3 no. flexible coupling in series shall be installed near the pumps to reduce the noise and vibration.

93.9 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide", published by FM Global listing.

2. Pressure Rating: 300 psig (2070 KPa)

93.10 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide", published by FM Global listing.

2. Pressure Rating:

a. Standard Pressure Piping Specialty Valves: 175 psig (1200 KPa) minimum

b. High Pressure Piping Specialty Valves: 300 psig (2070 KPa)

3. Body Material: Cast or Ductile iron

4. Size: Same as connected piping

5. End Connections: Flanged or grooved

B. Wet Pipe Alarm Check Valves:

1. Alarm Check Valve: Cast iron body, flap type construction with flanged ends, metered bypass with ball valve for pressure maintenance flow, test and alarm flow parts, bolted access cover, pressure gauges (as specified elsewhere) at inlet and outlet

2. Test and Drain valve: All bronze valve with screwed ends complete with metering orifice, discharge turn dish etc.

3. Alarm test valve: All bronze ball valve with screwed ends, operating lever, engraved position indicator attached to body.

4. Strainer. All bronze, Y-type strainer with screwed ends, screwed cover and stainless steel screen for alarm supply line.

5. Water Motor Alarm: The Gong, Gong Mount and Water Motor Housing shall be fabricated from corrosion resistant aluminium alloys. The bearing type shall be polymer drive bearings which do not require lubrication, and the Gong shall be closely fitted to the Gong Mount to eliminate the need for a separate cover.

6. Pressure Switch: The switch housing shall be weather proof and oil resistant. The cover shall incorporate tamper resistant screws. It shall have normally closed/open contacts rated for 2.5 amps at 250 volts A/C.

C. Deluge Valves:

1. Deluge valve assembly shall be externally re-settable by hydraulic means, and shall employ a positive vent or priming line to ensure that the deluge will not prematurely reset.

2. Deluge valve: Shall low differential, latched closed spring assisted, self resetting clapper, pneumatic, hydraulic or electric release. Deluge valve and trim shall be UL Listed and FM approved for vertical and horizontal installation, supplied with grade "E" EPDM seal, housing cast of ductile iron confirming to ASTM A-536, grade 65-45-12, serviceable without removal from the line, flange ends for installation with ANSI class 150 flange rated service up to 300 psi (2070 KPa) working pressure.

3. Deluge valve shall be wet actuation trim, provided with quartzoid bulb detector.

D. Floor Control Valve Assembly

1. Provide UL Listed and FM approved zone check assembly to support monitoring, controlling, inspection, testing and maintenance of each zone in sprinkler system, where shown in the drawings as sprinkler zone control valve assembly.

2. Zone check assembly shall be installed to serve individual sections/floors of the building. Valves shall be butterfly type with ductile iron body, EPDM seat and aluminium bronze disk. The valve shall be hand wheel operated via a gearbox with a prominent coloured paddle position indicator. The body shall be either flanged or grooved to accept mechanical couplings. The valve shall be rated for an operating pressure of 175 psi (1200 KPa).

3. The valve shall incorporate pre-wired end of position switches terminated on the gearbox enclosure to provide remote indication of the valve position.

4. Pressure gauges shall be installed downstream of all zone control valves.

E. Test and Drain Valves

1. Test and drain valves shall be installed downstream of zone control valve/flow switch assemblies for the purpose of proving the operation of the water flow switch, and also for draining the sprinkler zone pipe work downstream of the zone control valve.

2. The test and drain valves shall be of the ball type with a cast bronze body and stainless steel ball suitable for working pressure of 12.1 bars. The ball shall be wrench operated and incorporate an orifice of equal diameter to represent the actuation of a single sprinkler head when in the test position. The body shall incorporate a sight glass on the drain side of the ball valve.

3. Test drain valves shall be UL Listed.

F. Pressure Reducing Valve

1. The body shall be bronze for pipeline size up to DN 65. For sizes DN 80 and above the body shall be ductile iron with bronze trim to ASTM A 536/B61 in either globe or angle pattern to suit the pipe work configuration. The diaphragm and disc shall be BUNA-N or EPDM. The pressure reducing valve shall be pilot valve controlled to provide a wide range of downstream operating pressures. The body shall have flanged or grooved ends.

2. The pressure reducing valves shall be rated for a minimum operating pressure of PN 20 with pressure adjustment range of 2 – 11.3 bar. Where upstream system pressure exceeds 18.0 bar, the operating pressure rating shall be increased to suit.

3. Pilot valves shall be bronze construction to ASTM B62 with stainless steel trim. Interconnecting pipe work shall be soft copper swaged to brass fittings

4. The body shall be externally epoxy coated and shall be all internal wetted surfaces.

5. Pressure reducing valves shall be UL Listed

6. Pressure gauges shall be installed upstream and downstream of all pressure reducing valves

93.11 FIRE DEPARTMENT CONNECTIONS

A. Flush-Type, Fire Department Connection:

1. Standard: UL 405

2. Type: Flush, wall mounting

3. Pressure rating: 175 psi (1200 Kpa) minimum

4. Body Material: Corrosion resistant metal

a. Inlets: Brass with threads according to NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers

b. Caps, Brass, lugged type, with gasket and chain

c. Escutcheon plate: Rectangular, brass, wall type

d. Outlet: With pipe threads

e. Body Style: Square

f. Number of Inlets: Four

g. Escutcheon Plate Marking: Similar to "AUTO SPR"

h. Finish: Polished chrome plated

i. Outlet Size: NPS 6 (DN 150)

93.12 AUTOMATIC AIR RELEASE VALVES

A. Air release valve shall be made of copper alloy to BS 1400. The valve shall be 100 mm size and tested to 2415 KPa.

93.13 SPRINKLERS

A. General Requirements:

1. Quick response 57 deg. C to 77 deg. C semi-recessed heads shall be used throughout the residential areas and concealed type for public areas such as lobbies and corridors. Freezers, cold rooms and mechanical room temperature ratings shall be verified to ambient room temperature based on NFPA 13, sprinklers shall be used. All sprinklers shall be standard/high pressure type rated for 1207 KPa/1730 Kpa. Sprinklers shall be UL Listed and FM approved.

2. Sprinkler head temperature ratings shall be ordinary classification between 57 deg. C and 77 deg. C. The exceptions are that intermediate classification sprinklers rated 100 deg. C shall be used in electrical closets and 141 deg. C sprinklers with head guards shall be used in autoclave areas, mechanical rooms and any other areas which high temperatures are experienced. For systems with high pressure, all sprinklers shall be high pressure type rated for 1730 KPa.

3. All sprinklers shall be installed at least 12 inches from any distribution devices. Sprinkler location at wall mounted and peninsular shelving units shall be a minimum 450 mm away.

4. Provide two (2) sprinkler head wrench for each type of sprinkler head.

5. All sprinklers shall be supplied from one (1) manufacturer unless specified otherwise. Submit one (1) sample for each sprinkler to be utilized on this project.

B. Quick Response Sprinkler

1. Exposed Sprinklers – Quick response

a. Exposed sprinkler shall be glass bulb operated Quick response upright of pendent automatic sprinklers as indicated on the drawings with chrome finish. Temperature ratings shall be 57 deg. C to 77 deg. C at 1730 KPa.

2. Horizontal Sidewall Sprinklers – Quick Response (Light Hazard Areas only)

a. Horizontal sidewall sprinklers shall be glass bulb operated, quick response horizontal sidewall sprinkler rated 57 deg. C. Sprinkler shall be chrome plated/color shall be selected by the Architect.

b. Semi-recessed sprinklers – Quick Response

C. Sprinkler Finishes:

1. Chrome plated

2. Bronze

3. Painted

D. Special Coatings

1. Wax

2. Lead

3. Corrosion-resistant paint

E. Sprinkler Guards:

1. Standard: UL 199

2. Type: Wire cage with fastening device for attaching to sprinkler

F. The sprinkler heads shall be of spray pattern installed in an upright position or pendent position as may be required where indicated in the drawing.

G. Installed in areas without false ceiling: Provide upright, glass bulb sprinkler head, 13 mm orifice and chrome plated. The sprinkler shall be UL/FM approved

H. Horizontal Sidewall Sprinkler: The automatic sprinkler designed for installation along with a wall or lintel. The sprinkler shall be glass bulb type and shall have UL/FM approval.

I. Spare Sprinklers: A set of spare sprinkler heads shall be provided in a cabinet together with sprinkler spanners as per NFPA 13-requirement for use in removing and installation of heads.

J. Horizontal Sidewall Extended Coverage Sprinkler covering 7300 mm: Shall use 20 mm orifice with ¾" NPT inlet.

93.14 SUPERVISORY SWITCHES

A. Provide UL Listed and FM approved tamper switches on all control valves. PIV switches shall be weather resistant and shall monitor target position. OS&Y switches shall monitor stem movement and shall be complete with mounting J-bolts. Electric valve supervision switches shall be installed for all internal (inside) and external (outside) fire protection valves 2-1/2 inches or larger.

B. Electric valve supervision switches shall be installed for all internal (inside) and external (outside) fire protection valves 2-1/2 inches or larger. The devices shall be electrical; single pole, double throw; with normally closed contacts and include design that signals controlled valve is in other than normal position.

C. For wet pipe sprinkler systems, install a pressure operated water flow alarm initiation device, unless otherwise noted on the contract drawings.

D. All vane type flow alarm initiation devices shall be equipped with an adjustable delay of audible alarm initiation. Adjustments range shall be from 0 to 120 seconds. Vane type water flow switch shall be as per Manufacturer's List.

E. Water flow vane type alarm initiation devices shall be labelled as to the correct orientation of flow when mounted on system piping. When drilling of the system riser is necessary to mount flow switch, the drill out disc (coupon) shall be retrieved and attached to the mounting u-bolt of the flow switch.

F. Where pressure operated water flow alarm initiation devices are used, any valve installed upstream of the device on the alarm line shall be electrically supervised. Pressure operated alarm initiation devices shall be an electrical-supervision type, water flow switch retard feature. The device shall include single pole, double throw, normally closed contacts and design that operates on rising pressure and signals water flow.

G. A vane type water flow initiation device shall be installed on the air gap drain for all reduced pressure backflow prevention devices.

H. Pressure Switch: System Sensor, Alarm contact ratings 10A, ½ HP @ 125/250vac. 2.5@6/12/24 VDC. Working pressure 300 psi (2070 KPa) and maximum adjustment range 4-20 psi. Differential pressure to be 3 psi, UL 4 x and NEMA 4 rated for indoor and outdoor use.

I. Low pressure supervision shall be installed on all dry pipe system and be connected into the Fire Alarm System.

J. Any device is to be installed in a hazardous location defined by NFPA 70 shall be rated for occupancy.

93.15 PRESSURE GAUGES

A. Standard: UL 393

B. Dial Size: 3-1/2 to 4-1/2 inch (90 to 115 mm) diameter

C. Pressure Gauge Range: 1 to 300 psi (1 to 2070 KPa)

D. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face

E. Air System Piping Gage: Include retard feature and "AIR' or "AIR/WATER" label on dial face.

PART 94 - PRODUCTS

94.1 RESPONSIBILITIES

A. The Contractor is responsible for the installation of the fire protection system in accordance with these specifications and the contract drawings. The Contractor shall coordinate with Architectural, Mechanical and Electrical, design and construction documents, to ascertain the required information, to affect a properly designed and installed sprinkler system for the building construction and occupancy classification. The installation shall reflect high quality professional work that properly accounts for practical maintenance concerns and aesthetics.

B. The installation of the fire protection systems shall be complete with all necessary accessories for proper operation and shall be accomplished by a specialist fire fighting contractor or licensed company regularly engaged in this type of work, and in accordance with requirements of the national Fire Protection Association Standards (NFPA) and the Authority having Jurisdiction (Dubai Civil Defense).

C. The fire protection system installation shall be coordinated with the other trades (mechanical, electrical, architectural and structural, etc.)

D. The installation shall comply with all mandatory, advisory interpretations and recommended applicable rules of the latest editions of the NFPA standards and the Authority Having Jurisdiction (Dubai Civil Defense)

94.2 PREPARATION

A. Perform Fire hydrant and sprinkler system flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" article.

B. Report test results promptly and in writing.

94.3 SERVICE ENTRANCE PIPING

A. Connect sprinkler piping to water service piping for service entrance to building. Comply with requirements for exterior piping in Division 2 Section "Facility Fire-Suppression Water Service Piping".

B. Install shutoff valve, backflow preventer, pressure gage, drain and other accessories indicated at connection to water service piping.

C. Install shutoff valve, check valve, pressure gage and drain at connection to water service.

94.4 WATER SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water distribution piping. Comply with requirements of interior piping in Division 15 "Domestic Water Piping".

B. Install shutoff valve, backflow preventer, pressure gage, drain and other accessories indicated at connection to water distribution piping.

C. Install shutoff valve, check valve, pressure gage and drain at connection to water supply.

94.5 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics and diagrams indicate general location and arrangement of piping. Install piping as indicated as far as practical.

B. Deviations from approved working plans for piping require written approval from Authorities having Jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Piping Standard: Comply with requirements for installation of sprinkler in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

F. Install flanges, flange adapters, or couplings for grooved end piping on valves, apparatus and equipment having NPS 2-1/2 (DN 65) and larger end connections.

G. Install "Inspector's Test Connection" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies and drain riser adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13, Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main at each sprinkler test connection and at top of each standpipe. Include pressure gages with connection not less than NPS ¼ (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Pressurize and check pre-action sprinkler system piping and air pressure maintenance devices.

O. Fill sprinkler system piping with water.

94.6 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus and equipment having NPS 2-1/2 (DN 65) and larger end connections.

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

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

F. Flanges Joints: Select appropriate gasket material in size, type and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Twist Locked Joints: Insert plain end of steel pipe into plain end pipe fitting. Rotate retainer lugs one quarter turn or tighten retainer pin.

I. Steel Piping, Pressure-Sealed Joints: Join light wall steel pipe and steel pressure seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

K. Shop welded pipe joints where welded piping is indicated. Do not use welded joints for galvanized steel pipe.

L. Steel Piping, Cut Grooved Joints: Cut square edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant and bolts. Join steel pipe and grooved end fittings according to AWWA C606 for steel pipe joints.

M. Steel Piping, Rolled Grooved Joints: Roll rounded edge, groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel pipe grooved joints.

N. Steel Piping, Pressure Sealed Joints: Join Schedule 5 steel pipe and pressure seal fittings with tools recommended by fitting manufacturer.

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

P. Copper Tubing Grooved Joints: Roll rounded edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel pipe grooved joints.

Q. Copper Tubing, Pressure Sealed Joints: Join copper tube and copper pressure seal fittings with tools recommended by fitting manufacturer.

R. Extrude-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop and braze branch tube into collar.

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

94.7 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

94.8 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls and specialties according to NFPA 13 and Authorities Having Jurisdiction.

B. Install listed fire protection shut off valves supervised open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water supply connection. Install backflow preventers instead of check valves in portable water supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

2. Alarm Check Valves:

   a. Shall be provided with internally and externally galvanized trim piping and fittings, pressure gauges, a retarding chamber, water motor gong, alarm switches, testing bypass, and all necessary pipe fittings and accessories.

   b. The retarding chamber drain line shall be piped independently of the main drain line.

   c. The drain line from the water motor gong shall be piped to discharge through the wall as close to the grade line as possible.

   d. Piping between the alarm check valve and a pressure actuated alarm initiating device shall be galvanized piping not less than 3/8 inch nominal pipe size.

   e. Piping supplying the retard chamber, water motor gong, and associated drains shall be galvanized. Galvanized fittings are to be used where galvanized piping is required.

3. Deluge Valves:

   a. Install in vertical position, in proper direction of flow, and in main supply to deluge system.

   b. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill line attachment.

   c. Dry pipe and associated trimmings shall be installed in readily visible and accessible locations.

   d. All nipple, fittings and devices must be clean and free of scale and burns before installation. Use pipe thread sealant sparingly on male pipe threads only.

4. Floor (Zone) Control Assemblies

   a. The use of 65 mm nom. size valve with adjustment spool shall be permitted up to 100 mm nom. line size.

   b. The system drain line shall be connected to the nearest drain (waste water or storm water system only).

5. Automatic Air release valves

   a. Provide access doors in shaft walls, where installed in inaccessible places. Provide drain pipe to convenient location.

94.9 EXCESS PRESSURE PUMP INSTALLATION

A. Assemble components and mount on wood backing.

B. Install excess-pressure pumps, control devices and supports for sprinkler piping application.

C. Mounting: Install on wall, where indicated attached to water supply pipe.

94.10 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels coordinated with Architectural design. This may result in additional heads which shall be provided at no additional cost unless otherwise indicated.

B. Accurately align sprinkler heads in hung ceiling areas symmetrically with diffusers, grilles, lighting fixtures and ceiling units and ensure that maximum distance and requirements stipulated in NFPA 13 are met.

C. Install dry type sprinkler with water supply from heated space. Do not install pendent or sidewall, wet type sprinklers in areas subject to freezing.

D. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

E. Sprinkler shall not be installed closer than 1800 mm apart.

F. Where suspended ceiling are installed, the sprinkler contractor shall install pendent sprinklers as shown on reflected ceiling plans. Where these plans do not specify the location of the pendent sprinklers, the Contractor shall obtain the original reflected ceiling plans, and design sprinkler locations at least 150 mm from ceiling tile edges, (dimension the location) and 750 mm from HVAC supply diffuser. If a sprinkler lands with 750 mm of HVAC supply diffuser the Contractor shall install an intermediate temperature rated sprinkler. Locate sprinklers along straight lines to extent possible, follow repetitive pattern. Pendent sprinklers shall be installed by means of an approved flexible application (such as flex head or approved equal), or return bends from 25 mm outlet tees in branch lines.

94.11 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall type fire department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire department connection

94.12 IDENTIFICATION

A. Install labelling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring cabling and terminals.

C. A hydraulic data information nameplate shall be secured to the riser with chain. Directly above the controlling alarm check valve and shall include the following design data.

1. Building designation
2. Location of remote area
3. Design density
4. Area of application

5. System demand gpm (l/s) and psi (KPa) at base riser

6. Data shall be permanently engraved on the nameplate.

7. Material shall be durable plastic and aluminium. Minimum height of lettering is 1/8".

D. The Contractor shall furnish and place in clear, plastic envelope attached to each sprinkler alarm check valve riser: one complete set of typed or printed maintenance and operating instructions, a set of prints of the as-built working drawings and hydraulic calculations of the sprinkler system.

E. Contractor shall supply each riser with a cabinet containing maintenance and repair equipment (spare heads, wrench, etc)

F. Each Contractor shall affix an identification tag on each system riser indicating:

Name of Contractor
Business Address of the Installing Contractor
Phone Number
24-hour emergency contact phone number

94.13 FLUSHING

A. Before connecting sprinkler systems to the main supply, each sprinkler supply line shall be flushed out thoroughly by the Fire Protection Specialist Contractor in the presence of the engineer, through an unrestricted opening not less than (100 mm) 4 inches in diameter. Minimum flowing quantities are specified in NFPA 13.

B. Failure to comply with this requirement shall necessitate flushing of the entire sprinkler system by the Contractor at no additional cost.

C. A (100 mm) 4 inch temporary pipe of two 2-1/2 inch fire hoses shall be provided by the Contractor to discharge water to a suitable location as designated by the engineer.

94.14 PAINTING AND LABELLING

A. The above ground steel piping system including valves, piping in finish areas, miscellaneous metal work shall be clean, pre-treated, primed and painted.

B. Coating shall only applied on clean, dry surfaces using clean brushes. Surface shall be cleaned to remove all dust, dirt, rust and mill scale.

C. Galvanized pipe shall wash primed with proper material before painting. Application shall be as per the manufacturer recommendation for pipe surface corrosion protection.

D. Contractor shall paint those portions of fire protection as required by Section 09900, "Painting and Labelling".

E. Sprinkler system (e.g. inspector's tests, drain valves) shall be labelled with all information required by NFPA Standard 13.

F. Labelling shall be accomplished with the use of permanently marked weatherproof metal or rigid plastic identification signs. The signs shall be secured with corrosion resistant wire, chain or other approved means. These signs shall be provided by the manufacturer, manufacturer's representative or installer of the sprinkler system.

G. Sprinkler riser shall be labelled with building and sprinkler system riser numbers. Labelling shall be accomplished with the use of approved self sticking labels. The color and size shall contrast the surface that is applied to.

94.15 FIELD QUALITY CONTROL

A. Perform Tests and Inspections

1. Hydrostatic pressure testing shall be performed as per the requirement of NFPA before any ceiling is installed below the sprinkler piping. Each water control valve shall be fully opened and closed under water pressure proper operation.

2. Where sprinkler locations are roughed-in, using plugged drop nipples projecting below the level of finished ceiling; the hydrostatic testing shall be performed two times.

   a. First, after the system is completed using the plugged drops, and before the ceiling panel is installed.

   b. Second, after the plugged drop nipples are cut to length for the finished ceiling or replaced with other drop nipples of correct length, and the sprinkler installed.

3. Prior to the acceptance of the installation, the Specialist Contractor shall, in the presence of the engineer, subject the system to the tests required by NFPA for the completion of the Contractor's Material and Test Certificate. In addition complete operating test of dry pipe, water spray, standpipe and hose system shall be performed.

4. The system shall be complete, tested and ready for operation and shall include all necessary and required connections and shall be accomplished prior to carpet installation. Testing shall be as required to conform to current applicable requirements of NFPA and local code authority. The serving authority having jurisdiction engineers and owners shall be allowed to conduct such tests as may be required. Any cost in connection with these, test is borne by the contractor.

5. Alarm Testing: Contractor shall be responsible for testing new alarms and modified alarms installed under this contract. Defective alarms shall be replaced immediately.

6. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

7. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

8. Flush, test and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" chapter.

9. Energize circuits to electrical equipment and devices.

10. Start and run excess pressure pumps.

11. Coordinate with fire alarm tests. Operate as required.

12. Coordinate with fire pump tests. Operate as required.

13. Verify that equipment hose threads are same as local fire department equipment

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

94.16 CLEANING

A. Clean dirt and debris from sprinklers

B. Remove and replace sprinklers with paint other than factory finish.

94.17 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain specialty valves and pressure maintenance pumps.

94.18 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard weight steel pipe with grooved ends; grooved end fittings; grooved-end pipe couplings; and grooved joints

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard and High pressure wet type fire suppression sprinkler system piping shall be galvanized, ERW to ASTM A-53, Sch. 40 Grade B. This shall be approved by Dubai Civil Defence.

94.19 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without ceiling: See Division 21 00 01
2. Rooms with suspended ceiling: Division 21 00 01 and as indicated in drawings.
3. Wall Mounting: Sidewall sprinklers
4. Space Subject to Freezing: Upright Sprinklers, Pendent, dry sprinklers as indicated in drawings
5. Deluge Sprinkler System: open sprinklers
6. Special Applications: Extended-coverage, flow control, and quick response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass with factory painted white cover plate
2. Flush Sprinklers: Bright chrome, with painted white escutcheon
3. Recessed sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential sprinklers: Dull chrome
5. Upright, pendent and sidewall sprinklers: Chrome plated in finished spaces exposed to view, rough bronze in unfinished spaces not exposed to view, wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

XXX. FOAM WATER SYSTEM

PART 95 - GENERAL

95.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and the following sections of the specification:

1. Section 104400 – Fire Protection Specialties
2. Section 210500 – Common Work Results for Fire Suppression
3. Section 210548 – Vibration Controls for Fire Suppression Piping and Equipment
4. Section 211200 – Fire Suppression Standpipes
5. Section 211313 – Wet Pipe Fire Suppression Sprinklers
6. Section 212200 – Clean Agent Extinguishing Systems
7. Section 213113 – Electric Drive Centrifugal Fire Pumps
8. Section 213116 – Diesel Drive Centrifugal Fire Pumps
9. Section 213400 – Pressure Maintenance Pumps
10. Section 283112 – Digital Addressable Fire Alarm System “not specified in this section”

95.2 SUMMARY

A. This Section includes fixed, low-expansion, AFFF fire extinguishing systems and the following:

1. Concentrate piping and piping specialties
2. Proportioning tanks and proportioning devices
3. Foam concentrate
4. Discharge devices
5. Monitoring and alarm devices

95.3 DEFINITIONS

A. AFFF: Aqueous film-forming foam

B. AR-AFFF: Alcohol-resistant aqueous film-forming foam

C. ATS: Acceptance Testing Specifications

95.4 SYSTEM DESCRIPTION

A. Description: Engineered, fixed, deluge, automatically actuated, low expansion, AFFF fire extinguishing system for:

1. Flammable-liquid fires: System includes diaphragm proportioning tanks and devices as described in NFPA 16 "Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray System".
2. NFPA 418 "Standard for Heliports"
3. NFPA 110 "Standard for Emergency and Standby Power Systems"

4. NFPA 37 "Standard Installation and Use of Stationary Combustion Engines and Gas Turbines"

95.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 KPa).

B. Minimum design parameters to be used with the approval of authorities having jurisdiction are as follows:

1. Solution: 3% foam-water solution minimum concentration, solution concentration shall be verified by specialist vender for each type of application.

2. Sprinkler Spacing: Maximum of 100 sq.ft. (9.5 sq.m) per sprinkler, and maximum 12 foot (3.7 m) spacing for enclosed rooms only.

3. Design Density: Minimum 0.16 gpm/sq.ft. (0.108 l/s per sq.m)

4. Foam Supply: Minimum 10 minute discharge time

5. Water Supply: Minimum 60 minutes

6. Remote Area: Minimum 5000 sq.ft. (476 sq.m) design area for closed sprinkler systems. Open sprinkler systems shall discharge over the entire system area.

7. Sprinkler Temperature Rating: Maximum 250 to 300 deg. F (121 to 149 deg C) at a roof or ceiling and 135 to 170 deg F (57 to 77 deg. C) for intermediate sprinklers.

8. Discharge nozzles suitable for heliport applications. Locations and distributions of foam nozzles shall be prepared by specialist approved vender.

95.6 SUBMITTALS

A. Product data for the following:

1. Piping and equipment restraints

2. Valves

3. Proportioning tanks and proportioning devices

4. Foam concentrate

5. Discharge devices. Include flow characteristics

6. Monitoring and alarm devices. Include electrical data

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following for each hazard area, drawn to scale:

1. Include plans, elevations, sections, details and attachments to other work. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components and location and size of each field connection.

2. Wiring Diagrams: Power signal, and control wiring

3. Design Calculations: For amount of foam concentrate required for each hazard area

4. Plans: Show the following:

a. Foam solution proportioning tanks and devices, piping, discharge devices, monitoring and alarm devices, and accessories

b. Method of attaching hangers to building structure

c. Fire alarm panel

d. Equipment and furnishings

C. Permit-Approved Drawings: Working plans, prepared according to NFPA 16 that have been approved by authorities having jurisdiction. Include design calculations.

D. Welding certificates

E. Field quality control test reports

F. Operation and Maintenance Data: For foam fire extinguishing to include in emergency operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data", include the following.

1. Valves and specialties

2. Proportioning tanks and proportioning devices

3. Foam concentrate

4. Discharge devices. Include flow characteristics

5. Monitoring and alarm devices.

G. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

95.7 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

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

C. FMG Compliance: Provide components that are FMG approved and that are listed in FMG's "Fire Protection Approval Guide".

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

95.8 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.

B. Discharge Devices: Not less than 20 percent of amount of each type installed.

C. Foam concentrate: Not less than 200 percent of amount installed.

95.9 TRAINING REQUIREMENTS

A. Prior to final acceptance, the installing fire fighting specialist contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include system operation, manual and functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

95.10 WARRANTY

A. All fire fighting and sprinkler system including fire pump set components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

PART 96 - PRODUCTS

96.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved list of manufacturers in Supplement I or comparable products.

96.2 PIPE AND FITTINGS

A. Steel Pipe: ASTM, A 53/A, ASTM A 135, ASTM 1 106 or ASTM A 795, Schedule 40 with factory or field formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1
2. Malleable-Iron Threaded Fittings: ASME B16.3
3. Gray-Iron Threaded Fittings: ASME B16.4
4. Butt Weld Fittings: ASTM A 234/ A 234M, Grade WPB, Schedule 40, Carbon steel butt-weld fittings
5. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
6. Steel threaded couplings: ASTM A 865

B. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic joining materials.

96.3 VALVES

A. Ball Valves: Bronze body with threaded or flanges ends. Comply with UL 1091, except with stainless steel ball instead of disc.

96.4 SPECIALTIES

A. Concentrate Storage tank: Buna-N, bladder type, proportioning tank complying with UL 162 and ASME Boiler and Pressure Vessel Code: Section VII. Include bladder, internal piping, fill and drain, pipe assembly, glass sight gage, piping and valves. Concentrate to be contained in the bladder.

1. Orientation: Horizontal design with saddle or Vertical design with skirt support.

B. Proportioning Controller: Venturi type complying with UL 162 and of capacity to match design at minimum and maximum flow.

C. Concentrate Control Valves: Water-operated ball or deluge valve designed to open with flow through the proportioning controller.

D. Concentrate Strainers: Bronze body and stainless steel mesh strainer with minimum of 0.125 inch (3.2 mm) perforations to remove solids that would block system components.

E. Provide devices that comply with NFPA 16, are compatible with the foam concentrate, and are designed to be drained and cleaned.

96.5 FOAM CONCENTRATE

A. Description: AFFF liquid concentrate, complying with NFPA 11 and UL 162 for making foam water fire extinguishing foam solution.

96.6 PRESSURE GAGES

A. Description: Comply with UL 393, with 3-1/2 inch (90 mm) minimum diameter dial 0 to 300 psi (1 to 2070 KPa) dial range, and caption "WATER" or "CONCENTRATE" on dial face.

96.7 DISCHARGE DEVICES

A. General: Discharge devices shall be listed and approved by UL and FM.

B. Sprinklers: Non-air aspirating type complying with UL 162 and suitable for discharging foam.

C. Spray Nozzles: Foam water spray nozzles including foam generator and distributing deflector complying with UL 162 and designed to distribute foam or water in the absence of foam solution in a special pattern peculiar to a particular head.

96.8 MONITORING DEVICES

A. Valve Supervisory Switches: UL 753, electrical, single pole, double throw, with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

96.9 ALARM DEVICES

A. Description: UL listed and FM approved, low voltage and surface mounting. Alarm and monitoring devices are specified in Division 28 Section "Fire Detection and Alarm".

PART 97 - EXECUTION

97.1 CONCENTRATE STORAGE TANK INSTALLATION

A. Install proportioning tanks on concrete bases. Concrete bases are specified in Division 21 Section "Common Work Results for Fire Suppression".

B. Install tank levels and plumb, according to layout drawings, original design, and references standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Anchor tanks to substrate.

97.2 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. AFFF-Concentrate Piping: Steel Pipe, malleable or cast iron threaded fittings, and threaded joints.

C. Foam solution piping is specified in Division 21 Section "Wet Pipe Sire Suppression Systems".

97.3 PIPING INSTALLATION

A. Install piping and other components level and plumb

B. Refer to Division 21 Section "Common Work Results for Fire Suppression", for basic pipe installation and joint construction

C. Install proportioning tanks anchored to substrate

D. Install pipe and fittings, valves and discharge devices according to requirements listed in NFPA 16, "Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems".

1. Support piping using supports and methods according to NFPA 13

2. Install seismic restraints for proportioning tanks and piping systems.

3. Install monitoring and alarm devices according to NFPA 16 and NFPA 72.

97.4 CONNECTIONS

A. Piping installation requirements are specified in Division 21 Section "Wet Pipe Fire Suppression System". Drawings indicate general requirement of piping, fittings and specialties.

B. Provide concentrate control, maintenance service, and drain valves with piping to permit maintenance of the foam concentrate with continuous sprinkler system service.

C. Install proportioning controller in fire suppression piping to provide coverage to area indicated on Drawings.

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

E. Connect electrical devices to building's fire alarm system. Electrical power, wiring and devices are specified in Division 28 Section "Fire Detection and Alarm".

97.5 LABELLING

A. Install labelling on piping, equipment and panels according to Division 21 "Wet Pipe Fire Suppression Systems".

97.6 CHARGING SYSTEM

A. Fill proportioning tanks with foam concentrate after field quality control testing is complete and satisfactory results have been achieved.

97.7 FIELD QUALITY CONTROL

A. Inspection: Engage the services of a qualified professional engineer to inspect installed fire-extinguishing systems, prepare installation report, and certify that installation complied with the Contract Documents, calculations and requirements of Authorities Having Jurisdiction.

B. Comply with operating instructions and procedures in NFPA 16 "Acceptance Tests" Chapter. Include the following tests and inspection to demonstrate compliance with requirements:

1. Check mechanical items
2. Inspect equipment and fire-extinguishing foam concentrate, and check mountings for adequate anchoring to substrate.
3. Check electrical systems
4. Flush piping
5. Perform acceptance test
6. Perform pressure test
7. Perform operating test
8. Perform discharge test
9. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
10. Report test results promptly and in writing to Architect and Authorities having Jurisdiction.

C. Perform the following field tests and inspections and prepare test reports:

1. After installing foam fire extinguishing piping system and after electrical circuit has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, "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 systems to confirm proper unit operation.
5. Test and adjust control and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

XXXI. CLEAN AGENT EXTINGUISHING SYSTEM

PART 98 - GENERAL

98.1 SCOPE OF WORK

A. This specification outlines the requirements of a "Total Flood" Clean Agent Fire Suppression System with automatic detection and control. The work described in the specification includes all engineering, labour, materials, equipment and services necessary and requires, completing and testing the suppression system.

98.2 WORK INCLUDED

A. Design & Engineering of Clean Agent fire suppression system

B. Prepare workshop drawing and technical submittals

C. Perform flow calculation

D. Clean Agent gas storage cylinders filled with gas and all hardware accessories

E. Gas cartridge actuators and release interface modules

F. Cylinder manifold and discharge piping

G. Discharge nozzles

H. Gas low pressure switch and gas discharge pressure switch

I. Fire detection and alarm system c/w ionisation smoke detectors, optical smoke detectors, manual release, Auto/manual selector switch, abort unit, first stage alarm bell, second stage sounder, strobe horn, gas cartridge warning sign and associated cabling etc.

J. Gas release control panel

K. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers.

L. Providing drop curtains for any permanent openings

M. Integrity test and functional test

N. Training to client representative

O. Provide As-built drawings and Operation Maintenance Manuals

P. Sealing of openings to maintain the protected room enclosure as Air Tight

98.3 RELATED WORKS

A. Section 104400 – Fire Protection Specialties

B. Section 210500 – Common Work Results for Fire Suppression

C. Section 210548 – Vibration Controls for Fire Suppression Piping and Equipment

D. Section 283112 – Digital Addressable Fire Alarm System “not specified in this section”

98.4 REFERENCES

A. NFPA 2001 – Clean Agent Fire Extinguishing Systems

B. NFPA 70 – National Electrical Code

C. NFPA 72 – Standard Fire Alarm System

D. ASTM A 120 – Steel Pipe, Welded or Seamless, Black or galvanized – Dimensions (BS 1387) Ref: "Steel" in schedule.

E. ASTM A 106 – Steel pipe, black, for high temperature service (BS 1600, Part 1) – Ref: "Wrought Steel" in schedule.

F. ASME B16.9 – Pipe Fittings of wrought Carbon Steel or Alloy Steel for moderate and elevated temperatures.

G. ANSI B2.1 – Pipe Threads (BS 21)

H. ASME B16.1 – Cast Iron Flanges (BS 4504)

I. ANSI B16.5 – Steel Flanges (BS 1560)

J. ANSI B16.3 – Black or Galvanized Malleable Iron Threaded Pipe Fittings (BS 143/ISO R 7)

K. ANSI B16.11 – Black or galvanized Malleable Iron Threaded Pipe Fittings (BS 143/ ISO R 7)

L. ANSI B16.21 – Non-metallic gasket for pipe flanges

M. BS7786 – PTFE (Teflon) tape for Thread Sealing Applications

N. ANSI B31.1 – Power Piping

O. AWS B2.1 – Standard for Building Service Piping

P. ASME Sec. 9 – Welding and Bracing Qualifications

Q. API 600 – General Design Specifications for gate, Globe and Check valves (BS 1414, BS 1873, and BS 1868 respectively).

R. ANSI B 16.34 – Pressure temperature ratings of valves (BS 5351, BS 1560)

S. ANSI B 16.10 – Face to face dimensions of cast iron gate, globe and check valves (BS 2080)

T. ANSI B16.5 – End flange dimensions of cast steel valves (BS 1560)

U. The standard listed, as well as all other applicable codes and standards shall be used as "Minimum" design standards. Also to be considered are good engineering practices.

98.5 QUALITY ASSURANCE

A. The requirements of the following organizations shall conform with, as appropriate:

1. Dubai Civil Defence

2. National Fire Protection Association of USA (NFPA)

B. The clean agent system shall be executed only by a specialist contractor licensed/approved for the purpose, by Civil Defence.

C. Clean Agent System and the components shall be listed or approved by UL, FM, Fire Office Committee, UK or other approved agencies of international repute.

D. The contractor shall submit the shop drawings and materials used for the works covered by this Section to Dubai Civil Defence, and obtain their approval. Dubai Civil Defence shall be submitted to the Engineer prior to placing any order or proceeding with any installation.

E. Refer to electrical specification for system power supply ratings, de-rating factors, fault levels of breaker and other similar general criteria. These shall be binding and mandatory for works covered by this section.

F. Valves and similar control gear shall have the manufacturer's name or logo, size, pressure rating and direction of flow cast-on, on the body. Uniformity shall be maintained in respect of connection standards (Threads or flanges), throughout. Where this is not practical due to justifiable reasons; compatibility shall be ensured by using appropriate adaptors, conversion spools, mating flanges and the like; with the written approval of the Engineer.

G. Pipes incorporated in the works shall have the standard of manufacturer, type, class or rating etc. continuously printed or marked otherwise in compliance with the with the standard of manufacturer. Materials without such identification shall be rejected.

98.6 SUBMITTALS

A. The installing contractor shall submit the following information for approval to the Local Fire Prevention Agency, Owner's Insurance Underwriter, Architect/Engineer and all other Authorities having Jurisdiction before starting installation:

1. Product data, samples and shop drawings shall be submitted under provisions of the general conditions of Contract.

2. Field installation layout drawings detailing the location of all agent storage tanks, pipe runs, including pipe sizes and lengths, control panel(s), detectors, manual pull stations, abort stations, audible and visual alarms, etc.

3. Auxiliary details and information such as maintenance panels, door holders, special sealing requirements and equipment shutdowns.

4. Separate layouts or drawings shall be provided to each level (i.e: room, underflow and above ceiling) and for mechanical and electrical work.

5. A separate layout or drawings shall show isometric details of agent storage containers, mounting details and proposed pipe runs and sizes.

B. Electrical layout drawings shall show the location of all devices and include point to point conduit runs and description of the method(s) used for detector mounting.

C. Internal control panel wiring diagram shall include power supply requirements and field wiring termination points.

D. Graphic annunciator wiring schematics and dimensioned display panel illustration shall be provided.

E. Complete hydraulic flow calculations from a UL listed computer program, for all engineered clean agent system.

F. Provide calculations for the battery standby power supply taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions.

G. A complete sequence of operation detailing all alarm devices, shutdown functions, remote signalling, damper operation, time delay and agent discharge for each zone or system.

H. Listing/approval certificated, stating that the system and its components only with NFPA requirements shall be submitted.

I. Submit clause by clause specification compliance statement to confirm specified parameters are met.

98.7 DELIVERY STORAGE AND HANDLING

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

B. Weatherproof covering on control panels, operating mechanism etc. shall be retained until commissioning.

98.8 SYSTEM INTERFACES

A. Power supply connections shall be extended to the isolating switch provided by the electrical trade.

B. Interlocking wiring shall be extended up to the starter panels of HVAC equipment, standby diesel generator set etc. for the purpose of shutting off the equipment in the event of fire.

C. Terminal blocks shall be provided in the system control panel for the purpose of annunciation of fire condition in Clean Agent protected areas, in the building fire alarm panel.

98.9 TRAINING REQUIREMENTS

A. Prior to final acceptance, the installing fire fighting specialist contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include system operation, manual and functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

98.10 WARRANTY

A. All fire fighting and sprinkler system including pump set components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

PART 99 - PRODUCTS

99.1 CLEAN AGENT SYSTEM CONTROL PANEL

A. The control panel shall be of solid state, modular construction, capable of executing the following:

1. Fire alarm indication – General and zonal
2. Fault indication – general and zonal
3. Audible (buzzer) alarm for fault indication and fire alarm diversion
4. Monitoring of clean agent storage pressure
5. System status indication at each zone
6. Manual selection of the following by a key operated electrical switch:
    a. System in "Automatic Mode"
    b. Sound evacuation alarm
    c. Cancel alarm
    d. Reset system
    e. Test fault
    f. Test fire
7. Holding of fire doors in open position

B. The control panel shall execute the following on receipt of signal from the first circuit:

1. Sound general fire alarm
2. Shut down interlocked equipment
3. Release magnetically held doors
4. Activate building fire alarm system
5. Activate first circuit of extinguishing lock off unit.

C. The control panel shall execute the following on receipt of signal from the second circuit:

1. Sound evacuation alarm
2. Activate second circuit of extinguishing lock off unit which initiates discharge time delay.
3. Initiate cylinder release and directional valve opening circuits at the end of time delay
4. Release fire curtains

D. The control panel shall have a mains powers supply unit comprising the following:

1. Lockable isolator switch fuse suitable for 220V/240V/ 1ph/50 Hz supply, rated 15 amps.
2. Solid state rectifier for 24 DC output
3. Supply healthy indicator

E. The control panel shall have a standby power supply unit comprising the following:

1. Constant potential type battery charger suitable for 220V/240V/1ph/50Hz input and 24 volts DC output of appropriate current rating.

2. Lead Acid battery bank for 24 volts (min. 6.0 AH) output, to provide 48 hours standby power and one (1) hour full alarm power.

3. Battery connected indicator

99.2 SMOKE DETECTORS

A. Optical or Ionization type protected against ingress of dust and dirt, suitable for use in areas with high wind velocity or fluctuating environmental conditions. The detachable base shall have indication for fire conditions and facility for connecting to remote indicators.

99.3 BEAM DETECTORS

A. Optical or laser type of construction suitable for installation in cable trenches

99.4 GRAPHIC ANNUNCIATION

A. The unit shall be suitable for recessed installation and shall have three (3) nos. panel type lamps indicating the following:

1. Amber ..... System in automatic

2. Green ..... System locked off – manual discharge only

3. Red ..... Extinguishant discharge

B. Status indicators shall be installed outside each zone, preferably above the door. Provide as many as the number of doors.

99.5 LOCK OFF AND MANUAL DISCHARGE STATION

A. The unit shall have key operated electrical switch with the following positions and manual discharge break glass station as single combined unit or as separate units; suitable for recessed installation:

1. Normal running (system automatic)

2. System locked off

3. Evacuation alarm

4. Manual discharge

B. Lock off and manual discharge station shall be installed at 130 cm above finished floor level at the main entry to each zone.

99.6 MAGNETIC DOOR HOLDERS

A. The unit shall compromise of a solenoid and keeper plate. The solenoid shall be housed in a robust metal base with manual push button release on one side. The keeper plate shall have an integral swivel to accommodate misalignment and shall be attached to the door. In normal conditions, the solenoid shall be energized and will hold the door when swung back close to it.

B. Disruption of power supply either by the detector or by the manual release shall collapse the magnetic field or release the door.

99.7 ABORT STATION

A. Banshee type electronic sounder which produces continuous distinctive sounds. These shall be mounted outside the room 20 cm above the door.

99.8 AUDIBLE ALARM DEVICE

A. Alarm bell shall be under dome type of 150 mm (6 inch) size, fitted with circuitry for line fault monitoring. The unit shall be mounted outside the Clean Agent Room at 220 cm above finished floor level.

99.9 CLEAN AGENT

A. Cylinders shall be certified and stamped by the US Department of Transportation or equal, approved authority for storage of Halon at the super pressurization pressure.

B. Super-pressurization shall be 2069 KPa (360 psig) or 4137 KPa (600 psig) at 21 deg, C (70 deg. F) at the discretion of the specialist supplier, subject to condition that all the system components shall be compatible and selected for this pressure and that refilling facilities are available in UAE.

C. Super pressurization pressure shall not be accepted as a reason for increasing the number of cylinders, equipment area or any such claim involving additional expense to the client.

D. Filling density shall not exceed 1123 kg/cu.m (70 lbs/cu.ft) and shall not be less than 640 kg/cu.m (40 lbs/cu.ft).

E. Cylinder Banks: Required number of cylinders shall be arranged together and attached to a structural steel framework, which in turn shall be anchored to the floor / wall to prevent displacement.

F. The cylinders shall be positioned at least 10 cm above the finished floor level.

G. The Clean Agent discharge manifold shall be securely attached to the same steel framework.

H. Cylinder Valves shall be of brass construction, pressure seated, high flow rate design, incorporating a brass steel piston with seal, pressure releasing pilot check assembly, safety disc assembly, pressure outlet port and facility for connecting emergency manual release mechanisms.

I. Valve actuators shall be electrically operated electric/pneumatic type for use with cylinder banks.

J. The cylinder shall be fitted with a siphon tube to enable efficient discharge.

K. The cylinder valve shall be provided with suitable trim to prevent rocking or spinning of the cylinder during discharge conditions, in the event of the cylinder being not properly fixed in position.

L. Flexible Connections: Metallic flexible hoses of appropriate pressure rating, with union ends shall be used for the discharge of Clean Agent from the cylinder to the manifold.

M. Non return valve of brass construction shall be built inside the entry to the manifold from each cylinder (for main and reserve cylinders).

N. Discharge Pressure-switch assembly shall be mounted on the cylinder valve and shall be connected to the system control panel for cylinder pressure monitoring.

O. Clean Agent Storage: Clean Agent storage shall be sufficient to produce the minimum recommended concentration in the respective zones in the system, allowing for leakage and any other losses.

99.10 NOZZLES

A. Nozzles shall be of chrome plated brass or aluminium alloy construction, of appropriate type and size to suit individual instances. The nozzles shall be drilled only after making computations based on actual as-built piping. The nozzles shall have the orifice size and mode of installation (horizontal/vertical, etc) punched on the body.

99.11 PIPES AND FITTINGS

A. Requirements of Section 210500 and Section 211200 shall be referred to and complied with in respect of standard(s) of manufacture of pipes and fittings.

B. Piping Schedule:

SERVICE	LOCATION	TYPE
a. Clean Agent system		Galvanized steel
1) Piping up to 50 mm dia.	All	Sch. 80, seamless
b. Clean Agent system		Galvanized steel
1) Piping 65 mm dia. and above	All	Sch. 80, seamless

C. Joints:

1. Galvanized steel, 50 mm (2 inch) nom. dia. and less: Threaded, with Teflon tape or joining compound (non-toxic) applied to pipe threads.

2. Black Steel: Electric arc (A/C) welded joints.

3. Piping joints shall be rated for 2070 KPa (300 psig) working air pressure at 121 deg. C (250 deg. F).

D. Flanges, Unions and Couplings:

1. For pipe sizes 50 mm (2 inch) nom. dia. and under: Malleable iron unions with brass seat, threaded ends.

2. For pipe sizes 65 mm (2-1/2 inch) nom. dia. and over: Cast/forged steel welding neck flanges.

3. Compressed fibre gaskets shall be used for flanges (use of rubber gasket is prohibited).

99.12 SUPPORTS AND HANGERS

A. Section 211200 shall be referred to and complied with in all respects.

B. Horizontal Piping at Ceiling: Band type hanger with locking sleeve and back nut.

C. Horizontal Piping near Walls: Fabricated steel wall back plate. Use U-bolt with stop and lock nuts attaching pipe to bracket.

D. Horizontal piping in Voids: Offset riser clamp

E. Vertical Piping in Clean Agent Room: Offset riser clamp

99.13 SEALANTS FOR OPENINGS

A. Fibreglass cloth bags filled with mineral fibres shall be used for sealing cable entry openings in fire rated walls / floors.

B. Sleeves of schedule 40 shall be used at all pipe penetrations. Annular space shall be packed with 96 kg/cu.m (6 lbs/cu.ft) fibreglass and both sides caulked with fire rated sealant.

PART 100 - EXECUTION

100.1 SELECTION AND INSTALLATION

A. Clean Agent System Control Panel:

1. Panels shall be fabricated from minimum 1.5 mm thick sheet steel with continuously welded butt joints. Two coats of red oxide primer and two coats of baked on Fire Red enamel shall be applied on the panels. All required holes and cut outs shall be done at the factory. The enclosure standard shall be IP-44 as minimum requirement.

2. The internal wiring shall be done in a neat and professional manned using cable ties, slip-on spiral bundle sheets etc. Ample free lengths shall be provided to allow the full swing of doors.

3. Panels shall be stiffened with profiled sections welded to the back plate, as required for wall mounting. Panel shall be mounted with the top at 180 cm above FFL.

4. Inside of battery compartment of panels, shall be specially treated to resist corrosion from the battery electrolyte.

B. Detectors:

1. Detectors shall be proof against false operation by the presence of suspended dust in the room.

2. Smoke detectors installed in rooms without proper sealing against the entry of dust are prone to false operation. The Contractor shall identify and highlight such hazards to the Engineer for suitable remedial measures.

3. Conduit and Wiring

4. Stranded copper, PVC insulated, color coded wires of appropriate size shall be used for all power and control wiring.

5. Crimped on brass terminal lugs shall be used for the termination of wires. Terminals shall be numbered using slip-on numbering ferrules for quick identification.

6. Heavy duty galvanized iron conduits shall be used for all exposed wiring. These shall be fixed to walls/ceiling with 2 piece clamps, spaced at no more than 120 cm.

7. Project electrical specifications shall be referred to and complied with in all respects.

C. Piping:

1. Section 210500 and 211200 shall be referred to and complied with, in all respects.

2. Tee fittings after cylinder manifold shall be installed in the horizontal plane only; vertical side cuts shall be prohibited.

3. The piping shall be blown out with compressed air, before fixing nozzles.

D. Electrical Power Supply:

1. As far as possible, the power supply for the system shall be obtained from the standby power supply system.

E. Cylinder Bank – Steel Framework

1. This shall be fabricated with metered, fully welded butt joints. The joints shall be finished by grinding and two (2) coats of primer and two (2) coats of fire red enamel applied to the completed assembly.

F. Signage:

1. Identification labels and warning signs in English and Arabic shall be provided as appropriate.

100.2 PIPE SUPPORTS AND HANGERS

A. Section 211200 shall be referred to and complied within all respects.

100.3 PIPING PROTECTION

A. The following protective coating / wrapping shall be given to piping. Piping above louvered ceiling shall be painted black as further described in architectural finish schedule.

B. Galvanized steel piping, exposed and in ceiling spaces:

1. Two coats of zinc chromate primer
2. Two coats of fire red enamel paint

C. Galvanized steel piping, concealed in shafts

1. Two coats of zinc chromate primer
2. two coats of coal tar enamel

D. Black steel piping, exposed and in ceiling spaces:

1. Two coats red oxide primer
2. two coats of fire red enamel paint

E. Black steel piping, concealed in shafts

1. Two coats of red oxide primer
2. Two coats of coal tar enamel

100.4 INSPECTION, TEST AND ADJUSTMENTS

A. During the manufacture (at Contractor's premises only) and installation and after completion of works; the system, sections of the system or its components shall be tested by the specialist Contractor 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 connection with the same.

B. Basic materials for conformity with the specified standard

C. Supports and anchors for ability to withstand required loads.

D. Piping in general for line, level and slopes. Pressure tightness at 690 KPa (100 psig) air/nitrogen prior to installation of nozzles.

E. Standby battery power pack for capacity, charging, duration of supervision power maintenance, etc

F. Smoke detectors using calibrated smoke generating equipment. Immeasurable sources shall not be accepted. Manual lock off station, manual discharge break glass station, door holders etc.

for proper operation, alarm and interlock functions. Disconnect valve operating link from solenoid during such tests.

G. Live Clean Agent discharge test in any one zone at the Contractor's option. All system operational parameters including time delays, alarms and clean agent concentration shall be measured and recorded. Test shall be repeated if results are not satisfactory.

H. System performance checks (including detectors, lock-off station, manual discharge, alarms and interlocks), to be conducted prior to substantial completion

I. The Contractor shall coordinate with the Civil Defense, arrange and facilitate their visit to site during system tests, and obtain their approval.

100.5 SYSTEM DEMONSTRATION

A. The services of a competent engineer shall be provided by the Contractor to supervise the testing and commissioning of all equipment and the system and to train the Owner's personnel in all aspects of the same during a five (5) working day period, during normal hours. All expenses in connection with the above shall be allowed for by the Contractor.

B. The system demonstrations shall be conducted only after the substantial completion of the project. A minimum of one week's written notice shall be given and the Owner's written consent obtained, prior to such demonstrations.

100.6 MAINTENANCE

A. The following activities shall be allowed for, by the Contractor, in respect of the complete system, for a period of two (10) calendar years from the date of substantial completion.

B. Defect liability/breakdown maintenance, inclusive of replacement parts.

C. Preventive maintenance as scheduled, inclusive of replacement parts and consumables.

D. Attending to emergency situations, this may damage property or endanger lives, even outside normal working hours.

E. A written report, detailing the maintenance work performed; including dates, parts replaced etc, shall be submitted to the Owner.

F. The Owner's personnel shall be allowed to witness or participate (without damaging interference) in the above activities.

XXXII. FIRE PUMPS

PART 101 - GENERAL

101.1 SUMMARY

A. Section includes:

1. Fire Hydrant Pump System and Controllers
2. Fire Hydrant Treatment Loop and controllers

101.2 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM International (ASTM):
    a. A48, Standard Specification for Gray Iron Castings.
    b. B505, Standard Specification for Copper-Base Alloy Continuous Castings.
    c. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
2. British Standards (BS)
3. Hydraulic Institute (HI):
    a. Standards for Centrifugal, Rotary, and Reciprocating Pumps.
4. International Electronic Commission (IEC)
5. International Fire Code (IFC):
    a. Section 913.
6. National Fire Protection Association (NFPA):
    a. 20 – Standard for the Installation of Stationary Pumps for Fire Protection
    b. 25 – Standard for the Inspection, Testing, and Maintenance of Water-
    c. Based Fire Protection Systems.
    d. 70 – National electric Code
    e. 110 – Standard for Emergency and Standby Power Systems.

B. Factory visit shall be provided by Contractor for Employer representative to witness factory testing of Fire Pump before shipment.

101.3 SUBMITTALS

A. Shop Drawings

1. Comply with Division 01 requirements for the mechanics and administration of the submittal process.
2. Comply with all submittal requirements described in Section 23

B. Approvals

1. Per NFPA 20, 5.2.2., a complete plan and detailed data describing pump, driver, controller, power supply, fittings, suction and discharge connections, and liquid supply conditions shall be submitted to local fire authority for approval

C. Test Reports

1. Field acceptance test for entire fire hydrant pump system including: duty and stand-by fire pumps, Jockey Pump, and associated controllers.

    a. All tests of fire hydrant pump system components shall be witnessed by representatives of the Local Fire Protection Authority

D. Operation and Maintenance Manuals:

1. See Division 01 for requirements for:

    a. The mechanics and administration of the submittal process.

    b. The content of Operation and Maintenance Manuals.

PART 102 - PRODUCTS

102.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable providers of a preassembled Fire Hydrant Pump Package (skid) including one (1) duty, one (1) stand-by horizontal split case centrifugal pumps, and one (1) multistage in-line Jockey Pump; each pump to be supplied with dedicated motor, motor controller, appropriate valving and other appurtenances:

1. Refer to Vendor's List in Division 20 Appendix 1.A.

B. Approved Elements of manufacturer's package Fire Hydrant Pump System

1. Approved manufacturer's of Horizontal Split-case Centrifugal Pump to be included in manufacturer's package on skid with dedicated pump driver and controller:

    a. Refer to Vendors List in Division 20 Appendix 1.A.

    b. Approved substitute that shall be designed and tested specifically for compliance with NFPA 20

2. Approved manufacturer's of Multistage, In-line Fire Hydrant System Jockey Pump to be included in manufacturer's package on skid with dedicated pump driver and controller,

    a. Refer to Vendors List in Division 20 Appendix 1.A.

    b. Approved substitute that shall be designed and tested specifically for compliance with NFPA 20

3. Approved manufacturer's of Fire Hydrant Pump and/or Jockey Pump

4. Controllers to be included in manufacturer's package on skid:

    a. Refer to Vendors List in Division 20 Appendix 1.A.

    b. Approved substitute that shall be designed and tested specifically for compliance with NFPA 20

C. Submit required for substitutions in accordance with Division 01.

102.2 MATERIALS

A. Fire Hydrant Pumps, Motors and Controllers:

1. General - one (1) duty, one (1) stand-by horizontal split-case centrifugal pumps compliant with IEC and British Standards requirements shall be included in manufacturer's package designed and tested specifically for compliance with NFPA 20. Each fire hydrant pump shall have a dedicated shaft, electric motor, motor controller. IEC and British Standards compliant fire hydrant pumps, pump casings, electric motors, pump controllers and accessories supplied as part of complete package system.

2. Fire Hydrant Pump valving and appurtenances

   a. General: All piping, valving, metering, and sensing equipment from the suction header to the common discharge header shall be included in a manufacturer's fire pump package system, and designed and factory tested by the manufacturer specifically for compliance with NFPA 20. As such, all valving and appurtenances required by NFPA 20 shall be included on the skid and may not be listed explicitly in this section.

   b. Suction Piping and appurtenances:

      1) Vortex plates shall be installed at the entrance to the suctions lines. Vortex plates are not necessarily included in a manufacturer's skid and will be the responsibility of the contractor.

      2) No device or assembly that will restrict flow in a suction line, unless specifically required by NFPA 20 shall be installed on the suction line

      3) Elbows and Tees with a centerline plane parallel to the horizontal split case pump shaft shall not be permitted.

3. Discharge Piping and appurtenances

   a. Elbows and Tees with a centerline plane parallel to the horizontal split case pump shaft shall not be permitted.

   b. The manufacturer's package shall provide for a main discharge relief valve capable of discharging to the supply source (Fire Hydrant Water Tank) at rated conditions. The relief valve shall be run independently and not be combined with discharge(s) from other relief valves.

   c. No shut off valve shall be installed on the relief valve supply or discharge piping.

B. Fire Hydrant Pump System Jockey Pump, motor and controller

1. General - one (1) duty multi-stage in-line pressure maintenance pump fully compliant with IEC and British Standards requirements shall be included in manufacturer's package designed and tested specifically for compliance with NFPA 20. Jockey pump shall have a dedicated motor and motor controller. Jockey Pump, pump casing, electric motor, pump controller and accessories supplied as part of complete package system by manufacturer.

2. Fire Hydrant Jockey Pump valving and appurtenances

   a. General: All piping, valving, and sensing equipment associated with the Fire Hydrant Jockey Pump shall be included in a manufacturer's fire pump package system, and shall be designed and factory tested by the manufacturer specifically for compliance with NFPA 20.

102.3 EQUIPMENT

A. Fire Hydrant Pump Performance and Configuration Requirements:

1. Design condition: 63l/s at 105m TDH with minimum pump efficiency of 70 percent.
2. Rated Efficiency: 73%
3. Shutoff condition: 0l/s at 105m TDH.
4. Pump configuration: Horizontal, split case, single stage
5. Nominal pump speed: 2950 rpm.
6. Drive type: Constant speed.
7. Drive configuration: Flexible coupled.
8. Minimum solids passage: No solids passage.
9. Pump casings (2): Cast iron, ASTM A48, Class 30 or equivalent with suction and discharge flanges rated for 17.2 bar (250-psi)
10. Impellers (2): Bronze, ASTM B584-AL836.
11. Each pump shall have a single dedicated shaft constructed of 1040 Cold Roll Steel or equivalent.
12. Impeller wear rings (2): Bronze, ASTM B505-AL932.
13. Shaft sleeve (2): Bronze, ASTM B505-AL932.
14. Baseplate (2): Steel with copper tubing extending to nearest floor drain.
15. Packed stuffing box and extra packing (2).

B. Fire Hydrant Pump Motors

1. General: Each fire hydrant pump shall have a dedicated electric motor compliant with IEC and British Standards
2. Rated Power: 98 Kw
3. Capacity shall be adequate for pumping duty at any condition of load without overloading.
4. Pump rotation viewed from driver end: Clockwise

C. Fire Hydrant Jockey Pump Performance and Configuration Requirements:

1. Design condition: 1.3/s at 105m TDH
2. Shutoff pressure: 5.17 bar
3. Pump configuration: multi-stage in-line
4. Rated Power of Motor: 5.50 Kw
5. Motor: TEFC
6. Pump casing: Cast iron, ASTM A48, Class 30 or equivalent with suction and discharge flanges rated for 250-psi
7. Impellers: Bronze, ASTM B584-AL836.
8. Fire Hydrant Jockey Pump Controllers

a. General: The fire hydrant jockey pump motor shall have an IEC and British Standards compliant motor controller in a free-standing IEC compliant metal enclosed cabinet (minimum enclosure rating per IEC IP11)

102.4 ACCESSORIES

A. All accessories associated with Fire Hydrant Pumps, Fire Hydrant Jockey Pump, and their associated motors and controllers specifically identified in NFPA 20, 25, and 110 shall be provided by manufacturer as part of manufacturer's Fire Hydrant Pump System Package.

1. Where Fire Hydrant Pump System accessories are not specifically indicated in NFPA 20, 25, and 110, contractor shall refer to Section232123.

102.5 CONTROLS

A. Fire Hydrant Pump Controllers

1. General: Each fire hydrant pump motor shall have an IEC and British Standards compliant motor controller in a free-standing IEC compliant metal enclosed cabinet
2. Solid state staring electric controller with soft start and soft stop capabilities
3. Pressure switch connection to each controller to initiate automatic start sequence.
4. Capability to monitor, record, and display system information with door mounted display/interface
5. Voltage Surge protector
6. Main Disconnect Switch
7. Fire Pump Circuit breaker
8. Emergency manual run mechanism
9. Electrical interlocking to prevent multiple fire hydrant pumps from running simultaneously. The following indicator LED displays shall be visible at each dedicated fire pump controller with an additional audible alarm as indicated:
    a. POWER ON
    b. PUMP RUN
    c. PHASE FAILURE (+ audible)
    d. PHASE REVERSAL (+ audible)
    e. LOW PRESSURE (+ audible)
    f. DELUGE OPEN
    g. INTERLOCK ON
    h. FAILURE TO START
    i. SOFT STARTER OVERTEMPERATURE

B. The fire hydrant jockey pump controller shall have the following capabilities:

1. Magnetic Starter
2. Pressure switch connection to initiate automatic start sequence with adjustable differential range of 1 -8.3 bars.
3. Running period timer to prevent too frequent automatic starts

4. Mechanically interlocked disconnect switch

5. Capability to monitor, record, and display system information with door mounted display/interface

6. HAND-OFF-AUTO selector switch

7. Fire Hydrant Jockey Pump Circuit breaker

8. The following indicator LED displays shall be visible at the dedicated pump controller associated with the fire hydrant jockey pump.

    a. POWER ON
    b. ELAPSED TIME METER
    c. TROPICALIZATION
    d. PUMP OPERATING

9. The following audible/visible alarms shall be provided by the fire hydrant jockey pump controller as required by NFPA-20.

    a. PUMP OVERLOAD
    b. PUMP POWER FAILURE
    c. PHASE REVERSAL

102.6 FABRICATION

A. Fabrication of Fire Hydrant Pump System Package including one (1) duty, one (1) stand-by horizontal split case centrifugal pumps, and 1 multistage in-line Jockey Pump with associated controllers, valving and other appurtenances shall be fabricated and assembled by manufacturer specifically to meet or exceed requirements established by NFPA 20, 25 and 100, and British Standards.

B. Manufacturer shall certify that all fittings subjected to discharge pressure shall be rated to withstand 17.2 bar of pressure.

C. Manufacturer shall certify that all fittings subjected to suction pressure shall be rated to withstand 10.3 bar of pressure.

D. Manufacturer shall ensure that all steel piping shall be joined by means of screwed, flanged mechanical grooved joints, or other approved fittings as indicated in NFPA 20

E. Manufacturer shall ensure that furnished pump casings shall withstand 17 bar.

F. Careful consideration shall be given by the manufacturer to the possible effects of system component damage during shipment to the project site

G. Manufacturer shall ensure that the structural integrity of the Fire Hydrant Pump System Package shall be maintained with minimal flexing and movement

H. Manufacturer shall ensure that all necessary supports and restraints shall be installed to prevent damage and breakage during transit

I. Manufacturer shall ensure that pump skid meets or exceeds the requirements of NFPA 20 Sections 5.27 through 5.27.4

102.7 SOURCE QUALITY CONTROL

A. Each individual pump included in the manufacturer's Fire Hydrant Pump System Package shall be tested at the factory to provide detailed performance data and demonstrate compliance with specifications

B. Prior to shipment, each individual pump included in the manufacturer's Fire Hydrant Pump System Package shall be hydrostatically tested by the manufacturer for a period of time not less than 5 minutes

C. Pump casings shall be essentially tight at test pressures

D. Suction and discharge piping shall be thoroughly inspected; including checking all flanged and mechanical connections per manufacturer's recommendations after the Fire Hydrant Pumps System Package Skid is set in place on its permanent foundation.

102.8 MAINTENANCE MATERIALS

A. Extra Materials

1. For each individual pump included in the manufacturer's Fire Hydrant Pump system Package, manufacturer shall furnish owner the following extra parts for each pump service category:

a. Shaft sleeves: Two set.
b. Shaft O-rings: Two set.
c. Bearings: Two set.
d. Wear rings: Two each.
e. Gaskets: Two set.
f. Seals: Two set.

B. Treatment System Recirculation Pump

1. Standard manufacturer's spare parts package

102.9 POWER SOURCE AND CONTROL PANELS

A. Each individual pump included in the manufacturer's Fire Hydrant Pump system Package shall have a dedicated power feed and control panel.

B. Each individual pump and controller shall have a single dedicated power feed. Each feed shall be capable of delivering power from the local utility or from the emergency generator system on-site. Provisions for transfer switch arrangements need not be included in the instrumentation associated with the manufacturer's Fire Hydrant Pump system Package, as the power feed transfer mechanism will be designed, tested, and certified by others.

XXXIII. DIESEL DRIVE CENTRIFUGAL FIRE PUMPS

PART 103 - GENERAL

103.1 SUMMARY

A. Section includes:

1. Split case fire pumps
2. Fire pump accessories and specialties
3. Flow meter systems

103.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire Pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event".

C. Pump Equipment, Accessory, and Specialty Pressure rating: 300 psig (2070 KPa) minimum depending on system pressure requirements.

103.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves with each selection point indicated, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire pumps, engine drivers, and fire pump accessories and specialties. Include plans, elevations, sections, details and attachments to other work.

C. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.

D. Wiring Diagrams: For power, signal and control wiring.

E. Product Certificates: For each fire pump from manufacturer.

F. Source quality control reports

G. Field quality control reports

H. Operation and Maintenance Data: For fire pumps to include in operation and maintenance

I. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

103.4 QUALITY ASSURANCE

A. Source Limitation: Obtain fire pumps, pressure maintenance pumps and controllers through one source from a single manufacturer for each type of equipment.

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

C. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection".

D. Comply with standards of Authorities having Jurisdiction pertaining to materials, hose threads and marked for intended use.

E. Factory visit shall be provided by Contractor for Employer representative to witness factory testing of Fire Pump before shipment.

103.5 COORDINATION

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

103.6 TRAINING REQUIREMENTS

A. Prior to final acceptance, the installing fire fighting specialist contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include system operation, manual and functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

103.7 GUARANTEES AND WARRANTEES

A. Furnish client with manufacturer's guarantee and warranty certificate, duly registered with the manufacturer.

B. All fire fighting and sprinkler system including fire pump set components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance

PART 104 - PRODUCTS

104.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements and/or as per Approved Vendors List in Division 20 Appendix 1.A.

104.2 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

A. Description: UL 448, factory assembled and tested, centrifugal fire pump capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shut off head limited to 140 percent of total rated head.

B. Base: Fabricated and attached to fire pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

C. Finish: Red Paint applied to factory-assembles and tested unit before shipping.

D. Equipment like fire pumps, fire pump drivers and fire pump controllers and accessories shall be UL listed / FM approved and shall be to the approval of the AHJ (Dubai Civil Defense).

E. Components such as fuses, contractors, indicators, timers, etc. which may require replacement in future, shall be products of the same standard/manufacture as that of the electrical works of the project

F. Equipment like fire pumps and control panels shall have local dealers/representatives certified to check, test, adjust and commission the equipment.

104.3 SINGLE STAGE, SPLIT CASE FIRE PUMPS

A. Manufacture: Subject to compliance with requirements

B. Pump:

1. Standard: UL 448, for split case pumps for fire service
2. Casing: Axially split case, cast iron with ASME B16.1 pipe flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
6. Shaft Bearings: Grease lubricated ball bearings in cast iron housing
7. Seals: Stuffing box with minimum of four rings of graphite impregnated braided yarn and bronze packing gland.
8. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.

C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.

D. Driver:

1. Standard: UL 1247
2. Type: Diesel engine

3. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.

4. Engine Cooling System: factory installed radiator

5. Coolant: Type recommended by driver manufacturer.

6. Engine Cooling System: Factory installed water piping valves, strainer, pressure regulator, heat exchanger, coolant pump, bypass piping and fittings.

7. Piping: ASTM B 88, Type L (ASTM B 88M, Type B), copper water tube; ASME B16.22, wrought-copper, solder-joint pressure fittings; AWS A5.8/A5.8M, BCup series brazing filler metal; and brazed joints.

8. Engine Jacket Water Heater: factory installed electric elements

9. Dual Batteries: Lead acid storage type with 100 percent standby reserve capacity.

10. Fuel System: Comply with NFPA 20

11. Fuel Storage Tank Size indicated but not less than required by NFPA 20. Include floor legs, direct reading level gage, and secondary containment tank with capacity at least equal to fuel storage tank.

12. Exhaust System: ASTM A 53 / A 53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld type pipe fittings; ASME B16.5 steel flanges and ASME B16.21, non-metallic gaskets. Fabricate double wall, ventilated thimble from steel pipe.

13. Exhaust Connector: Flexible Type

14. Exhaust Silencer: Residential Type

15. Capacities and Characteristics: Refer to schedules in drawings.

104.4 FIRE PUMP CONTROLLERS

A. Description: UL 218 and NFPA 20. Listed for Diesel Drive, fire pump service; combined automatic and manual operation; factory assembled and wired; and factory tested for capacities and electrical characteristics.

1. Rate controllers for scheduled fire pump horsepower.

2. Enclosure: UL 50, Type 2, drip proof, indoor, unless special purpose enclosure is indicated. Include manufacturer's standard red paint applied to factory assembled and tested unit before shipping.

3. Mounting: Floor type field electrical components.

4. Control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used, and specified items listed.

5. Battery charge UL 1236, built-in dual battery type.

6. Time clock for weekly automatic test

7. System pressure recorder, electric AC driven with spring backup

8. Timing relay for automatic stop

9. Power failure start, with time delay to prevent start at momentary loss of power

10. Low fuel level alarm

11. Alarm contacts for remote of "Engine Run". "Switch Off", and "Engine failure", to enable remote indication at both fire alarm system and BMS.

12. Pump room alarms, including both audible and visible signals.

13. Nameplate: Complete with capacity, characteristics. Approvals and listings and other pertinent data.

14. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with non-ferrous metal sensing piping, NPS ½ (DN 15), with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32 inch (2.4 mm) orifice in clapper or ground face union with non-corrosive diaphragm having 3/32 inch (2.4 mm) orifice.

104.5 FIRE PUMP ACCESSORIES AND SPECIALTIES

A. Automatic Air Release Valves: Comply with NFPA 20 for installation in fire pump casing

B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.

C. Relief valves:

D. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire suppression water supply piping.

E. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.

F. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

G. Discharge Cone: Closed type

H. Suction and discharge pressure gages.

I. Ball drip Valve: UL 1726

J. Hose Valve Manifold Assembly"

1. Standard: Comply with requirements in NFPA 20

2. Header Pipe: ASTM A 53 / A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.

3. Header Pipe Fittings: ASME B16.4, galvanized cast iron threaded fittings

4. Automatic Drain Valve: UL 1726

5. Manifold:

   a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.

   b. Body: Flush type, brass or ductile iron with number of outlets required by NFPA 20.

   c. Nipples: ASTM A 53 / A 53M, Schedule 40, galvanized steel pipe with ends threaded according to ASME B1.20.1.

   d. Adapters and Caps with Chain: Brass or bronze with outlet threaded according to NFPA 1963 and matching local fire department threads.

   e. Escutcheon Plate: Brass or bronze, rectangular

f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire department threads.

g. Exposed Parts Finish: Polished

h. Escutcheon Plate marking: Equivalent to "FIRE PUMP TEST".

104.6 ALARM PANELS

A. Description: Factory assembled and wired remote panel complying with UL 508 and requirements in NFPA 20. Include audible and visible alarms matching controller type.

1. Enclosure: NEMA 250, Type 2, remote wall mounting type.

2. Finish: Manufacturer's standard red paint applied to factory assembled and tested before shipping.

3. Features: Include manufacturer's standard feature and the following:

4. Motor operating condition

5. Loss of line power

6. Phase reversal

7. Low water alarm

104.7 FLOW METER SYSTEMS

A. Description: UL Listed or FM Approved, fire pump flow meter system with capability to indicate flow to not less than 175 percent of fire pump rated capacity. Include sensor of size to match pipe, tubing, flow meter and fittings.

B. Pressure Rating: 300 psig (2070 KPa) depending on system pressure requirement

C. Sensor: Annubar probe, orifice plate, or venture unless otherwise indicated. Sensor size shall match pipe, tubing, flow meter and fittings.

D. Permanently Mounted Flow meter: Compatible with flow sensor, with dial not less than 4-1/2 inches (115 mm) in diameter. Include bracket or device for wall mounting

E. Tubing package: NPS 1/8 or NPS ¼ (DN 6 or DN 10) soft copper tubing with copper or brass fittings and valves.

F. Portable Flow meter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter and with two 12-foot (3.7 m) long hoses in carrying case.

104.8 PRESSURE GAGES

A. Description: UL 339, 3 ½ or 4 ½ inch (90 to 115 mm) diameter dial with range of 0 to 500 psig (0 to 3450 KPa) minimum, include caption 'WATER" on dial face.

104.9 GROUT

A. Standard: ASTM C 1107, Grade B, post hardening and volume adjusting, dry, hydraulic cement grout.

B. Characteristics: Non shrink and recommended for interior and exterior applications.

C. Design Mix: 5000 psi (3450 KPa), 28 day compressive strength.

D. Packaging: Premixed and factory packaged.

104.10 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests".

B. Verification of Performance: Rate fire pumps according to UL 448.

C. Fire pumps will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 105 - EXECUTION

105.1 EXAMINATION

A. Examine equipment bases and anchorage provisions with installer present, for compliance with requirements and for conditions affecting performance of fire pumps.

B. Examine roughing in for fire suppression piping systems to verify actual locations of piping connection before fire pump installation.

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

105.2 INSTALLATION

A. Fire Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves and related components.

B. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings and accessories.

C. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified.

D. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch (450 mm) centers around the full perimeter of concrete base.

E. For supported equipment, install epoxy coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

F. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

G. Install anchor bolts to elevations required for proper attachment to supported equipment.

H. Install fire pump suction and discharge piping equal to or larger than sizes required by NFPA 20.

I. Support piping and pumps separately so weight of piping does not rest on pumps.

J. Install valves that are same size as piping connecting fire pumps by passes, test headers and other piping systems.

K. Install pressure gages in fire pump suction and discharge flange pressure gage tappings.

L. Install piping hangers and supports, anchors, valves, gages and equipment supports according to NFPA 20.

M. Install fuel system according to NFPA 20.

N. Install water supply and drain piping to diesel engine heat exchangers. Extend drain piping from heat exchangers to point of disposal.

O. Install exhaust system piping for diesel engines. Extend to point of termination outside structure. Install pipe and fittings with welded joints; install components having flanged connections with gasketed joints.

P. Install condensate drain piping for diesel exhaust system. Extend drain piping from low points of exhaust system to condensate traps and to point of disposal.

Q. Install flow meters and sensors. Install flow meter system components and make connections according to NFPA 20 and manufacturer's written instructions.

R. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturer's wiring diagram submittals to electrical installer.

S. Wiring Method: Conceal conductors and cables in accessible ceiling, walls and floors where possible.

105.3 ALIGNMENT

A. Align split case pump and driver shafts after complete unit has been levelled on concrete base, grout has set, and anchor bolts have been tightened.

B. After alignment is correct, tighten anchor bolts evenly. Fill base plate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.

C. Align piping connections

D. Align pump and driver shafts for angular and parallel alignment and to tolerances specified by manufacturer.

105.4 CONNECTIONS

A. Comply with requirements for piping and valves.

B. Install piping adjacent to pumps and equivalent to allow service and maintenance.

C. Connect water supply and discharge piping for fire pumps with flexible connectors. Connect water supply and discharge piping to pressure maintenance pumps with flexible connectors.

D. Connect relief valve discharge to drainage piping or point of discharge.

E. Connect cooling system water supply and drain piping to diesel engine heat exchangers.

F. Connect flow meter system meters, sensors, and valves to tubing.

G. Connect fire pumps to their controllers.

H. Connect fire pump controllers to building fire alarm system.

105.5 IDENTIFICATION

A. Identify system components. Comply with requirements for fire pump marking according to NFPA 20.

105.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect, test and adjust field assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform field test for each fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, and then retest to demonstrate compliance. Replace equipment that cannot be satisfactory corrected or that does not perform as indicated. And then retest to demonstrate compliance. Verify that each fire pump performs as indicated.

C. Perform the following field test and inspections and prepare test reports.

1. Leak Test: After installation, charge system and test leaks. Repair leaks and retest until no leak exist.

2. Final checks before start up: Perform the following preventive maintenance operations and checks.

   a. Lubricate oil lubrication type bearings

   b. Remove grease lubrication type bearing covers, flush bearing with kerosene and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.

   c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.

   d. Verify the pump is free to rotate by hand, if pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.

3. Starting procedure for pump is as follows:

   a. Prime pump by opening suction valve and closing drains and prepare pump for operation.

   b. Open sealing liquid supply valves if pump is so fitted.

   c. Start motor

   d. Open discharge valve slowly

   e. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately, but let packing run in before reducing leakage through stuffing boxes.

   f. Check general mechanical operation of pump and motor.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

5. Furnish fire hose in number, size and length required to reach storm drain or other acceptable location to dispose fire pump test water. Fire hose are for field acceptance test only and are not property of Owner.

105.7 INSPECTION, TESTS AND ADJUSTMENTS OF FIRE PUMPS

A. Prior to Start Up

1. Check the pump motor assembly alignment. Adjust of necessary. Weld steel cleats on pump and motor bases to lock them in aligned position.

2. Tighten and lock foundation and coupling bolts.

3. Check pump shaft for free rotation.

4. Check electrical continuity and insulation of motor and the control panel, by meggering.

5. Ensure that the relief valve is correctly calibrated and installed.

6. Shut off system isolating valve/s and open the test line.

7. Ensure that the circuit breaker trip rate is correctly selected and the elements properly installed. Adjust the star delta change over the timer to the period recommended by the motor manufacturer.

8. Check the system power supply voltage. Perform all other checks outlined in the controller operation manual, before energizing the controller.

9. Ensure that the suction lines and the pump casing are full of water.

B. Start Up

1. Check and correct, if necessary, the direction of rotation of the pump, by momentary operation of the emergency start lever.

2. Close the valve on the test line partially to avoid the operation of the pump at high discharge rates.

3. Start the pump on manual mode.

4. Check the motor full load current by manipulating the flow.

5. Check the pressure relief valve for proper operation gradually closing the test valve.

6. Check the pump and motor bearings for signs of overheating.

7. Check the suction line for signs for entry of air and proper suction intake flow.

C. Verification of Performance

1. Check the pump head at nominal flow and at 150% of nominal flow and ensure conformity with design requirements.

2. Close the test line and stop the pump. Release the system pressure gradually with the test valve. Check and adjust the pressure switch setting for automatic cut in. Check and adjust the pressure switch setting for automatic cut in and cut out of jockey pump.

D. Put System into Service

1. Isolate the fire pump controllers.

2. Close the test line and open the system isolating valve. Ensure that the system outlets are closed.

3. Fill the system with jockey pump. Maintain pressure for 24 hours and ensure that there are no leaks.

4. Energize fire pump controllers and ensure that the system is in automatic mode.

105.8 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

XXXIV. PRESSURE MAINTENANCE FIRE PUMPS

PART 106 - GENERAL

106.1 SUMMARY

A. Section Includes:

1. Multistage, pressure-maintenance pumps.
2. Regenerative-turbine, pressure-maintenance pumps
3. Submersible, pressure-maintenance pumps
4. Vertical turbine, pressure maintenance pumps

106.2 PERFORMANCE REQUIREMENTS

A. Pump equipment, accessory, and specialty pressure rating: 175 psig (1200 KPa) minimum depending on system pressure requirement.

106.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics and furnished specialties and accessories.

B. Shop Drawings: For pumps, accessories and specialties. Include plans, elevations, sections, details and attachments to other work.

C. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.

D. Wiring Diagrams: For power, signal and control wiring.

E. Field quality-control reports

F. Operation Maintenance Data: For pumps to include in operation and maintenance manuals.

G. Submit clause by clause specification compliance statement to confirm specified parameters are met.

106.4 QUALITY ASSURANCE

A. Electrical components, devices and accessories: Listed and labelled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

106.5 COORDINATION

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

106.6 TRAINING REQUIREMENTS

A. Prior to final acceptance, the installing fire fighting specialist contractor shall provide operational training to each shift of the owner's personnel. Each training session shall include system operation, manual and functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

106.7 GUARANTEES AND WARRANTY

A. Furnish the client with manufacturer's guarantee and warranty certificates, duly registered with the manufacturer.

B. All fire fighting and sprinkler system including fire pump set components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance

PART 107 - PRODUCTS

107.1 MANUFACTURERS

A. Subject to compliance with requirements and/or as per Section 230010, Approved manufacturer's list or comparable products

107.2 MULTISTAGE, PRESSURE MAINTENANCE PUMPS

A. Description: factory-assembled and tested, multistage, barrel type vertical pump as defined in HI 2.1-1.1 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.

B. Pump Construction:

1. Barrel: Stainless Steel
2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
3. Pump Head/Motor Mount: Cast iron
4. Impellers: Stainless steel, balanced and keyed to shaft.
5. Pump Shaft: Stainless Steel
6. Seal: Mechanical type with carbon rotating face and silicon carbide stationary seat.
7. Intermediate Chamber Bearings: Aluminium-oxide ceramic or bronze
8. Chamber base Bearing: Tungsten carbide
9. O-Rings: EPDM or NBR

C. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment".

D. Power Cord: Factory connected to motor for field connection to controller and at least 10 feet (3 m) long.

E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

F. Capacities and Characteristics: See schedules on drawings for flow and pressure ratings.

107.3 REGENERATIVE TURBINE, PRESSURE MAINTENANCE PUMPS

A. Description: Factory-assembled and -tested, close-coupled, single-stage, regenerative-turbine centrifugal pump as defined in HI 1.1-1.2 and HI 1.3; with pump and motor mounted horizontally.

B. Pump Construction:

1. Casing: Radially split, cast iron, with threaded inlet and outlet.
2. Impeller: Bronze, balanced, and keyed to shaft.
3. Pump Shaft: Stainless steel or steel with deflector.
4. Shaft Sleeve: Bronze.
5. Seal: Mechanical type with spring-loaded rotating head

C. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment."

D. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m) long.

E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

F. Capacities and Characteristics: See schedules on drawings for flow and pressure ratings.

107.4 SUBMERSIBLE, PRESSURE MAINTENANCE PUMP

A. Description: Factory-assembled and -tested, vertical, multistage, submersible pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted below pump.

B. Pump Construction:

1. Pump Head or Elbow: Cast iron, for surface discharge, with flanged or threaded connections.

2. Pump Shaft: Stainless steel.

3. Bearings: Bronze.

4. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.

5. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections 10 feet (3 m) or less, with strainer of cast or fabricated bronze or stainless steel between pump and bowl section.

C. Motor: Single speed with permanently lubricated ball bearings and capable of continuous operation under water. Comply with requirements in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment."

D. Power Cord: Capable of continuous under-water operation, factory-connected to motor for field connection to controller, and at least 10 feet (3 m).

E. Base: Cast iron or steel with hole for electrical cable.

F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

G. Capacities and Characteristics: See schedules on drawings for flow and pressure ratings.

107.5 VERTICAL TURBINE PRESSURE MAINTENANCE PUMPS

A. Description: Factory-assembled and -tested, vertical, multistage, open-line-shaft turbine pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted above pump head.

B. Pump Construction

1. Cast Iron, for surface discharge, with flange except connections may be threaded in sizes in which flanges are bit available.

2. Pump Head Seal: Stuffing Box and stuffing.

3. Line Shaft: Stainless Steel or Steel with corrosion resistant shaft sleeves.

4. Line Shaft Bearings: Rubber sleeve, water lubricated.

5. Impeller shaft: Monel metal or stainless steel.

6. Bowl Section: Multiple cast iron bowls, with closed-type bronze or stainless steel impellers.

7. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections 10 feet (3 m) or less, with strainer of cast or fabricated bronze or stainless steel at bottom.

C. Motors: Single speed with permanently lubricated ball bearings. Comply with requirements in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment."

D. Power Chord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m)

E. Base: Cast iron or steel with hole for electrical cable.

F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

G. Capacities and Characteristics: See schedules on drawings for flow and pressure ratings.

107.6 MOTOR

A. Comply with NEMA designation, temperature rating service factor, enclosure type and efficiency requirements for motors specified in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment".

B. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

C. Electrical Devices and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

D. Electrical motor, type and construction shall be as follows:

1.	Type	Squirrel cage induction, delta wound
2.	Enclosure	TEFC Hostile Duty
3.	Power Factor	85% minimum at full load
4.	Insulation	Class F
5.	Temperature Rise	Class B
6.	Electrical Supply	400v/3ph/50Hz

107.7 CONTROLLERS

A. General: UL 508, factory-assembles, wired and tested, across the line type for combined automatic and manual operation.

B. Enclosure: UL 508 NEMA 250, Type 2, wall mounting type for field electrical wiring.

C. Finish: Manufacturer's standard color paint applied to factory assembles and tested unit before shipping.

D. Rate controller for scheduled horsepower and include the following:

1. Fusible disconnect switch

2. Pressure switch

3. Hand-off auto selector switch

4. Pilot light

5. Running period timer

107.8 ACCESSORIES AND SPECIALTIES

A. Match pressure-maintenance pump suction and discharge ratings as required for pump capacity rating. Include the following:

1. Circulation valve

2. Suction and discharge pressure gauge

PART 108 - EXECUTION

108.1 EQUIPMENT INSTALLATION

A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.

B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."

C. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

D. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

E. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

F. Install anchor bolts to elevations required for proper attachment to supported equipment.

G. Attach pumps to equipment base using anchor bolts.

108.2 FIELD QUALITY CONTROL

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

B. Perform tests and inspections.

C. 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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

G. ADJUSTING

1. Lubricate pumps as recommended by manufacturer.

2. Set field-adjustable pressure-switch ranges as indicated.

XXXV. CONTROLLERS FOR FIRE PUMP DRIVERS

PART 109 - GENERAL

109.1 SUMMARY

A. Section Includes:

1. Full-service, full-voltage controllers rated 600V and less.
2. Limited-service controllers rated 600V and less.
3. Controllers for diesel-drive fire pumps.
4. Controllers for pressure-maintenance pumps.
5. Remote alarm panels.
6. Low-suction-shutdown panels.

109.2 DEFINITIONS

A. Retain definition(s) remaining after this Section has been edited.

B. ATS: Automatic transfer switches.

C. ECM: Electronic control module.

D. MCCB: Molded-case circuit breaker.

E. N.O.: Normally open.

109.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-pump controllers and alarm panels shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

C. Fire pumps shall be arranged to prevent both main and standby pumps from starting and running simultaneously and if done, the following arrangement is suggested:

1. Turning off or disconnecting power to the primary fire pump controller should not prevent the redundant fire pump from starting or running.
2. Turning off or disconnecting power to the redundant fire pump controller should not prevent the primary fire pump from starting or running.
3. Once the primary fire pump is locked out, it should remain locked out until manual reset.
4. Once the redundant fire pump is running, it should remain running until manual reset.
5. Either controller should always be capable of being operated by local manual starting regardless of any lockout that has occurred.
6. A local visual alarm and remote contacts should be provided to indicate that the primary fire pump has been locked out.

109.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.

C. Show tabulations of the following:

1. Each installed unit's type and details.

2. Enclosure types and details for types other than NEMA 250, Type 2.

3. Factory-installed devices.

4. Nameplate legends.

5. Short-circuit current (withstand) rating of integrated unit.

6. Features, characteristics, ratings, and factory settings of individual over current protective devices.

7. Retain first subparagraph below if specifying modifications in Part 2.

8. Specified modifications.

D. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.

E. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

F. Qualification Data: For qualified testing agency.

G. Product Certificates: For each type of product indicated, from manufacturer.

H. Manufacturer's factory test reports of fully assembled and tested equipment.

I. Source quality-control reports.

J. Field quality-control reports.

K. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

109.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.

B. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.

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

D. Comply with standards of authorities having jurisdiction pertaining to materials and installation.

E. Comply with NFPA 20 and NFPA 70.

F. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

109.6 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

109.7 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Notify Architect, Construction Manager, Owner no fewer than seven days in advance of proposed interruption of electric service, and comply with NFPA 70E.

109.8 COORDINATION

A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.

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

109.9 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.

B. Indicating Lights: Two of each type and color of lens installed; two of each type and size of lamp installed.

C. Auxiliary Contacts: One for each size and type of magnetic contactor installed.

D. Power Contacts: Three for each size and type of magnetic contactor installed.

E. Contactor Coils: One for each size and type of magnetic controller installed.

F. Relay Boards: One for each size and type of relay board installed.

G. Operator Interface: One microprocessor board(s), complete with display and membrane keypad

PART 110 - PRODUCTS

110.1 FULL-SERVICE CONTROLLERS

A. General Requirements for Full-Service Controllers:

1. Comply with NFPA 20 and UL 218
2. Listed by an NRTL for electric-motor driver for fire-pump service.
3. Combined automatic and non-automatic operation.
4. Factory assembled, wired, and tested; continuous-duty rated.
5. Retain subparagraph below for controllers used as means of disconnect and overcurrent protection for the service entrance, outside feeder, or separately derived source.
6. Service Equipment Label: NRTL labelled for use as service equipment.

B. Method of Starting:

1. Pressure-switch actuated.
    a. Retain first two subparagraphs below for automatic operation and pressure-switch actuation.
    b. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
    c. System pressure recorder, electric ac driven, with spring backup.
    d. Retain first two subparagraphs below for automatic operation.
    e. Programmable minimum-run-time relay to prevent short cycling.
    f. Programmable timer for weekly tests.
2. Magnetic Controller: Wye-delta (open transition) type.
3. Solid-State Controller: Reduced-voltage type.
4. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.

C. Method of Stopping: Automatic and non-automatic shutdown after automatic starting

D. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.

E. Method of Isolation and Over current Protection: Interlocked isolating switch and non-thermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.

F. Door-Mounted Operator Interface and Controls:

1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
2. Method of Control and Indication:
    a. Microprocessor-based logic controller, with multiline digital readout.
    b. Membrane keypad.

c. LED alarm and status indicating lights.

3. Local and Remote Alarm and Status Indications:

a. Manufacturers offer numerous alarm and status indications and interfaces. Consult manufacturers for availability and types.

b. Controller power on.

c. Motor running condition.

d. Loss-of-line power.

e. Line-power phase reversal.

f. Line-power single-phase condition.

4. Audible alarm, with silence push button.

5. Non-automatic START and STOP push buttons or switches.

G. Optional Features:

1. Extra Output Contacts:

a. One N.O. contact(s) for motor running condition.

b. One set(s) of contacts for loss-of-line power.

c. One each, Form C contacts for high and low reservoir level.

Z. Local alarm bell.

2. Door-mounted thermal or impact printer for alarm and status logs.

3. Operator Interface Communications Ports: USB, Ethernet, and RS485.

H. ATS:

1. Complies with NFPA 20, UL 218 and UL 1008

2. Integral with controller as a listed combination fire-pump controller and power transfer switch.

3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.

4. Allows manual transfer from one source to the other.

5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.

6. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with non-thermal sensing, instantaneous-only short-circuit over current protection to comply with available fault currents.

7. Local and Remote Alarm and Status Indications:

a. Manufacturers offer additional local and remote alarm and status indications and interfaces. Consult manufacturers for availability and types.

b. Normal source available.

c. Alternate source available.

d. In normal position.

e. In alternate position.

f. Isolating means open.

8. Audible alarm, with silence push button.

9. Non-automatic (manual, nonelectric) means of transfer.

10. Engine test push button.

11. Start generator output contacts.

12. Timer for weekly generator tests.

110.2 CONTROLLERS FOR DIESEL-DRIVE FIRE PUMPS

A. General Requirements for Controllers:

1. Comply with NFPA 20 and UL 218

2. Listed by an NRTL for diesel-engine driver for fire-pump service.

3. Combined automatic and non-automatic operation.

4. Factory assembled, wired, and tested.

B. Method of Starting:

1. Pressure-switch actuated.

a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.

b. System pressure recorder, electric ac driven, with spring backup.

c. Programmable minimum-run-time relay to prevent short cycling.

d. Programmable timer for weekly tests.

2. Dual, redundant dc-voltage battery units, with automatic changeover.

3. Emergency Control: Bypasses all automatic control circuits during manual starting and running.

4. Automatic engine start on loss of ac power to the controller.

C. Method of Stopping Automatic and non-automatic shutdown after automatic starting

D. Door-Mounted Operator Interface and Controls:

1. Monitor, display, and control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.

2. Method of Control and Indication:

a. Microprocessor-based logic controller, with multiline LCD readout.

b. Membrane keypad.

c. LED alarm and status indicating lights.

3. Local and Remote Alarm and Status Indications:

a. Manufacturers offer numerous local and remote alarm and status indications and interfaces. Consult manufacturers for availability and types.

b. Controller power on.

c. Engine-lubrication-system critically low oil pressure.

d. Engine-jacket coolant high temperature.

e. Engine fail-to-start.

f. Engine over speed shutdown.

g. Low fuel level.

h. Missing or failed battery.

i. Battery charger failure.

j. System overpressure.

k. ECM selector switch in alternate ECM position.

l. Fuel injector malfunction.

4. Audible alarm.

5. Non-automatic START and STOP push buttons or switches.

E. Optional Features:

1. Extra Output Contacts:

a. One Form C contacts for low pump-room temperature.

b. One each, Form C contacts for high and low fuel levels.

c. One each, Form C contacts for high and low reservoir levels.

2. Door-mounted thermal or impact printer for alarm and status logs.

3. Operator Interface Communications Ports: USB, Ethernet, and RS485.

4. Powered louver contacts.

5. Powered engine-oil heater contacts.

F. Battery Charger System:

1. Built-in, independent, dual battery chargers with automatic changeover; 12-V dc, 24-V dc for lead-acid batteries.

2. Standard: UL 1236

110.3 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

A. General Requirements for Pressure-Maintenance-Pump Controllers:

1. Type: UL 508 factory assembled, wired, and tested, across-the-line; for combined automatic and manual operation.

2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.

3. Factory assembled, wired, and tested.

4. Finish: Manufacturer's standard color paint.

B. Rate controller for scheduled horsepower and include the following:

1. Fusible disconnect switch.

2. Pressure switch.

3. Hand-off-auto selector switch.

4. Pilot light.

5. Running period timer.

110.4 REMOTE ALARM PANELS

A. General Requirements for Remote Alarm Panels: Comply with NFPA 20 and UL 218; listed by an NRTL for fire-pump service.

B. General Requirements for Remote Alarm Panels: Factory assembled, wired, and tested.

C. Supervisory and Normal Control Voltage: 240-V ac single or dual source

D. Audible and Visual Alarm and Status Indications:

1. Driver running.

2. Loss of phase.

3. Phase reversal.

4. Supervised power on.

5. Separate trouble on the controller.

6. Controller connected to alternate power source.

E. Audible and Visual Alarm and Status Indications: Manufacturer's standard indicating lights; non-push-to-test, with separate test push button.

1. Engine running.

2. Controller main switch turned to the off or manual position.

3. Supervised power on.

4. Separate trouble on the controller or engine.

5. Common pump room trouble.

6. Controller connected to alternate power source.

F. Audible alarm, with silence push button

G. Pump REMOTE START push button.

110.5 LOW-SUCTION-SHUTDOWN PANELS

A. General Requirements for Low-Suction-Shutdown Panels:

1. Listed by an NRTL for fire-pump service.

2. Factory assembled, wired, and tested.

3. Prevents automatic start of fire pump, and shuts down automatically started fire pump, on low-suction pressure.

4. Automatic reset.

B. Operation: External contact input or Integral pressure switch

C. Supervisory and Normal Control Voltage: 240-V ac single or dual source.

D. Include audible and visual alarms and status indications, with silence push button, for the following conditions:

1. Control power available.

2. Low-suction pressure.

3. Normal-suction pressure.

110.6 ENCLOSURES

A. Fire-Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.

1. Indoor, Dry and Clean Locations: Type 1 (IEC IP10)

2. Indoor Locations Subject to Dripping Noncorrosive Liquids: Type 2 (IEC IP11) Outdoor Locations: Type 3R (IEC IP14), Type 4 (IEC IP56) or Type 4X (IEC IP56)

3. Other Wet or Damp, Indoor Locations: Type 4 (IEC IP56) or Type 4X (IEC IP56) Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12 (IEC IP12).

B. Enclosure Color: Manufacturer's standard "fire-pump-controller red"

C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.

D. Optional Features:

1. Floor stands, 12 inches (305 mm) high, for floor-mounted controllers.

2. Space heater, 240-V ac with humidistat, with thermostat.

3. Tropicalization

110.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218

B. Verification of Performance: Rate controllers according to operation of functions and features specified.

C. Fire-pump controllers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 111 - EXECUTION

111.1 EXAMINATION

A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.

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

111.2 CONTROLLER INSTALLATION

A. Install controllers within sight of their respective drivers.

B. Connect controllers to their dedicated pressure-sensing lines.

C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, and bottom of enclosure not less than 12 inches (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

D. Floor-Mounting Controllers: Install controllers on 4-inch (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches (305 mm) above finished floor. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."

E. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

F. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.

G. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

H. Install anchor bolts to elevations required for proper attachment to supported equipment.

I. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

J. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

K. Comply with NEMA ICS 15.

111.3 REMOTE ALARM PANEL INSTALLATION

A. Install panels on walls with tops not higher than 72 inches (1829 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

111.4 POWER WIRING INSTALLATION

A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

111.5 CONTROL AND ALARM WIRING INSTALLATION

A. Install wiring between controllers and remote devices and facility's central monitoring system. Comply with requirements in NFPA 20, NFPA 70, and Division 26 Section "Control-Voltage Electrical Power Cables."

B. Install wiring between remote alarm and low-suction-shutdown panels and controllers. Comply with requirements in NFPA 20, NFPA 70, and Division 26 Section "Control-Voltage Electrical Power Cables."

C. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Division 28 Section "Digital, Addressable Fire-Alarm System."

D. Bundle, train, and support wiring in enclosures

E. Connect remote manual and automatic activation devices where applicable.

111.6 IDENTIFICATION

A. Comply with requirements in NFPA 20 for marking fire-pump controllers.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Division 26 Section "Identification for Electrical Systems."

111.7 FIELD QUALITY CONTROL

A. Testing Agency: 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. Acceptance Testing Preparation:

1. Inspect and Test Each Component:

a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.

b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.

c. Test continuity of each circuit.

2. Verify and Test Each Electric-Driver Controller:

a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any

motor, notify Architect, Construction Manager and Owner before starting the motor(s).

b. Test each motor for proper phase rotation.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Field Acceptance Tests:

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Architect, Construction Manager and Owner and authorities having jurisdiction.

2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.

3. Engage manufacturer's factory-authorized service representative to be present during the testing.

4. Perform field acceptance tests as outlined in NFPA 20.

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

G. Prepare test and inspection reports.

111.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

111.9 ADJUSTING

A. Adjust controllers and battery charger systems to function smoothly and as recommended by manufacturer.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.

C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

D. Set field-adjustable pressure switches.

111.10 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

111.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controllers, remote alarm panels, low-suction-shutdown panels, and to use and reprogram microprocessor-based controls within this equipment.

XXXVI. FIRE SUPPRESSION WATER STORAGE TANKS

PART 112 - GENERAL

A. CODES AND STANDARDS

1. BS EN 13280:2001 Specification for glass fibre reinforced cisterns of one piece and sectional construction, for the storage, above ground, of cold water
2. BS EN 806 Specifications for installations inside buildings conveying water for human consumption.
3. BS 4211:2005 Specification for permanently fixed ladders
4. CIBSE TM 13 Minimising the risk of legionnaire's disease B.

PART 113 - PRODUCTS

2.1 FIRE SUPPRESSION WATER STORAGE TANKS

Cold water storage tanks shall be the type and capacity as indicated.

Tanks shall comply with the requirements of the local authorities, and be fit for purpose for the storage of cold water for domestic purposes.

Tanks and connections shall comply with:

1. Municipality Regulations
2. Water Authority Regulations
3. CIBSE TM13 Minimising risk of legionnaires' disease
4. HSE L8 Legionnaires' disease – Control of legionella bacteria in water systems – Approved Code of Practice
5. BS EN 806

Cistern and tank connections shall be located to ensure adequate circulation of the contents with outlets from the bottom of the tank, wherever practical. Adequate support shall be provided to all tank connections, pipe fittings and valves to prevent excessive strain being imposed on the tank or cistern.

Tanks shall be stored and installed in accordance with manufacturer's recommendations.

Ensure adequate protection from damage and ingress of foreign matter to tanks and cisterns during, storage, erection and commissioning. Tanks and cisterns shall be thoroughly cleaned prior to testing and commissioning.

The internal surfaces of tanks and cisterns and their covers shall be free from such imperfections that may inhibit the cleaning of these internal surfaces.

Tanks and cisterns shall be installed to allow internal and external surfaces to be easily inspected and cleaned.

One-piece and sectional cold water storage tanks shall be in accordance with BS EN 13280 for the designated class indicated.

Class A one piece cistern or sectional tank for portable water storage.

Class B one piece cistern or sectional tank for use in the storing of cold non- portable water.

All tanks and cisterns shall be clearly and durably marked by a waterproof adhesive label with the information as required by BS EN 13280.

One-piece cistern and sectional tanks shall be provided with a screened air inlet to allow the escape of air and preserve the integrity of the stored water. The air inlet shall have a screen with apertures not exceeding 0.65 mm x 0.65 mm intended to prevent the ingress of insects and particles. The inlet shall be shrouded to alleviate the entry of dust and light, and prevent the entry of rainwater. The screens shall be non-corrosive material and easily removable for inspection and cleaning.

A fixing, connection provision or other device shall be provided to allow entry of a vent pipe through the cover. Such a device shall prevent any displacement or distortion of the cistern of tank or associate cover due to expansion or other movement of the vent pipe.

Warning pipes and/or overflow pipes shall be provided with a termination assembly for fitting through the side wall of the one-piece cistern or sectional tank which incorporates a free draining external watertight housing containing a screen for fitting to the warning pipe. The screen shall have apertures not exceeding 0.65 mm x 0.65 mm, shall not restrict the full flow and shall be easily removable for inspection and cleaning.

2.2 THERMAL INSULATION

Unless otherwise indicated tanks shall be thermally insulated to protect against freezing and against heat gain which would cause the content to rise to a temperature of 40° C or greater.

Insulation materials shall be incorporated as to protect them from the ingress of moisture, insects or vermin, including those points where connections are made. The materials shall not contain substances that shall support pests or encourage the growth of fungi.

Refer to the thermal insulation section of this specification.

2.3 CONCRETE TANKS

A. Above or below ground concrete water storage tanks shall be reinforced concrete construction and shall be of the capacity and dimensions as indicated in the drawings. They shall comply with the relevant standards of the local authority of jurisdiction.

B. Tanks shall be complete with the following:

1. 600x600 openings with sealed manhole cover for each valve / accessory.
2. Manholes with double sealed manhole covers.
3. Internal stainless steel or aluminium ladders.
4. Inlets, outlets, over flows, drains and insect proof vent cowls as required on Drawings.
5. High and low level controllers, level sensors, level switches and alarms all linked to the BMS.
6. Internal GRP lining or cementicious waterproof lining to the requirements of the local authority of jurisdiction and shall be fully potable guaranteed for 25 years.
7. With watertight hinged cover and locking device.

C. Necessary perforations (including puddle flanges where required) for the inlet and outlet pipes shall be provided. Each storage tank shall be equipped with overflow, warning pipes, and vent pipes, and drain sumps (located directly below the manhole).

2.4 ONE PIECE TANKS

Tanks shall be provided with close fitting lids complying with the Water Regulations. Tanks holding more than 1000 litres shall be provided with two part lids.

Tanks and lids shall be pre-insulated unless otherwise indicated.

2.5 SECTIONAL TANKS

A. The tank shall consist of base and side plates all constructed from flanged GRP panels with a jointing sealant or gasket between. The flanges of all panels shall be internal or external as indicated.

B. Where indicated tanks shall be subdivided into two or more compartments by the inclusion of division plates constructed from GRP sheet panels. Division plates shall be sealed leak tight and be capable of supporting water on either side to the maximum working depth.

C. Baffle plates and/or weir plates shall be fitted as indicated. They shall be constructed to withstand only the additional forces created by the water movement they are designed to induce, and in the case of weir plates, to withstand any additional force due to any imbalance in water pressure created by their use.

D. Internal metallic bracing system members shall be manufactured from stainless steel in accordance with grade 1.4401 or other appropriate steel selected from Table 3 of EN 1008-3. External structural supports shall be manufactured from either mild steel encapsulated in GRP laminate or

suitably protected from corrosion or galvanised or from stainless steel. The design of bracing shall minimise the possibility of bimetallic corrosion.

E. Fasteners, including bolts, nuts and washers, used outside the tank shall be stainless steel.

F. Tanks shall be provided with internal and external ladders manufactured to satisfy dimensional and safety requirements of BS 4211. Internal ladders shall be manufactured from stainless and external ladders galvanised steel unless otherwise stated.

G. Tanks shall be provided with a rigid and close fitting cover. The cover shall have a gap of less 0.65 mm and shall be secured or mechanically fixed with an effective seal to ensure the exclusion of light and the ingress of particles and/or insects and where connections pass through the cover they shall be sealed. All covers shall be capable of sustaining an imposed load of 0.6 kN/m² or 0.9 kN concentrated load, whichever produces the maximum deflection.

H. Manholes or access hatches of at least 600mm diameter or side dimension shall be provided in sectional tanks greater than 1000 litres and designed to prevent the ingress of rainwater, where external, dust and vermin. Each compartment of the tank shall have one manhole located over the ball float valve and one to gain access to an internal stainless steel ladder where indicated.

I. Base panels shall be designed to cope with downward force of a fluctuating static head. Side panels shall be designed to withstand fluctuating loads applied with rising and falling water levels. Roof panels shall be manufactured to take the specific point loads exerted by man-traffic.

J. Purpose designed automated drilling equipment shall be used to accurately drill panel to close manufacturing tolerances ensuring correct alignment of bolt holes, and to ensure proper joining and sealing panels. Panel sizes shall be 1.0 x 1.0 meter.

K. Sectional tanks shall be erected by the tank manufacturer.

2.6 LEVEL SENSORS

A. All level controllers, level sensors, level switches and alarms shall be provided and installed by the Contractor.

B. Each probe shall be of the correct length for its particular application and tank location. Electrodes shall be polished stainless steel 20mm outside diameter. Electrode holders shall be weather proof in all respect.

C. The earthing probes shall be connected and wired to the building earth system.

D. Each set of electrodes shall be installed inside a 200mm-diameter PVC pipe acting as a wave barrier.

E. The level switch set shall be operated with a stepped down voltage at 24V maximum. Stepped down transformer shall be provided for each set of control probes and shall be installed inside centralized control cubicles inside pump room.

F. Provide interface unit at the pump control panel for the levels to be monitored by BMS (refer to drawing).

G. The BMS control panel shall monitor the following outputs from the location for each Tank.

H. BMS Tank High Level (O/P)

I. Whenever the liquid level in the tank reaches a high level, a high level dry contact shall be provided by the contractor at the level controller and monitored by the BMS.

J. BMS Tank Low Level (O/P)

K. Whenever the liquid level in the tank reaches a low level, a low level dry contact shall be provided by the contractor at the level controller and monitored by the BMS.

L. BMS Level Sensing (O/P)

M. The BMS shall monitor the level of liquid in specified tanks via a level sensor provided by the Contractor. All level controllers shall provide a 4-20mA signal to the Contractor. This shall indicate the volume of water in the tank, directly readable from the BMS head end.

2.7 TANK FOUNDATIONS

The surface of the foundation, whether it is a flat screed concrete, steelwork, support walls or pillars, shall be flat, level and free from any irregularities. It should not vary more than 2 mm in any 1mm, or a total of 6 mm in any 6 m, measured laterally or diagonally. Intermittent supports shall be spaced in accordance with the manufacturer's instructions and should continue in one direction.

Both continuous and discontinuous foundations shall conform to any additional requirements provided by the manufacturer arising from the design of the cistern or tank.

Install water storage tanks according to manufacturer's written instructions and standards specified.

Excavate to sufficient depth for a minimum of 3 feet (1 m) of earth cover from top of tank to grade. Allow for cast-in-place, concrete ballast pad, plus 6 inches (150 mm) of sand or pea gravel between ballast base and tank.

Extend excavation 1 foot (300 mm) around perimeter of tank.

Set tie down eyelets for hold down straps in concrete ballast pad and tie to reinforced steel.

Place 6 inches (150 mm) of clean sand or pea gravel on top of ballast pad.

Set tank on fill materials, install hold down straps, and install pipe connections.

Backfill excavation with clean sand or pea gravel. Tamp back fill to consolidate.

Install filter mat between top of backfill and or pea gravel and earth fill.

The installer shall ensure the tank foundation meets the necessary requirements before the installation of the tank or cistern.

2.8 TANK MOUNTINGS

A. Water level indicators shall be provided for each tank compartment to provide visual indication of the stored water level. Water level indicators shall comprise dial gauges and sensors locally mounted. Where a BMS system is provided the gauges shall be capable of providing a content indication to the BMS as indicated. Gauge manufacturers shall be WRAS approved.

B. Overflow, warning pipes, drains, inlet pipes and balance pipes shall be as indicated and in accordance with the Water Supply Regulations.

2.9 CLEANING

Disinfect all potable water tanks including concrete water tanks according to the following method:

A solution of 200-mg/L available chlorine shall be applied directly to the surfaces of all parts of the storage facility that would be in contact with water when the storage facility is full to the overflow elevation.

The chorine solution may be applied with suitable brushes or spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it shall have available chlorine of not less than 10 mg/L when filled with water. Overflow piping need not be disinfected.

The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30-min. after which potable water shall be admitted, the drain piping shall be purged of the 10-mg/L chlorinated water, and the storage facility shall then be filled to its overflow level. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, water may be delivered to the distribution system.

2.10 TESTING

A. Tanks and cisterns shall be subjected to the tests defined in BS EN 13280.

B. Leakage tests shall be undertaken on all tanks and cisterns.

C. When erected a tank shall not show any visible leakage after filling in accordance with the manufacturer's recommendations. The duration of the test shall be for a minimum of 24 hours, commencing at least 2 hours after the tank has been filled. The test shall be carried out within 10 days of erection unless otherwise stated.

D. One-piece cistern - The cistern shall be mounted on a flat, level base and filled with water at a temperature of 5°C to 25°C to the test water line. Inspection for leaks shall be undertaken after 48 hours.

PART 114 - PART 3 - EXECUTION

Refer to detailed installation information in the Fire Fighting Services Particular Specification in Division 21 0001 of this Specification.

XXXVII. FIRE PROTECTION SPECIALTIES

PART 116 - GENERAL

116.1 SUMMARY

A. This section includes:

1. Installation Control Valve
2. Floor control valve assembly
3. Sprinklers
4. Spare sprinkler cabinets
5. Sprinkler line testers
6. Quick response sprinklers
7. Open type sprinklers
8. Deluge station
9. Fire cabinets
10. Landing valves
11. Portable fire extinguishers
12. Wheeled fire extinguishers
13. Fire brigade breeching inlets
14. Flow switches
15. Automatic air release valves
16. Automatic ball drip
17. Pressure reducing valves
18. Vacuum relief valves

116.2 REFERENCES

A. NFPA 10 – Standard for Portable Fire Extinguishers

B. NFPA 13 – Standard for the Installation of Sprinkler Systems

C. NFPA 14 – Standard for the Installation of Standpipe and Hose System

D. NFPA 20 – Standard for Installation of Stationary Pumps for Fire Protection

E. NFPA 22 – Standard for Water Tanks for Private Fire Protection

F. NFPA 24 – Standard for Installation of Private Service Mains and Their Appurtenances

G. NFPA 25 – Standard for Inspection, Testing, Maintenance of Water Based Fire Protection

116.3 SUBMITTALS

A. Submit product data, samples and installation details.

B. Submit selection criteria and ordering schedule, listing types against use and location

C. Submit clause by clause specification compliance statement to indicate all specified parameters are met.

116.4 QUALITY ASSURANCE

A. Use only those products specifically listed/approved for Fire protection services by Underwriters Laboratories Inc. USA (UL), Factory Mutual Testing Laboratories USA (FM Approved), Fire Offices Committee of UK or other approved agencies of international repute, where stipulated.

116.5 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site, store and protect.

B. Keep factory packed items in shipping cartons, until time of installation

C. Store factory calibrated items, which are dropped or subjected to shock otherwise in separate containers with appropriate labels; till completion of works. Keep a record of the same for inspection by the Engineer.

116.6 WARRANTY

A. All firefighting and sprinkler system including fire pump set components furnished, and installed under this contract, shall be guaranteed against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.

PART 117 - PRODUCTS

117.1 ACCEPTABLE MANUFACTURERS

A. Refer to approved manufacturer list on– Vendor List.

117.2 INSTALLATION CONTROL VALVE

A. Isolating Valve: Iron body, bronze mounted (IBBM), outside screw and yoke (OS & Y) construction with solid wedge and flanged ends. Isolating valves shall be UL 262 listed and shall be fitted to the installation in order to shut the valve, the spindle must turn clockwise. The hand wheels of all stop valves shall be clearly marked to indicate which direction the wheel is to be turned to close the valve

B. An indication shall also be provided which shows whether the valve is open or shut.

C. Each main stop valves shall be installed with a tamper/supervisory switch and interconnected to the building fire alarm system or secured open by a padlock or riveted strap.

D. Alarm Check Valve: IBBM, flap type construction with flanged ends, metered bypass with ball valve for pressure maintenance flow, test and alarm flow parts, bolted access cover, pressure gauges (as specified elsewhere) at inlet and outlet etc. It should be UL 753 listed conforming to NFPA 13. Retarding device of approved design to obviate false alarms due to mains pressure variations where necessary or where indicated.

E. Alarm valves shall be complete with Water Motor Alarm Gong, all required auxiliary valves and drains and with pressure switch for wiring into the building electrical alarm system.

F. Test and Drain Valve: All bronze, angle valve with screwed ends complete with metering orifice, discharge turn dish, etc.

G. All drain lines from test valves, drain down points etc. shall discharge over suitable and proper drain vent. Each drain vent shall be connected to 150 mm galvanized steel drain line which shall discharge over a suitable gully.

H. All drain vent, pipe fittings and support clips used for the drain lines shall be galvanized.

I. Alarm Test Valve: All bronze multi-port plug valve with screwed ends, operating lever, engraved position indicator attached to body.

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

K. Water Motor Alarm: Bronze fitted cast iron construction of through the wall type with threaded inlet and outlet connections, wall sleeve, drive shaft and bell which shall be located at a distance not exceeding 15 m from the alarm valve, and at a height not to exceed 6m above the alarm valve.

L. The pipe work and fittings used shall be galvanized and to the sizes determined by NFPA 13.

M. The pipe work shall be arranged to drain through a fitting having an orifice not exceeding 3 mm in diameter, the orifice plate may form an integral part of the fitting but shall be manufactured from a non-ferrous material to prevent the hole from becoming blocked by corrosion or foreign matter.

N. A 15 mm test valve shall be installed on the installation side of each alarm valve.

O. Pressure Switch: Fully enclosed construction with tapped conduit entry and volt free, normally closed/open contacts rated for 5 amps at 250 volts A/C. It should be UL 753 listed and shall be installed in the system as per NFPA-13. It shall be mounted on a vertical branch pipe at least 300 mm long.

P. The pressure switch shall be sufficiently sensitive to operate when only one sprinkler is discharging. The pressure switch shall be provided with volt free contacts to facilitate monitoring by a Building Management System, and wired to the main fire alarm panel.

Q. Pressure Gauges: Pressure gauges shall be fitted to meet the requirements of LPC. Pressure gauges shall conform to BS 1780 or equivalent International Standard. The maximum reading of the scale is 150% of the maximum system pressure and each scale shall have divisions not exceeding 0.2 bar.

117.3 ZONE CHECK ASSEMBLY

A. A zone control valve set shall be UL/FM approved and it is to be provided for each sprinkler system zones as shown on the tender drawings and shall compromise:

1. Butterfly Valve shall have a UL 1091 listing. It shall be fitted with factory UL/FM approved tamper switch.
2. Flow Alarm Switch shall be UL Listed and FM Approved for the size of the pipe in which it is installed as a paddle type water flow indicator. Shall be fixed after the butterfly valve, on the main supply pipe and before any connection is taken off
3. Inspector Test and Drain Connections
4. Dial Pressure Gauges suitable for the water pressure shall be fitted so arranged that it can be easily removed for testing and checking without shutting down the water supply.

117.4 SPRINKLERS

A. All sprinklers shall be automatic glass bulb type, standard orifice (15 mm) (1/2 inch) color coded as follows:

1. 57 deg. C ..... Orange
2. 68 deg. C ..... Red
3. 79 deg. C ..... Yellow
4. 93 deg. C ..... Green

B. Air-conditioned areas with:

1. Front of house and ID Area: Factory painted brass, spray type, concealed sprinkler 0.3 mm frangible glass bulb, standard orifice (12mm) rated 57 deg. C, installed pendant with matching ceiling plates. Ceiling plate shall match ceiling color and/or to meet architect's requirements.
2. All Offices, residential and other (core & shell) areas: Recessed/pendent type sprinklers 0.3 mm frangible glass bulb type, standard orifice (15mm), rated 57 deg. C without cover plate.

C. Air-conditioned Plant Rooms: Brass construction, conventional type, rated 68 deg. C, installed upright or pendent as appropriate.

D. Non air-conditioned Plant Rooms and other Areas: Brass construction, conventional type rated 79 deg. C, installed upright or pendant as appropriate.

E. Through wall sprinklers (conditioned areas): Chrome plated brass, rated 68 deg. C, complete with sleeved escutcheon.

F. Sidewall sprinklers (Non air-conditioned areas): Chrome plated brass, rated 68 deg. C installed upright.

117.5 SPARE SPRINKLER CABINETS

A. Spare sprinkler cabinets shall be provided with the following contents:

1. 2 Nos. sprinkler log books
2. 2 Nos. sprinkler spanners of each type
3. 24 Nos. conventional (68 deg. C) sprinklers used in plant areas
4. 24 Nos. spray (57 deg. C) concealed sprinkler used in corridors
5. 24 Nos. spray (57 deg. C) recessed pendent sprinkler used in areas with ceiling
6. 24 Nos. spray (57 deg. C) sidewall sprinkler used in residential areas
7. 12 nos. Spray (57 deg. C) (K=115) extended coverage sidewall sprinkler used in areas where room length is more than 6.3 m

117.6 SPRINKLER LINE TESTERS

A. Forged brass fitting with 1-inch female threaded inlet, 15 mm (1/2-inch nominal) threaded sprinkler outlet and 25-mm (1-inch nominal) make hose threaded, drain outlet with cap and chain. The drain valve shall be wrenched operated.

117.7 QUICK RESPONSE SPRINKLERS

A. Chrome plated brass, pendant type rated 57 deg. C

117.8 OPEN TYPE SPRINKLERS

A. Bronze standard pendant type

117.9 DELUGE STATION

A. General

1. Deluge assembly shall be externally re-settable by hydraulic means, and shall employ positive vent on the priming line to ensure that the deluge will not prematurely reset.
2. Deluge Valve: Shall low differential, latched closed spring assisted, self resetting, clapper, pneumatic, hydraulic or electric release. Deluge valve and trim shall be UL Listed and FM approved, for vertical or horizontal installation, supplied with grade "E" EPDM seal, housing cast of ductile iron conforming to ASTM A-536, grade 65-45-12, serviceable without removal from the line, flange ends for installation with ANSI class 150 flange rated service up to 300 psi (2065 KPa) working pressure.
3. Deluge valve shall be with wet actuation trim, provided with quartzoid bulb detector.

B. System Components

1. Isolating Valves: All bronze rising stem construction with screwed ends, Sold wedge and union bonnet.

2. Control valve: Cast iron body with bronze/stainless steel trim flanged ends, pilot operated diaphragm valve assembly complete with pressure gauges.

3. Heat Detectors

4. Manual emergency station

5. Control panel

6. Solenoid valve

7. Motor alarm gong

8. Proportional head (Venturi): Chrome plated brass inline conductor.

9. Foam Solution Tank:

   a. Foam bladder tank a component of a balance pressure foam system. The tank shell shall be constructed of steel complying ASME specifications, tensile strength not less than 70,000 psi. The circumferential, as well as the longitudinal body seam shall be machine welded. Bladder shall be manufactured of a vinyl based polymer or a polyester reinforced copolymer. The bladder material shall have an ASTM D-412 tensile strength of at least 3000 psi and an ASTM D-624 graves tear strength of at least 420 psi.

117.10 LANDING VALVES

A. 65 mm (2 ½ inch) nominal diameter landing valve located at each fire hose cabinet on car parks, corridors or at each mid landing of staircases as indicated on the drawings.

1. Pressure regulating type:

   a. These shall be used at levels where standpipe residual pressure exceeds 6.9 bars (100 psig) at inlet to the landing valve. The valves shall be factory calibrated to supply minimum 57 cu.m/hour (250 US GPM) at a pressure range of 4.5 to 6.9 Bars (65 to 100 psig) at the valve outlet.

   b. The valve shall be UL/FM approved. The body shall be cast brass with 65 mm diameter female threaded inlet, internal pressure regulator and 65 mm nom. dia. Female instantaneous outlet to BS 336.

117.11 FIRE HOSE

A. Fire hose shall be UL Listed/FM approved, for 65 mm (2-1/2 inch) and 40 mm (1-1/2 inch) and minimum 30 meter (100 ft). Fire hose shall be 100% polyester double jacket with synthetic rubber lining. Specifically designed for where abrasion resistance and high pressure required 100% virgin polyester yarn in both wrap, inner jacket twill weave plain waive on outer jacket, with applicable coupling to the local fire brigade connection.

B. Rubber hose 25 mm (1 inch) shall be non-kink rubber, hose has three ply with two synthetic rubber layers and a textile reinforcement working pressure of 15 bar.

117.12 COUPLINGS

A. Hose coupling shall be gunmetal, chrome plated instantaneous design to BS336, listed with Kitemark or LPCB approved.

117.13 FIRE HOSE RACK

A. Hose rack assembly shall be polyester coated steel; swivel type with water retention device and pins for 40 mm dia. at 30 meter length of hose. Provide escutcheon, rack nipple and hose coupling. Rack shall be UL 47 approved.

117.14 FIRE HOSE REEL (AUTOMATIC TYPE)

A. The hose reel drum shall be made of mild steel with the cabinet supported with reinforced support arm, which shall be chrome plated and swing through 180 degrees. Welding of any part on cabinet front shall not be allowed. The reels shall comply with BS-EN 671 and comprise a reinforced rubber hose, 25 mm dia. x 30 m long coiled on a revolving drum. The outer end of a hose shall be fitted with a "jet/spray/shut off" control nozzle. The inner end of the hose shall be connected through the reel to the water supply.

B. The reels shall incorporate a valve that automatically turns on the water supply when more than approximately 3 meter of hose is unreeled, and shut off again when the hose is re-wound onto the reel. A manual shut off valve of the wheel type shall also be installed on the service pipe to each hose reel.

C. The hose nozzle shall be (Jet spray/Shut off) type nozzle.

D. Each hose reel shall be installed and tested to BS 5274 and shall be deliver not less than 0.4 l/s when two top most reels are in use simultaneously providing a jet of approximately 6 meter in length. Pressure reducing devices shall be provided whenever necessary to limit the pressure as per local authority point requirement.

E. An instruction plate shall be supplied with each reel indicating the method of use in English and Arabic.

F. The hose reel shall be suitable for working pressure up to 4.5 bar and shall be installed in accordance with the manufacturer's instruction.

117.15 FIRE CABINETS

A. Cabinet shall be manufactured by an ISO-9001 manufacturing company and certified (e.g. BVQI, LPCB, UL or any reputed certifying bodies).

B. Fire hose cabinets, hose, valves, nozzle and coupling shall be approved and listed intended for fire use and shall be conformance with the requirement of the Authority Having Jurisdiction (Dubai Civil Defense) and provide where shown on the drawings in accordance with specification.

C. Where floor areas having block work enclosure fire hose cabinets shall be recessed frameless type as per the architect drawings. Door shall be made of 1.2 mm thick stainless steel design to hold the cladding of the same finish of wall. Hinges shall be of the same material from steel rods and welded to cabinet door. The cladding finish shall be of the same material of the wall and to the approval of the Architect.

D. Recessed fire hose cabinet shall be of 1.2 mm thick electro galvanized steel sheet. Fabricated that all joints shall be welded and ground smooth. Architrave trimming shall be 100 mm depth

of the same finish of the door. Hinges shall be solid pin type machined from steel rods and welded to cabinet door. Cabinet shall be electro static power coated painted, to RAL finish and to the architects approval. Cabinets shall be installed as shown in the drawings and where applicable.

E. Surface mounted fire hose cabinet shall be 1.5 mm thick electro galvanized steel sheet. Fabricated that all joints shall be welded and ground smooth, hinges shall be solid pin type machined from steel rods and welded to cabinet door. Cabinet shall be electro static powder coated painted to RAL 9010 and to the architect approval, Cabinets shall be installed as shown in the drawing and where applicable.

F. All fire hose and valve cabinets except ground floor lobby cabinet shall be clearly marked to indicate contents letters shall be red and shall be 65 mm in height visibly identified as per the requirement of NFPA-14 and to the approval of the Authority Having Jurisdiction (Dubai Civil Defense).

117.16 CONTENTS OF FIRE CABINETS (FHC)

A. 65 mm nom. dia. pressure reducing landing valve

B. 25mm/40mm nom. dia. automatic hose reel/hose rack, 30 m long with jet/spray nozzle suitable for 12 bars working pressure, complete with lock shield type isolating valve.

C. 6 Kg. DCP fire extinguisher

D. 6 Kg. CO2 fire extinguisher

E. 65 mm dia hose with nozzle

F. All fire cabinet use in the through penetration fire rated wall shall be UL fire rated cabinets with insulation materials UL classified to restore fire stop around penetrations.

117.17 PORTABLE FIRE EXTINGUISHERS

A. General

1. Fire extinguishers shall comply with NFPA-10 for installation.
2. The classification of fire extinguisher shall consist of a letter that indicated the class of fire on which a fire extinguisher has been found to be effective, preceded by a rating number (Class A and Class B only) that indicated the relative extinguishing effectiveness.
3. The distribution of fire extinguisher shall comply with prescribed requirements of NFPA-10, as shown on the drawings and specific requirements of the Local Civil Defense Authorities.
4. Cabinets housing fire extinguishers shall not be locked.
5. Portable fire extinguishers shall be maintained in a fully charges and operable condition, and kept in their designated places at all times when they are not being used.

117.18 DEFINITIONS

A. The type of extinguisher needed depends on the right type of fire that may occur in the room or building.

1. Class A Fires: Fires on ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

2. Class B Fires: Fire in flammable liquids combustible liquids, petroleum greasers, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

3. Class C Fires: Fire that involve energized electrical equipment where the electrical non conductivity of the extinguishing media is of importance. (Where electrical equipment is de-energized, fire extinguishers for class A or B fires can be used safely.

4. Class D Fires: Fires in combustible metals, such as magnesium, titanium, zirconium, sodium, lithium and potassium.

5. Class K Fires: Fires in cooking appliances that involves combustible cooking media (vegetable or animal oils and fats).

B. Building presenting Class B and C fire hazard shall be equipped with a regular number of Class A extinguishers dedicated to the building protection, and shall also be equipped with adding Class B or Class C extinguishers.

C. According to these definitions, all parts of the building shall be equipped with Class ABC type extinguishers. In the meantime, rooms such as Storages, Workshops and other rooms housing electrical equipments, shall be equipped with adding Class C extinguishers.

117.19 PRODUCTS

A. Water Fire Extinguisher: Shall have Kite mark approval and comply with BS-EN standard. The cylinder shall be special CRCA sheet with Argon/CO2 welding process factory tested to 30 bar.

B. Carbon Dioxide Fire Extinguisher: Shall have Kite mark approval and comply with BS-EN3 standards. The cylinder shall be made of high grade steel and shall have high gloss polyester finish. The cylinder shall be tested to 250 bar. Provide CO2 fire extinguisher of 5 Kg and the rating shall be 55 B.

C. Dry Powder Fire Extinguisher: Shall have Kite mark approval and comply with BS-EN3 standards. The cylinder shall be made special cold rolled steel sheet with Argon/ CO2 welding process and the rising pipe shall be made of Aluminium. The cylinder shall have minimum working pressure of 14 bar. Provide Dry Powder Fire extinguishing of 6 kg with 34 A and 183 B rating.

D. Wet Chemical Fire extinguishers: Shall have Kite mark approval and comply with BS:7937 standards. The cylinder shall be tested to 15 bar and shall have safety valve for maximum safety. The capacity shall be 6 liters with 75 F/13 A ratings. They shall be provided in all kitchens and as indicated in the drawings.

117.20 FIRE BLANKETS

A. Provide fire blankets in kitchens where indicated in the drawings. It should have BS Kitemark and should be LPCB approved. Fire blankets shall be manufactured from 430 gm/sq.m glass fiber material which shall withstand temperature up to 550 deg. C. The size be 4 ft. x 4 ft. x 6 ft.

117.21 WHEELED FIRE EXTINGUISHERS

A. Dry Powder: Large extinguishers with 50 Kg dry powder, external nitrogen cylinder for propelling the charge, 50 feet long flexible hose with suitable discharge nozzle etc. all mounted on a trolley with handle, brackets for winding the hose and solid rubber tyres. Suitable protective covers shall be provided for units exposed to the elements.

B. Carbon Dioxide: Large extinguishers with 50 Kg CO2 cylinder with screw down valve and bursting device, high pressure hose with extinguishing shower/snow pipe. All mounted on trolley with solid rubber tyred disc wheels.

117.22 FIRE BRIGADE BREECHING INLETS

A. Iron body, bronze mounted construction, with 150mm (6 inch) nominal diameter flanged bottom/back outlet, 4 nos. 65 mm (2-1/2 inch) nominal diameter, instantaneous male inlets with chain and cap, integral spring loaded check valve, drain valve etc. complete.

B. A non-return (check) valve shall protect the inlet. The coupling shall comply with BS336. The breeching inlet shall have BSI Kite Mark approval. The breeching inlet shall be housed box with wired glass door. Construction material for the cabinet shall be polished stainless steel.

117.23 FIRE BRIGADE BREECHING INLET CABINETS

A. Cabinet shall be manufactured by ISO9001 manufacturing company and duly certified e.g. LPCB, UL and others.

B. The inlet breeching unit shall be housed in an approved 1.2 m stainless steel 316 L polished finish, flush box with wired glass glazed front panel or as per Architect requirement and:

1. Conspicuously indicated by words: "FIRE BRIGADE – "SPRINKLER SYSTEM" or "STANDPIPE SYSTEM" in block letters on inner face of the glass, both on English and Arabic.

2. Fastens only by means of a spring lock, which can also be operated from inside without the aid of a key after the glass has been broken.

3. Made large enough for hose to be connected to inlets even if the door cannot be opened and the only means of access is by breaking the glass.

C. The box shall be built into the structure with a fall of one in 12, from the rear of the base to the front of the base. Construction material for the cabinet shall be polished finished stainless steel.

117.24 FLOW SWITCHES

A. Provide vane type flow switches with volt free, normally open contacts rated for 5 amps at 250 volts A/C (max) and enclosure with tapped conduit entry. The flow switch shall be adjustable, to give contact at flow equal to that of one sprinkler. The unit shall be completed with pipe size saddle, clamp, sealing gasket etc.

117.25 AUTOMATIC AIR RELIEF VALVES

A. Bronze body with non-ferrous float and internal working parts. Construction shall be take-apart type for easy maintenance. Outlet shall be tapped for connection to drain line.

117.26 AUTOMATIC BALL DRIP

A. All bronze, with male threaded inlet and female threaded outlet.

117.27 PRESSURE REDUCING VALVES FOR HOSE REEL SUPPLY

A. Angle reducing vales for hose reel pilot controlled, diaphragm type, normally open valve of cast iron construction with flanged ends; UL listed for fire protection services. The trim and pilot assemble shall be of brass/bronze/stainless steel and pressure setting shall be made with a

single screw, housed in a screw on, sealable housing. Wetted areas of the valve body shall be epoxy coated. The assembly shall be complete with shut off valve, strainer, pressure gauges, size adjustment spools, etc.

117.28 VACUUM RELIEF VALVES

A. Pressure type vacuum relief valve, diaphragm operated with large parts to admit air to the pipe when line pressure is below atmospheric. Cast iron body with bronze trim, nylon reinforced diaphragm and threaded ends.

PART 118 - EXECUTIONS

118.1 INSTALLATION CONTROL VALVE

A. Isolating Check Valve Assembly: Shall be enclosed in tamper proof wire mesh cage with steel angle frame work, anchored to wall, where exposed.

118.2 ALARM CHECK VALVE

A. Alarm check valves shall be provided with internally and externally galvanized trim piping and fittings, pressure gages, a retarding chamber, water motor gong, alarm switch, testing bypass, and all necessary pipe, fittings and accessories.

B. The retarding chamber drain line shall be piped independently of the main drain line.

C. The drain line from water motor gong shall be piped to discharge through the wall as close to the grade line as possible.

D. Piping between the alarm check valve and a pressure actuated alarm initiating device shall be galvanized piping not less than 3/8 inch nominal pipe size.

E. Piping supplying the retard chamber, water motor gong, and associated drains shall be galvanized. Galvanized fittings are to be used where galvanized piping is required.

118.3 FLOOR CONTROL ASSEMBLIES

A. The use of 65 mm (1 ½ inch) nom. size valve with adjustment spool be permitted up to 100 mm (4 inch) nom. line size.

B. The system drain line shall be connected to the nearest drain (waste water or storm water systems only) through an approved air gap fitting.

C. The power supply and alarm unit shall be arranged to have its power supply drawn from the automatic standby power supply system.

D. Suitable access covers shall be provided in the shaft wall for floor control stations/sprinkler supply isolating valves, where required.

118.4 SPRINKLERS

A. Do not install sprinklers, until after the complete system has been flushed.

B. Do not install sprinklers which are contaminated with paints or similar coatings, that are once installed and removed for any reason and those which are dropped or have visible physical damage.

C. Use only wrenches, supplied by the sprinkler manufacturer for installing the sprinkler.

D. Use adjustable return drops with threaded fittings for installing sprinkler in areas with false ceiling.

E. Do not exceed 30 cm length for standpipes or drop pipes for installing sprinklers, where so required.

F. Install guards on sprinklers prone to mechanical damage.

1. Install sheet metal water shields on sprinklers located near electrical or other equipment prone to damage from water.

G. Provide additional sprinklers at the underside of HVAC ducts wider than 80 cm.

H. Accurately align sprinkler heads in hung ceiling areas symmetrically with diffusers, grilles, lighting fixtures and ceiling tiles.

I. Install heads in center tiles/coordinated with architectural design this may result in additional heads which shall be provided at no additional cost unless otherwise indicated.

J. Sprinkler shall not be installed closer than 1800 mm apart.

K. Where suspended ceiling are installed, the sprinkler contractor shall install pendent sprinkler as shown on the reflected ceiling plans. Where these plans do not specify the location of the pendent sprinklers, the Contractor shall obtain the original reflected ceiling plans, and design sprinkler locations at least 150 mm from ceiling tile edges, (dimension the location) and 750 mm from HVAC supply diffuser. If a sprinkler lands within 750 mm of the HVAC supply diffuser the contractor shall install an intermediate temperature rated sprinkler. Locate sprinklers along straight lines to the extent possible, follow a repetitive pattern. Pendent sprinklers shall be installed by means of an approved flexible application (such as flex head or approved equal), or return bends from 25 mm outlet tees in branch lines.

118.5 DELUGE VALVE

A. Proper operation of the Deluge valve depends upon its trim being installed in accordance with manufacturer's instruction.

B. The dry pipe valve and associated trimmings shall be installed in a readily visibly and accessible location.

C. All nipple, fittings, and devices must be clean and free of scale and burrs before installation. Use pipe thread sealant sparingly on male pipe threads only.

118.6 FIRE CABINETS

A. Provide wooden framing of correct size, extending to the plaster finish on all recessed fire cabinets, secure fire cabinets in wall by screws, at the wooden frame.

B. Provide steel angle base supports for taking up the weight of cabinets installed in shaft walls.

C. Cut openings in fire cabinets using appropriate tools. Provide rubber grommets at these openings to prevent rattling and entry of dust.

D. Provide boxed sheet metal stiffeners or external, supporting steel framing for installing hose reels and similar items.

118.7 LANDING VALVES

A. Schematic riser diagrams, clearly indicating the identification number of each landing valve, their elevations with respect to the pump center line and maximum pump discharge pressure etc. shall be furnished to the manufacturer of pressure reducing type valves for the purpose of calibrating these landing valves.

B. Pressure reducing type landing valves installed at site shall be calibrated at the factory and sealed and tagged to this effect.

118.8 AUTOMATIC AIR RELEASE VALVES

A. Provide access doors in shaft walls, where installed in inaccessible places. Provide drain pipe to convenient location.

118.9 AUTOMATIC BALL DRIP

A. Provide at the lowest point in piping between the Fire Brigade Breeching inlet and the check valve on the system side and un-drainable parts of the system piping.

118.10 SPRINKLER LINE TESTERS

A. Provide one per every distribution main in the sprinkler system, for testing purposes, in accessible locations. Provide this fitting for the last sprinkler on all the ranges which are not drainable from the ICV.

118.11 FLOW SWITCHES

A. Install on sprinkler supply mains or cross mains covering areas requiring separate indication of sprinkler operation and where indicated in drawings.

118.12 VACUUM RELIEF VALVES

A. These shall be installed on top of express risers connecting high level water storage tanks to the fire protection piping.