SECTION 22 00 00

PLUMBING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Service Connections to External (City) Utilities

B. Water Storage, Filtration and Transfer

C. Sanitary Cold/Hot Water Supply

D. Soil, Waste and Vent System

E. Storm and Waste Water Drainage

F. Sanitary Fixtures

G. Plumbing Equipment

H. Water Features

I. Swimming Pools

J. Insulation for Piping and Equipment

K. Electrical Works

L. Commissioning of Plumbing System

1.02 RELATED SECTIONS

A.	Divsion1	General Requirements
B.	Division 3	Concrete works
C.	Division 9	Finishes and Paintings
D.	Section 21 00 00	Fire Suppression
E.	Section 22 05 00	Common Work Results for Plumbing
F.	Section 22 05 13	Common Motor Requirements for Plumbing Equipment
G.	Section 22 05 16	Expansion Fittings and Loops for Plumbing Piping
H.	Section 22 05 19	Meters and Gages for Plumbing Piping
I.	Section 22 05 23	General Duty valves for Plumbing
J.	Section 22 05 29	Supports and Hangers For Plumbing Piping and Equipment
K.	Section 22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
L.	Section 22 05 53	Identification for Plumbing Piping and Equipment
M.	Section 22 07 00	Plumbing Insulation
N.	Section 22 11 16	Domestic Water Piping
O.	Section 22 11 19	Domestic Water Piping Specialties
P.	Section 22 11 23	Domestic Water Pumps
Q.	Section 22 13 16	Sanitary Waste and Vent Piping
R.	Section 22 13 19	Sanitary Waste Piping Specialties
S.	Section 22 13 29	Sanitary Sewerage Pumps
T.	Section 22 14 13	Facility Storm Drainage Piping
U.	Section 22 14 23	Storm Drainage Piping Specialties

V.	Section 22 14 29	Sump Pumps
W.	Section 22 32 00	Domestic Water Filtration Equipment
X.	Section 22 33 00	Electric Water Heaters
Y.	Section 22 40 00	Plumbing Fixtures
Z.	Section 22 42 00	Commercial Plumbing Fixtures
AA.	Section 26 00 00	General Provisions for Electrical Installation
BB.	Section 32 80 00	Irrigation
CC.	Section 33 11 13	Water Utility Distribution Piping
DD.	Section 33 30 00	Sanitary Sewerage Utilities
EE.	Section 33 40 00	Storm Drainage Utilities
FF.	Section 33 52 00	Liquid Fuel Distribution

1.03 REFERENCES

A. Requirements of the Codes, ordinances, rules and regulations of the State of Kuwait and its lawful enforcement agencies shall be conformed to the followings, as mentioned hereunder:

1. Ministry of Public Works (MPW), Kuwait – General Specifications for Building and Engineering Works, Volumes I and II, 1990
2. Ministry of Electricity and Water (MEW), Kuwait (Latest editions)
    a. Codes of Practice and Energy Conservation (MEW – R6)
    b. Guidelines for Design of Water Distribution System (MEW Water Department.)
3. Ministry of Health (MOH), Kuwait
4. Environmental Public Authority (EPA), Kuwait
5. Kuwait Fire Force (KFF), Kuwait
6. Kuwait National Petroleum Company (KNPC), Kuwait

B. Requirements of the following International Standards shall be conformed to, as appropriate:

1. International Plumbing code of USA
2. National Plumbing Code of USA
3. Uniform Plumbing Code of USA
4. American Society of Plumbing Engineers(ASPE,) USA
5. Charted Institute of Building Services Engineer (CIBSE)
6. Recommendations of the British Institute of Plumbing
7. American Society of Testing and Materials (ASTM)
8. American Society of Mechanical Engineers (ASME)
9. British Standards Institute (BSI)
10. Occupational Safety and Health Administration (OSHA)
11. Underwriters Laboratories (UL) Inc
12. American Society of heating, Refrigerating and Air-Conditioning Engineering (ASHRAE)
13. National Fire Protection Association (NFPA)

1.04 SUBMITTALS

A. General: Product data, samples and shop drawings shall be submitted in accordance with the General Conditions of Contract. All submissions for approval shall be submitted sufficiently in advance of requirements to allow the Engineer ample time for checking and approving.

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

C. Product Data:

1. Manufacturer's Data: Prior to the submission of shop drawings, submit to the Engineer full details, specifications, installation instructions, tc., of all materials and equipment proposed for use but in all cases no such materials/equipment shall be ordered, delivered or installed without the prior written approval of the Engineer to the Contractor's shop drawings incorporating the said materials/equipment. Any material or equipment which is not approved but installed shall be removed and replaced at the Contractor's expense.

2. The details of materials and equipment shall include the following:

a. Full technical specifications of equipment including construction, materials, degree of protection, characteristic curves, test and performance certificates of equipment, diagrams, capacities, rating, dimensions, fixing details, etc.

b. Relevant sheets of manufacturers' catalogues, specifications, technical data, etc.

c. The estimated current consumption and heat dissipation of any equipment proposed.

d. Maintenance and supervisory statistics as approved by others for similar systems.

3. At the time of providing the above details submit a statement from manufacturer to the effect that the proposed materials, equipment and systems' performance and functions comply fully with the relevant Clauses of the Specification and, in case of deviation from the Specification, submit a schedule of deviations listing all points not conforming to the Specification.

4. At the same time submit a preliminary time schedule to indicate all logistical elements (i.e. design, submission for approved, ordering, shipping, delivery, installation, etc.).

D. Shop Drawings:

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

2. Equipment installation and piping layout, double line drawings off toilets, bathrooms, kitchens, plant rooms, sump pumps, etc. Clearly indicating all fittings, supports, valves etc. to a scale of 1:20. Submit sections and wall elevations as appropriate.

3. Typical floor plans indicating shafts, risers locations etc. to a scale of 1:50.

4. Builder's work layout plans to a scale of 1:100/1:50 as above along with shaft detail plans to 1:10.

5. Assemblies like pressure reducing valves and items of similar nature to a scale of 1:10.

6. Vacuum breakers, hydrants, air release valves, sleeves and penetrations, all types of drains and clean outs, etc. to a scale of 1:5.

7. Equipment like filters, water heaters and items of similar nature to a scale of

1:20.

8. Electrical wiring diagrams (NTS) and panel installation details (1:20).

9. Calculations / details to substantiate the shop drawings.

E. Progress record Drawings: Submit project record documents of all works installed under this section, in accordance with the following:

1. Furnish and keep on the job at all times one complete and separate set of blackline prints of the plumbing work on which shall be clearly, neatly and accurately noted, promptly as the work progresses all plumbing changes, revisions and additions to work as actually installed. Wherever work is installed other than as shown on the Contract Drawings, such changes shall be noted.

2. Indicate daily progress on progress prints by colouring in the various pipes, fixtures, apparatus and associated attachments as they are erected.

3. No approval for payment of work installed will be given unless supported by coloured-up record prints as required above.

F. “As-built” Drawings:

1. At the conclusion of work, prepare and submit “as-built” Drawings prepared from the latest progress prints.

2. Contractor shall prepare as-built drawings and submit and obtain approval from MPW, PART, MEW, KFF, etc., for the respective services. Necessary follow-up, calculations shall be submitted by the Contractor as required by these authorities.

G. Operation and Maintenance Instruction Manuals

1. Three (3) hard bound copies of "Operation and Maintenance Manual" shall be submitted in accordance with the General Conditions of Contract, with complete data for each piece of equipment installed, as detailed below:

2. Manual shall contain:

a. Table of contents

b. Plumbing material submittal with the Engineer's and local authorities’ approval

c. Manufacturer's installation instructions

d. Manufacturer's internal wiring diagrams

e. Manufacturer's assembly details

f. Replacement parts, number listings and description

g. Preventive maintenance schedules listing frequency of service and or replacement.

h. Lubrication materials, equivalents and schedules

i. Names, addresses and telephone and fax numbers of manufacturers, sales and service agencies and local representatives / distributors

j. Contact details of Contractor's maintenance department, including emergency contact telephone numbers

3. Contents of the manual shall be arranged in sections with tags, grouping each class of equipment as pumps, fixtures, water heaters, filters, controls, etc.

4. Contents of each section shall be arranged in the sequence as listed above.

5. Comprehensive, priced list of tools and spare parts, clearly cross-referenced with As-Built Drawings and Operation and Maintenance Manuals; as recommended by the manufacturer. Prices offered shall be valid during the

maintenance period.

1.05 QUALITY ASSURANCE

A. Materials used shall carry specific listing / approval for Plumbing Services by approved international agencies.

B. Systems and components described herein and detailed in the drawings are intended to perform stipulated service, in compliance with reference standards. Contractor shall, in his tender, highlight and allow for alterations / modifications to the system or the system components; which in his opinion are necessary to accomplish the intended purpose.

C. Materials

1. Materials incorporated in the work covered by this Section shall be unused, new products in good condition. Materials spoiled due to improper storage or mishandling shall be rejected

2. Materials of similar nature shall be products of the same manufacturer. Mixing up products of different standards or those of different manufactures shall not be permitted for the same service

3. No acoustic insulation or sound-deadening material manufactured from any form of animal hair shall be used in the project

4. Materials to equivalent British (BS), German (DIN), or Japanese (JIS) or other international standards shall be acceptable, provided that the Contractor substantiates their equivalence and ensures their compatibility with other components of the system. Copies of the current version of the reference standards shall be submitted for comparison, if required by the Engineer.

5. Test certificates for materials used in the work covered by this Section, from approved independent laboratories or testing agencies shall be furnished at no extra cost if required by the Engineer.

6. Requirements of product quality, workmanship, materials etc. are identified by a known product of a particular manufacturer and is written as “Ref.: …….”.

D. Protection against corrosion / environmental effects

1. Equipment / system components shall be coated with epoxy and / or given other appropriate treatment at the factory to resist deleterious effects of any adverse environment, prevailing at the site. Contractor shall allow for conducting necessary tests and / or investigations for establishing the degree of such protection and additional cost thereof

2. Copper alloy(s) used for manufacturing valves, pipe-fittings, sanitary fittings, plumbing specialties etc., which comes in contact with water, shall be dezincification resistant type

1.06 QUALIFICATIONS

A. Works covered by this Section shall be executed by a contractor having:

1. Engaged in the installation and maintenance of Plumbing systems as primary business for at least ten (10) immediately preceding years.

2. Approved by relevant Authorities.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

C. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

D. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.07 PRE-INSTALLATION MEETINGS

A. Refer and comply with Division 1– Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.08 CLOSEOUT SUBMITTALS

A. Refer and comply with Division 1– Closeout Submittals

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Refer and comply with Division 1- Product Requirements for Product storage and handling requirements.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 SYSTEM INTERFACES

A. Electrical power supply requirement and connections to Plumbing Services equipment/components shall be coordinated with electrical contractor. Any additional Electrical power supply required during equipment selection shall be coordinated with electrical contractor and execute the complete system without any additional cost and time.

B. BMS interfacing relays and provisions shall be coordinated with BMS specialist contractor and provide the required interfacings components as part of the fire protection equipment.

1.11 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. Information as to the general construction shall be derived from Architectural and Structural drawings and specifications only.

B. Limitations or exclusions in the language used in drawings or specifications shall not be interpreted to mean that accessories or appurtenances required to install, operate or maintain equipment of systems are to be omitted.

C. Symbols or schematic diagrams, used to indicate work, shall neither have any dimensional significance nor delineate every item required for the intended installation.

D. Work shall be installed in accordance with the diagrammatic intent expressed in drawings, in conformity with dimensions indicated in Architectural / Structural drawings and equipment shop drawings.

E. Details that are specific regarding dimensioning and positioning of work are intended for establishing general feasibility and not to obviate field co-ordination of the work indicated.

F. In the event that HVAC/Mechanical Sub-contractor’s select equipment/machinery whose electrical power requirements are different from that mentioned on the contract MEP drawings/documents, then the HVAC/Mechanical Sub-contractor’s shall bear the cost of all electrical variation works arising as a consequence of this selection.

1.12 ELECTRICAL WORKS - GENERAL

A. Requirements of Sections 22 05 13 and 26 00 00 shall be referred to for details of system power supply, selection of system components and fabrication / installation of control panels and Motor Control Centers.

B. Electrical schematic drawings shall be referred to and complied with in respect of power distribution.

C. Details of control panels, where specified, are intended for defining the requirements, but not to limit other safety measures / components which are required by the codes and standards.

1.13 GUARANTEES AND WARRANTIES

A. Refer and Comply with Division1 – Closeout Submittals for product warranties and product bonds.

B. Contractor shall provide guarantee and warranty for a period of Two (2) years minimum from the date of substantial completion, for all the equipment and material used in the Plumbing Division 22 and other mechanical systems. This warranty shall include replacement of the equipment and material that have defective workmanship, leakage, breakage or improper.

C. Contractor shall execute and furnish the Owner with additional / extended warranties, in accordance with the requirements as mentioned in respective specification sections and of the General Conditions of Contract, where stipulated, prior to and as a pre-condition to the issuance of Completion Certificate.

1.14 EXTRA MATERIALS / SPARE PARTS

A. Refer and Comply with Division1 – Closeout Submittals for Spare parts and maintenance products.

B. Contractor shall supply spare parts as listed in the respective specification sections for all the equipment and material for two years' operation as minimum.

C. Spare parts supplied under this clause shall be provided in original packing, referenced to the Operation and Maintenance manual and clearly labeled.

D. Tools and spare-parts supplied under this clause can be used by the O & M Contractor during the maintenance period with the written permission of the Employer but shall replenish the stock and hand over all the spare parts as per list at the start of O & M period. (Contractor shall procure spare parts, tools, consumables etc. required to fulfil his obligations to operate and / or maintain the systems in the Contract maintenance period).

PART 2 - SYSTEM DESCRIPTION

2.01 FRESH WATER STORAGE, FILTRATION AND TRANSFER

A. A GRP break tank located at the basement level will receive inflow from the external fresh water mains located at the site through self-cleaning in-line filters. The potable water will then be pumped to the GRP water tank placed at the roof level.

B. Packaged booster pump sets pump this water through cartridge filters to the building facilities.

2.02 SEWERAGE

A. Sanitary fixtures installed at all levels in the main building will be drained by gravity to city sewage network through external site sewerage system.

B. Sanitary fixtures installed at basement 1 level will be drained by using a sewage ejector pump (located in basement 1) to external sewage network.

C. Inspection chambers (house trap), with fresh air inlet will be provided at the project side of every service connection, before entering a public sewer.

2.03 STORM AND WASTE WATER DRAINAGE

A. Storm and wastewater discharges from Ground level & all levels above the ground level in the main building will be drained by gravity to external storm water network.

B. Overflow and drain of sanitary water storage tank, and all other waste water in the basements will be discharged by gravity to waste water sump pits in the basements containing sump pumps which in turn pumps it to the city storm water network.

2.04 PIPE SUPPORTS

A. The Contractor shall provide pipe supports, racks, including all civil, steel structure, painting works as indicated on the drawings all services of Division 21, 22, and 23 (HVAC, Plumbing, Fire Protection) and Division 26 – Electrical Works in the following areas.

1. Mechanical Rooms
2. All Interstitial Floors and Mechanical Floors.
3. All Vertical Risers.
4. All Trenches.

PART 3 - EXECUTION

3.01 COORDINATION

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

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

C. Power requirements and location and type of the interface shall be coordinated with the electrical works of the project. Information as required by MEW, for obtaining approvals, shall be furnished.

D. Contractor shall furnish templates, patterns, setting out plans and other items for incorporation in the works of other trades and ensure timely placement of sleeves, inserts and the like.

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

F. Sufficiency of dimensions of plant areas, doorways etc. and suitability of slabs and other structural members for placement, operation and maintenance of equipment shall be ensured.

G. Contractor shall resolve conflicts in requirements with other trades and only those, which cannot be solved without changes to structure or system design shall be referred to the Engineer.

H. Hooks, rails or other items shall be provided to allow for the hoisting or movement of equipment in plant areas.

I. Data on heat loss to surroundings from equipment, in air-conditioned areas, shall be furnished to the HVAC trade.

J. Contactor shall furnish drawings and schedules detailing locations, sizes and functions of all required access panels and / or doors (minimum size of 00x00 mm), on walls and in ceilings (Minimum size 600x600 mm) as required for operation and maintenance of concealed equipment, valves, controls etc. to relevant trade(s) for incorporation.

3.02 INSPECTION, TESTS AND ADJUSTMENTS

A. During manufacture (at Contractor's premises only), installation and after completion of works; the system, sections of the system or its components shall be tested by the Contractor / specialist Subcontractor in the presence of the Engineer, as directed below

or elsewhere. Contractor shall procure all testing instruments and accessories and bear all costs in connection with the same:

1. Basic materials for conformity with the specified standards
2. Supports and anchors for ability to withstand required loads
3. Piping in general for line, level and slopes
4. Pumping equipment for the specified flow, head, controls, safety interlocks and alarms; noise criteria, etc.
5. Heat transfer equipment for full load capability, controls, safety interlocks, and alarms and operation of safety valves
6. Filtration equipment for flow, head loss, filtration fineness, controls, alarms, regeneration etc.
7. Control system for operating ranges, tolerances, cut-out, alarms etc.
8. Sanitary fixtures for operation of fittings and proper fixation
9. Water supply systems for required flow and pressure at outlets, simulated peak flow conditions (open sectional control valves with estimated number of outlets in open condition, in series)
10. Drainage systems for simulated peak-flow conditions and performance of trap seals (by simultaneous discharge of all water closets on the stack or groups)

B. Following items / systems shall be balanced / regulated:

1. Pressure switches for cut in and cut out pressures
2. Float switches for cut-in and cut-out levels
3. Operation and retention periods of timers and time switches
4. Globe valves on pump discharge for design flow
5. Balancing valves in circulating systems for equal or proportionate flow
6. Thermostats for cut in cut out temperatures or range
7. Angle valves on fixture supply for regulated flow

3.03 UTILITY CONNECTIONS

A. Contractor shall co-ordinate with the relevant governmental agencies, obtain all necessary information on available utility mains, obtain approvals and permits and pay all fees and expenses in this respect.

1.	Fresh water	MEW (Water Department)
2.	Sewerage	MPW (Sewerage Section)
3.	Storm water	MPW (Roads and Drainage Section)

B. Contractor shall prepare coordinated working drawings and application forms with all required information, submit to the relevant authorities and obtain their approval.

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

D. Manholes within and outside the site boundary (on the utility line or otherwise) shall be executed to MPW standards, in all respects.

E. Drop connections shall be executed on the inlet to sewerage manholes when the drop exceeds 1600 mm* and benching shall be provided at the manhole bottom.

F. Drop connections shall be executed at the inlet to storm water manholes, when the drop exceeds 1500* mm. Benching shall be provided at the bottom, where required.

*These figures to be rechecked & confirmed with government agencies at the time of

execution.

3.04 SYSTEM DEMONSTRATIONS

A. Services of a competent engineer shall be provided by the Contractor to supervise the commissioning of all equipment and to train the Owner's personnel in all aspects of the same during a six (6) working days' period, during normal working hours; after substantial completion of the project.

B. A minimum of one week's written notice shall be given and the Owner's written consent obtained, prior to such demonstrations.

C. Contractor shall co-ordinate with the relevant governmental agencies; prepare / submit application(s) for required services; pay all fees and expenses; facilitate their visit to site; test and demonstrate the system for their approval; obtain approvals and submit the same to the Owner.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Piping materials and fittings

B. Joining materials

C. Dielectric fittings

D. Mechanical sleeve seals

E. Piping Specialties

F. Grouting

G. Piping Insulation

H. Equipment Installation

I. Concrete Bases

J. Erection of Metal Supports

K. Erection of Wood Supports

L. Cutting and Patching

M. Grouting

N. Fire Stopping material

O. Protection against Corrosion

1.02 RELATED SECTIONS

A. Division 1 General Requirements

B. Division 3 Concrete works and Cast-in-Place Concrete

C. Division 6 Rough Carpentry

D. Division 7 Sheet Metal Flashing and Fire stopping

E. Divsion8 Access Doors and Frames

F. Division 9 Finishing and Paintings

G. Division 22 Plumbing Works

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: 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 plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.

2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.
4. PB: Polybutylene plastic
5. PE: Polyethylene plastic

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.

1. Product Data: For dielectric fittings, flexible connectors, plumbing sleeve seals, and identification materials and devices.
2. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
   a. Planned piping layout, including valve and specialty locations and valve-stem movement.
   b. Clearances for installing and maintaining insulation.
   c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
   d. Equipment and accessory service connections and support details.
   e. Exterior wall and foundation penetrations.
   f. Fire-rated wall and floor penetrations.
   g. Sizes and location of required concrete pads and bases.
   h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
   i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.05 QUALITY ASSURANCE

A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting plumbing and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases.

1. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design requirements. See drawings for equipment schedules and requirements.

1.06 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 prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate plumbing equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13"Access Doors and Frames."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.08 POSTED OPERATING INSTRUCTIONS

A. Provide and post operating instructions for all plumbing systems.

1.09 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements and as per approval of the Engineer.

B. Acceptable manufacturers

1. Metraflex, USA

2. Flexonics, USA

3. Mason, UK

4. Or other equal and approved under provisions of the General Conditions of Contract.

2.02 PIPE AND PIPE FITTINGS

A. Refer to individual Divisions 22 piping Sections for pipe and fitting materials and joining methods.

1. Section 22 11 16Domestic Water Piping.

2. Section 22 13 16 – Sanitary Waste and Vent Piping.

3. Section 23 11 23 – Facility Natural Gas Piping.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed

below.

B. Refer to VOC limit tables in Section 01 81 19 “Indoor Air Quality Requirements” for VOC limits for adhesive and sealant products in this Section.

C. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

D. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

E. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

F. Solder Filler Metals: ASTM B32.

1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.

2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.

3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.

4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.

5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.

G. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.

2. BAg1: Silver alloy.

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

H. Solvent Cements: Manufacturer's standard solvent cements for the following:

1. ABS Piping: ASTM D2235.

2. CPVC Piping: ASTM F493.

3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.

4. PVC to ABS Piping Transition: ASTM D3138.

I. Plastic Pipe Seals: ASTM F477, elastomeric gasket.

J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.

K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.

1. Sleeve: ASTM A126, Class B, gray iron.

2. Followers: ASTM A47 malleable iron or ASTM A536 ductile iron.

3. Gaskets: Rubber.

4. Bolts and Nuts: AWWA C111.

5. Finish: Enamel paint.

2.04 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

2. Insulating Material: Suitable for system fluid, pressure, and temperature.

B. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.

D. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Provide separate companion flanges and steel bolts and nuts for 150-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.05 PLUMBING SLEEVES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.

2. Stainless Steel Pipe: Welded pipes, Schedule 40, Stainless steel 316 L pipes, ASTM A778, bevel or plain ends for concrete water tanks.

3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

a. Underdeck Clamp: Clamping ring with set screws.

B. Type # 1 (for pipes through fire rated and fire resistive floors and walls): Schedule 40 galvanised steel pipe sleeve; packed with 96 kg/m3 (6 lbs/ft3) density fibreglass and caulked with approved fire rated sealant at both ends. Manufactured, proprietary products may be used for plastic drainage systems.

C. Type # 2 (for pipes passing through non-fire rated beams, walls, footings and dry floors): Schedule 40 galvanised steel pipe sleeve; packed with 96 kg/m3 (6 lbs/ft3) density fibreglass and caulked with approved type sealant at both ends. Sleeve shall be extended 50 mm (2 inch) above the finish floor level, for vertical piping.

D. Type # 3 (for ferrous pipes passing through external retaining walls): Schedule 40 galvanized steel or ductile iron with integral puddle; packed with 96 kg/m3 (6 lbs/ft3) density fibreglass; caulked at the inside end with approved sealant and at the outside end with hemp yarn and lead.

E. Type # 4 (for cast iron drain, waste and vent piping through wet floors): PVC pipe sleeve or wooden box to form the opening. After curing of the concrete this sleeve shall be removed and on completion of cast iron pipe installation, the opening shall be filled with non-shrinkable grout and both sides of slab shall be trowelled smooth and level.

F. Type # 5 (for pipes passing through roof slab): Flashing sleeve with integral flashing flange for waterproofing membrane.

G. Type # 6 (for pipes passing through RCC water storage tanks): Stainless steel 316L pipe with integral puddle of stainless steel 316L..

2.06 PIPING SPECIALTIES

A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.

1. ID: Closely fit around pipe, tube, and insulation of insulated piping.

2. OD: Completely cover opening.

3. Cast Brass: Split casting, with concealed hinge and set screw.

a. Finish: Polished chrome-plate.

4. Cast-Iron Floor Plate: One-piece casting.

B. Grout:

1. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.

a. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.

b. Design Mix: 5000-psig, 28-day compressive strength.

c. Packaging: Premixed and factory packaged.

2.07 ESCUTCHEONS

A. Setscrew type escutcheons, with size sufficient to completely cover exposed penetrations shall be provided at all pipe penetrations. This shall be finished with prime coat where adjoining surface is to be field painted, with baked enamel white finish where adjoining surface is fibre board and chrome finish where adjoining surface is tiled with ceramic, marble, etc.

2.08 FLASHING

A. Metal flashing: 0.5 mm (26 gauge) thick galvanised steel.

B. Lead flashing: 24.5 kg/m2 (5 lb/ft2) sheet lead for waterproofing; 5 kg/m2 (1 lb/ft2) sheet lead for soundproofing.

C. Flexible flashing: 1.25 mm (49 mil) thick synthetic sheet, compatible with roof and wall waterproofing.

D. Caps: Galvanised steel, 0.8 mm (22 gauge) minimum; 1.5 mm (16 gauge) at fire resistant elements.

2.09 FIRE STOPPING SYSTEM

A. DEFINITIONS

1. Fire stopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

B. Fire Stopping Material

1. Fire stopping Materials: ASTM E119 / ASTM E814 / UL 263 / UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating. Ratings may be 3-hours for fire stopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

2. Fire stopping Materials: ASTM E119 / ASTM E814 / UL 263 / UL 1479 to achieve fire ratings of adjacent construction / noted in Schedule at end of this section. In

accordance with FM / UL / WH Design Numbers noted on Drawings / noted in Schedule at end of this section.]

3. Fire stop interruptions to fire rated assemblies, materials, and components.

C. Performance Requirements

1. Fire stopping: Conform to FM/UL code for fire resistance ratings and surface burning characteristics.

2. Fire stopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

D. ENVIRONMENTAL REQUIREMENTS

1. Refer and comply with Division01 - Product Requirements: Environmental conditions affecting products on site and VOC limits for adhesive and sealant products in this Section.

1. Do not apply fire stopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).

2. Maintain this minimum temperature before, during, and for minimum 3 days after installation of fire stopping materials.

3. Provide ventilation in areas to receive solvent cured materials.

E. FIELD MEASUREMENTS

1. Verify field measurements prior to fabrication.

F. PROTECTION AGAINST CORROSION / ENVIRONMENTAL EFFECTS

1. Contractor shall investigate and conduct necessary tests, establish the degree of protection required and allow for such tests and protection
2. Dielectric fittings (insulating materials in the form of non-metallic fittings or joint rings) shall be incorporated at all connections between copper and ferrous (or other dissimilar metals) pipe work and / or equipment in order to prevent electrolytic corrosion
3. Copper alloy(s) used for manufacturing valves, pipe-fittings, sanitary fittings, plumbing specialities etc., which comes in contact with water, shall be dezincification resistant type
4. Equipment / system components shall be coated with epoxy and / or given other appropriate treatment at the factory to resist deleterious effects of any adverse environment prevailing at the site
5. Fasteners and accessories (screws, bolts, nuts, washers etc):
   a. These shall generally be of ferrous construction made resistant to corrosion by finishes like sheradizing, electro-galvanising, cadmium plating etc., unless otherwise stipulated
   b. Fasteners submerged under water, buried under earth and similar applications prone to corrosion shall be of corrosion resistant materials like stainless steel or high tensile brass
6. Wherever stainless steel is specified for resistance to corrosion from contact with water, the type used shall be AISI 316L or better, unless otherwise stipulated

PART 3 - EXECUTION

3.01 PIPING SYSTEMS – COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specifies otherwise. Individual Division 22 piping Sections specifies unique piping installation requirements.

B. General Locations and Arrangements: 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 as required by Division 01 Sections and as outlined in Part 1 of this section.

C. Install piping at indicated slope.

D. Install components with pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

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

L. Install couplings according to manufacturer's written instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.

2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.

3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.

4. Insulated Piping: Cast brass with concealed hinge, set screws, and chrome-plated finish.

5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

3.02 INSTALLATION-SLEEVES

A. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

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

a. Exception: Extend sleeves installed in floors of plumbing equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.

2. Build sleeves into walls and slabs as work progresses.

3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

4. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

B. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
3. Assemble and install plumbing mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

3.03 INSTALLATION – FIRE STOPPING

A. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials.

B. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring fire stopping.

C. Apply primer where recommended by manufacturer for type of fire stopping material and substrate involved, and as required for compliance with required fire ratings.

D. Apply fire stopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

E. Compress fibered material to maximum 40 percent of its uncompressed size.

OR

F. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

OR

G. Place intumescent coating in sufficient coats to achieve rating required.

H. Remove dam material after fire stopping material has cured. Dam material to remain.

I. Fire Rated Surface:

1. Seal opening at floor, / wall, / partition, / ceiling, / and / roof as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
2. Where cable tray bus, cable bus, conduit, wire way, trough, and penetrates fire rated surface, install fire stopping product in accordance with manufacturer's instructions.

J. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, / partition / floor, / ceiling, / and / roof opening as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Install type of fire stopping material recommended by manufacturer.
2. Install escutcheons / floor plates / or / ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with

manufacturer's instructions.

4. Interior partitions: Seal pipe penetrations at clean rooms, / laboratories, / computer rooms, / telecommunication rooms / data rooms / and. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.04 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings as follows and as specifically required in individual piping specification Sections:

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

2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

3. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."

4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

5. 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:

a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.

b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.

c. Align threads at point of assembly.

d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.

e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.

7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:

a. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

b. CPVC Piping: ASTM D2846 and ASTM F493.

c. PVC Pressure Piping: ASTM D2672.

d. PVC Non-pressure Piping: ASTM D2855.

9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657 procedures and manufacturer's written instructions.

a. Plain-End Pipe and Fittings: Use butt fusion.

b. Plain-End Pipe and Socket Fittings: Use socket fusion.

B. Piping Connections: Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.

2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATIONCOMMON REQUIREMENTS

A. Verify final equipment locations for roughing-in.

B. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

C. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.

D. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner’s Representative.

E. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

F. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

G. Install equipment giving right of way to piping installed at required slope as specified in other Division 22 sections.

H. Clearance from Electrical Equipment: Piping is prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.06 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00"Cast-in-Place Concrete."

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

C. Prime and paint all metal supports per Section 09 91 13 and 09 91 23 requirements.

3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor plumbing 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.

3.09 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

C. Refer to Division 01 Sections for additional requirements.

3.10 GROUTING

A. Install nonmetallic, non-shrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Electrical Motor and accessories, Equipment Control Panels and Motor Control Centres - General Requirements for all plumbing equipment.

B. Power Cabling between Switch Fuses / Sub-main Switchboards and Equipment Control Panels / Motor Control Centres

C. Power and Control Cabling between Motors and Control Panels

D. Provision of terminals for pickup by Building Management System

E. Provision of terminals for Earthing of Motors, Control Panels etc. for pick up by Division 26

1.02 RELATED SECTIONS

A. Division 01 General Requirements

B. Section 22 00 00 Plumbing

C. Section 22 11 23 Domestic Water Pumps

D. Section 22 13 29 Sanitary Sewerage Pumps

E. Section 22 14 29 Sump Pumps

F. Section 26 00 00 General Provisions for Electrical Installation

G. Section 26 05 26 Grounding and Bonding for Electrical Systems

H. Section 26 05 53 Identification for Electrical Systems

1.03 REFERENCES

Work shall conform to all applicable Specifications, Standards and Codes, regulatory requirements of Authorities having jurisdiction over the Work, including as specified and listed in Volume 2 -Technical Specifications, Part I.

A. British Standards:

1. BS 88 - Cartridge fuses for voltages up to and including 1,000 volts ac and 1,500 volts d.c.

2. BS 89 - Direct acting indicating analogue electrical measuring instruments and their accessories

3. BS 142 - Electrical protection relays

4. BS 729 - Specification for hot dip galvanized coatings on iron and steel articles

5. BS 731, Part 1 - Flexible steel conduits & adapters for the protection of electric cable

6. BS 1363 - Specification for 13 Amp fused plugs and switched and unswitched socket-outlets

7. BS 3676 - Switches for household and similar fixed electrical installations

8. BS 3871 - Specification for miniature and moulded case circuit breakers

9. BS 3938 - Specification for current transformers

10. BS 4293 - Specification for residual current-operated circuit breakers

11. BS 4343 - Specification for industrial plugs, sockets-outlets and couplers for a.c. and d.c. supplies

12. BS 4568 - Specification for steel conduits and fittings with metric threads of ISO form for electrical installations
13. BS 4579 - Specification for performance of mechanical and compression joints in electric cable and wire connections
14. BS 4607 - Non-metallic conduits and fittings for electrical Installations
15. BS 4662 - Specification for boxes for enclosure of electrical accessories
16. BS 4678 - Cable trunking
17. BS 5000 - Rotating electrical machines of particular types for particular applications
18. BS 5424 - Specification for control gear for voltages up to 1,000 volts a.c. and 1,200 volts d.c.
19. BS 5467 - Specification for cables with thermosetting Insulation for electrical supply up to and including 600 / 1,000 volts and up to and including 1,900 / 3,300 volts (IEC 502)
20. BS 5472 - Specification for low voltage switchgear and control-gear for industrial use; terminal marking and distinctive number - General rules
21. BS 5685 - Electricity Meters (IEC 521)
22. BS 5733 - Specification for general requirements for electrical accessories
23. BS 6004 - Specification for PVC-insulated cables (non-armoured) for electrical power and lighting (IEC 227)
24. BS 6053 - Specification for outside diameters conduits for electrical installations and threads for conduit and fittings (IEC 423 A)
25. BS 6081 - Specification for terminations for mineral insulated cables
26. BS 6121 - Mechanical cable glands
27. BS 6207 - Specification for mineral-insulated copper-sheathed cables with copper conductors (IEC 245)
28. BS 6231 - Specification for PVC-insulated cables for switchgear and control-gear wiring
29. BS 6234 - Specification for polyethylene insulation and sheath for electrical cables
30. BS 6346 - Specification for PVC-insulated cables for electricity supply
31. BS 6360 - Specification for conductors in insulated cables and cords
32. BS 6469 - Insulating and sheathing materials of electrical cables
33. BS 6500 - Specification for insulated flexible cords and cables (IEC 227)
34. BS EN 60439 - Specification for low voltage switchgear and control gear assemblies
35. BS EN 60529 - Specification for degree of protection provided by enclosures (IP code)
36. BS EN 60947 - Specification for low voltage switchgear and control gear

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 78 00 – Closeout Submittals: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Specifications and Drawings of Electrical Works of the project shall be referred to and complied with, as binding and mandatory for works covered by this Section, in respect of the following:

1. Electrical works covered by this Section

2. Ratings, de-rating factors, fault levels and other similar general criteria

3. Selection of components such as MCBs, MCCBs, contactor(s), timers, switches, fuses, earth leakage circuit breakers etc.

B. Requirements of the latest "Regulations for Electrical Installations in Buildings" issued by Ministry of Electricity and Water (MEW), Kuwait shall be conformed to in all respects.

C. Recommendations of the International Electro technical Commission (IEC) / British Standard Specifications (BS) / NEMA / ASTA / VDE shall be conformed to in the selection and installation of electrical system components.

D. Equipment used in the works shall, where necessary, be fitted with suppressers to limit radio interference to the level prescribed in reference standards.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum five years documented experience.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

D. For extended outdoor storage, remove motors from equipment and store separately.

1.10 EXTRA MATERIALS / SPARE PARTS

A. Follow Section 01 78 00 – Closeout Submittals for Spare parts and maintenance products.

1.11 SYSTEM INTERFACES

A. Electrical works starting from outgoing terminals of switch fuses / sub-main switchboards onwards for equipment pertaining to systems listed in related works are covered by this Section.

B. Power supplies to fire pumps, Shall be obtained from the building standby power supply system.

1.12 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements and as per approval of the Engineer.

B. Acceptable Manufacturers

1. ABB, Finland

2. Allen Bradley, USA

3. Schneider, Germany

4. Siemens, Germany

5. Eaton, USA

6. Or other equal and approved under provisions of the General Conditions of Contract.

C.

2.02 GENERAL

A. Climatic Conditions:

1. Temperature: Extremes of temperature, humidity and sandstorms are experienced in Kuwait. Equipment assemblies (sub-assemblies and components) shall be selected and / or derated for continuous operation in the following ambient conditions without detriment:

a.	Within air-conditioned rooms	0 - 40°C (32 - 113°F)
b.	Within mechanical Rooms	0 - 50°C (32 - 122°F)
c.	Within rooms with heat generating equipment	0 - 55°C (32 - 131°F)
d.	On roofs (in shade)	0 - 55°C (32 - 131°F)

2. Humidity: Periods of high humidity are common and relative humidity of 100 % has been recorded at 30 °C (87 °F). Equipment assemblies (sub-assemblies and components) shall be selected and / or derated for continuous operation in 0 - 95 % RH without detriment

3. Anti-condensation heaters shall be provided in control panels and MCCs installed in damp areas and in stator windings of motors subjected to prolonged disuse

B. Electrical Insulation: Electrical motors and accessories shall be of strong construction and their components shall be insulated with class `B' materials, as minimum requirement, unless otherwise stated.

C. Enclosure: Violent sand and dust storms occur and even on comparatively calm days fine dust is carried in atmosphere. Equipment shall have enclosures to IP - 44, as minimum requirement, unless otherwise stated.

D. System Power Supply Ratings (Kuwait)

1. Components of the electrical system shall be suitable for system power supply ratings stated below:

a. 415 volts / 3 ø / 50 Hz

b. 240 volts / 1 ø / 50 Hz

2. Components of the electrical system shall be capable of withstanding the following tolerances of the system power supply:

a. Voltage ± 6 %

b. Frequency ± 4 %

2.03 SYSTEM COMPONENTS

A. Requirements of specifications of electrical works of the project shall be referred to and complied with as appropriate

B. Components such as fuses, contactor(s), indicators, timers etc. which may require replacement in future, shall be products of the same standard / manufacturer as that of the Electrical Works of the project

2.04 CABINETS OF MOTOR CONTROL CENTRES AND CONTROL PANELS

A. Cabinets shall be constructed from minimum 1.5 mm thick sheet steel panels built up on rolled steel or boxed sheet steel section framework and shall have continuously welded butt joints. The assembly shall be capable of withstanding the maximum fault current stresses that may develop. All required holes and cut-outs shall be done at the factory.

B. Cabinets shall be divided internally with sheet metal webs to separate low voltage equipment from instruments and control equipment and to prevent overheating.

C. MCCs and control panels shall have access doors to ensure ease of maintenance of equipment and back panels of MCC shall be completely removable. Access doors shall have concealed hinges, stops and interlocks where required, and a dust excluding gasket contained in a rebate. Hinges shall be strong and may be taken off only by the use of special tools.

D. Door handles shall be the rotating type closing onto ramp of approved pattern finished in a black, hard wearing non-conductive material.

E. Cabinets shall have adequate means for lifting and shall be capable of being moved into the installation position and bolted directly to the floor or to steel framework as the case may be.

F. After fabrication, steel work shall be cleaned, zinc sprayed and stove enamelled with one primer coat, two undercoats and one finishing coat, the surface being rubbed down after each coat. The finish colour shall be light grey.

G. Internal wiring shall be done with PVC insulated, colour coded cables in a neat and professional manner, using cable ties, slip on spiral plastic bundle sheaths etc. Ample free lengths shall be provided to allow for full swing of doors. Wires shall be extended to labelled, anti-turn, solder-less type terminal boards, suitable for cable sizes shown on the Drawings, for the connection of external services. Control cables termination shall be numbered using slip-on ferrules for quick identification.

H. Earthing bar shall be provided for equipotential bonding.

I. Internal components shall preferably be the products of one manufacturer.

J. Circuit devices shall be individually mounted in a cubicle form, front accessible for installation, adjustment and inspection and rear accessible for connection with line and load connection terminals. The operating handles of each protective device shall project from cut outs in the front door and all switching and protective devices shall have clear on / off identification.

2.05 WIRES AND CABLES

A. Stranded copper, PVC insulated colour coded wires of appropriate size shall be used for power and control wiring in conduits, trunking and panels.

B. Stranded copper, PVC / SWA / PVC single core or multi-core cables, laid on cable trays, shall be used for power supply connections and supply to motors.

C. Brass cable glands with armour retainer shall be used at entry of cables to terminal boxes

and panels.

D. Crimped on, brass terminal lugs shall be used for termination of wires and cables.

2.06 CONDUITS, TRUNKING AND CABLE TRAYS

A. Heavy duty galvanised iron conduits shall be used for exposed wiring.

B. Slotted, galvanised steel cable trays shall be used for extending services to motors, unit control panels etc. Factory manufactured offsets, transition pieces etc. shall be used where required.

C. PVC conduits tied down on cable trays may be used for control wiring extended to unit assemblies.

D. Enclosed, galvanised steel trunking shall be used at or near the ceiling soffit for connecting conduits to control panels. Entry of multiple conduits to control panels shall be avoided.

E. Factory manufactured, suspended cantilever type supports shall be used for cable trays.

F. Dead lock type plastic cable ties shall be used for attaching cables to cable trays.

G. Project electrical specifications shall be conformed to in respect of construction details of cable trays, trunking etc.

2.07 ELECTRIC MOTORS

A. General

1. Motors shall be manufactured to the reference standards, wound for the system power supply ratings and suitable for continuous operation in the ambient conditions stated. Motors shall be designed to work for a period of at least five (5) minutes at 75 % of the system power supply voltage without abnormal overheating and damage.

2. Motors shall be squirrel cage induction type, with TEFC enclosure unless otherwise stated on particular schedules (fire pumps) or dictated by selection (canned rotor type for hot water circulating pumps, oil cooled type for submersible pumps etc.).

3. Rotation and colour of phases shall be in accordance with reference standards.

4. Ends of the windings shall be terminated in a box with junction, cable inlet and adapter plate with adjustment (cable pincers etc.); adequately sized to suit the type of cable used and arrangement shall be such that an easy permutation of two phases is possible without upsetting the connections. Tapping for cable entry shall be made to suit the site requirements

5. Motors shall have foundations, bolts and sliding rails where required.

6. Motors shall have a minimum power factor of 0.85 at 75 % to full load.

7. Motors shall have windings with class `B' temperature rise and class `F' insulation. Anti-condensation heaters shall be provided in stator windings.

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

9. Motor nameplates of etched aluminium stating the following shall be attached to the body by riveting:

a. Name of manufacturer

b. Serial number and frame size

c. Power, speed and power factor

d. Electrical supply

e. Type of starting

B. Motor Starters

1. Motors shall have starters complying with the requirements of the reference standards and shall include all control and protective gear, as listed here or elsewhere. These shall be automatic type unless otherwise specified
2. Starters shall be assembled in a cast iron or steel enclosure, protected from vermin and dust. These enclosures shall be designed to be fixed to a wall, floor or shall be part of a panel
3. Starters shall be supplied with push buttons or selector switches and an isolator (SPN / TPN as appropriate). Push buttons shall be of strong, non-hygroscopic material and shall not swell
4. Contacts of starters shall be strong, self-cleaning type and those exposed to air shall be of silver or platinum. Contactors as well as other components shall be designed for 40 operations per hour
5. When the control supply is provided from a source other than the source of the motor circuit, the control circuit shall be through an auxiliary contact in the main isolator so that the main isolator shall isolate the control supply along with the motor supply
6. Starters shall have an auxiliary contact suitable for low voltage DC supply so as have remote on / off indication
7. Starters shall be supplied with cable glands, where required.

C. Types of Starting

1. Motors up to 15 HP: Direct-on-line (DOL) (or star-delta, if situation warrants) type, limiting the starting current to six (6) times the full load current at rated voltage
2. Motors from 15 to 50 HP: Star-delta type to limit the starting current to 2.5 times the full load current at rated voltage, unless stated
3. Motors over 50 HP: Star-delta or auto-transformer type, as is specified
4. Contractor may propose alternate, superior starting methods for reasons of excessive starting time or other valid reasons

D. Protection of Motors: Motors shall have the following protections, unless otherwise stipulated.

1. On load pattern switch with HRC fuses
2. Under voltage release
3. Thermal over current trip
4. Single phasing prevention
5. Earth leakage trip

2.08 VARIABLE SPEED DRIVES

A. Type: High performance digitally controlled direct torque control (DTC) OR pulse width modulated (PWM) design, generating a sine-coded and three-phase output with the following characteristics for driving conventional squirrel cage induction motors. VSD supplied, either manufacturer's proprietary products or OEM, shall be acceptable subject to compliance with requirements stated herein. Insulated gate bi-polar transistors (IGBT) shall be used in the invertor section of the drive to achieve very high switching frequency (at least 2 kHz) throughout the power range. VSDs shall have the following characteristics as a minimum:

1. Power factor >0.96
2. Electrical efficiency >97% at nominal load
3. Acceleration / Deceleration time 0 – 1800 sec, adjustable
4. Overload capability 10% of FLA for 1 min in every 10 min 150% of FLA for 2 sec in every 15 sec

5. Max. Relative Humidity 95%, non-condensing
6. Ambient temperature 40 °C unless otherwise mentioned elsewhere.
7. Main Protective Features: Where any of these are not available with the VSD, then separate protection shall be arranged including related hardware by the VSD supplier
    a. Overload
    b. Stall
    c. Output Over-current
    d. Output short circuit
    e. Motor cable ground fault
    f. Under-load
    g. Network failure
    h. Low input signal level
    i. Panel fault
    j. Over-voltage / input voltage spike
    k. Under-voltage
    l. External Fault
    m. Automatic fault reset under voltage
    n. Automatic fault reset on over voltage, over current, low signal
    o. Fault history
8. Accuracy: VSDs shall maintain motor speeds true to programmed values. Drives above 40 kW shall have minimum speed control accuracy of ± 0.5 % without tacho-generator feedback and a dynamic accuracy of at least 0.4 %. If this accuracy cannot be achieved without tacho-generator feedback, then a tacho-generator shall be fitted in the motor, by the VSD supplier, at no extra cost
9. Ratings
    a. Rated current of the drive shall be higher than or equal to the rated motor current.
    b. Drives designated for 50 °C ambient temperatures shall be suitably de-rated
    c. For pump / fan applications, squared load characteristics shall be considered
    d. In order to protect the VSD and its internal circuits from the effect of short circuits due to regenerative effect of the motor, variable speed drives rated above 40 kW shall have a short circuit withstand capacity of 50 kA for 1 sec as standard. Short circuit type test certificate from an independent laboratory shall be furnished, as required

B. Drive Controller: Programmable logic controller integrated with required number of inputs and outputs to perform the following:
1. Adjustable voltage / frequency
2. Eliminate induction of notching distortion(s) back to the utility line
3. Maintain synchronisation between drive frequency and motor speed under all conditions
4. Automatically restart a coasting motor after a power outage of any duration, without tripping or shutdown

5. Apply rated torque to accelerate the motor to the commanded speed within 0.5 seconds of reapplication of the drive power or the removal of a fault condition, rate of acceleration being limited only by the rated torque and load

6. Built-in flux optimisation function, which reduces energy consumption even when driving at nominal speed but with less than nominal load

7. Built-in flying start feature, to allow a motor unit, which has been shut down or has fault tripped, but is still rotating, to be restarted without first stopping the motor. VSD shall restart the motor from the speed at which it is rotating and then re-accelerate to the speed as per the speed reference signal.

8. There shall be at least three (3) critical speed selection bands to avoid particular motor speeds or resonance bands such that if the critical speeds are reached during the operations, the VSD shall automatically select the low or high speed limit according to the acceleration / deceleration ramp.

9. It shall be possible to select up to 7 constant pre-set speeds based on digital inputs.

10. Electro-magnetic Compatibility (EMC):

    a. VSDs shall carry the CE mark indicating that it complies with the essential requirements of relevant EU directives.

    b. Compliance with latest EMC directives for Radio Frequency Interference (RFI) Immunity and RFI Emission (both conducted and radiated)

C. Input / Output (I/O) characteristics

1. Ethernet / Modbus suitable for coaxial cable wiring

2. Analogue input / output channels of 0 – 10 volts or 4 – 20 mAmp rating

3. Digital input / output channels of appropriate type / rating with changeover dry contact

D. Software

1. Factory application program where the VSD is used without a control panel providing a general purpose I/O configuration

2. Manufacturer’s standard application program for general purpose applications including pre-set speeds

3. Application program for interface of potentiometer with PLCs that vary the speed of the drive using digital signals

4. Hand / Auto application program for I/O configuration

5. Proportional Integral Derivative (PID) control application program for the closed loop control systems

6. Pre-magnetising application program to enable rapid starting of motors by eliminating flux build-up delay

7. Pump / Fan control program to operate two / three / four pumps or fans enabling the speed control of one motor and ON / OFF of others

8. VSD manufacturer shall also have ready-made PC based software for programming the VSDs, as an option; enabling set up and / or modification of parameters, control of the drive, reading of actual values and making trend analysis.

9. Separate software with the following features shall be available for servicing of the drives:

    a. Fault and warning indications

    b. Testing and verifying the possible causes of the faults

    c. Viewing the location of the faulty components graphically

d. Repairing and replacement of components

e. Logging problems and maintenance activities

E. Self-Diagnosis: VSDs shall have self-diagnostic properties to display faults and warnings as it occurs and shall be able to store at least 3 previous fault / warning memories. Previous fault events shall remain in the memory through a power switch off. Events shall be displayed in words along with the total “power-on” time of the drives. Following control functions shall be at least possible from the keypad:

1. Run
2. Stop
3. Local / Remote selection
4. Forward / Reverse (if function enabled)
5. Accelerate (manual / mode)
6. Decelerate (manual / mode)
7. Parameter setting
8. Scrolling & Viewing through actual values

F. Man Machine Interface will comprise a detachable keypad with a back-lit, 4 line, 20 character alphanumeric operating display for programming and controlling, with the following features:

1. Display shall be user-friendly using descriptive text messages (codes not acceptable)
2. Password protection shall be provided to avoid unauthorised tampering
3. It shall be possible to read and write the set parameters with the help of the control pad, hence making it possible to copy parameters between VSDs of similar application
4. Direct keypad entry shall be provided to observe the following actual parameters, any three of which can be displayed simultaneously:
   a. Input Voltage
   b. Input frequency
   c. Output Voltage
   d. Output Frequency
   e. DC Bus voltage
   f. Output Power
   g. Output Torque
   h. Output Current
   i. Motor Speed
   j. Process Speed
5. Following parameters shall be displayed at all times:
   a. Frequency Reference
   b. Run / Stop / Fault
   c. Remote / Local
6. At least one extension cable kit of minimum 3 M length shall be provided for the purpose of programming (for bringing the detachable keypad down to the floor level)

G. VSD Assembly / Enclosure / Accessories

1. VSD units installed within MCCs shall have a protection of IP 21 as a minimum
2. Where VSD units are installed as standalone, rapid acting coordinated semiconductor fuse / breaker for unit protection
3. Local isolation, hand / off / auto selector switch run / trip indicators etc. shall be provided as appropriate

H. Cable Terminations:

1. Motor Windings shall be terminated in such a manner that permits plugging in of the VSD over the motor terminal box, where appropriate
2. VSD shall have cable terminals of appropriate type and size matching with the cable supplied by the electrical trade

I. Interconnection with Building Management System (BMS):

1. Controller / PLC within the VSD shall interface with and / or replace the Distributed Control System (DCS) controller, without the use of additional hardware / software, where Building Management System (BMS) is employed
2. Communication protocol employed by the VSD shall be compatible with the regulations of American Society of Heating and Refrigerating and Air-conditioning Engineers (ASHRAE)
3. VSD shall support all major building automation systems present in the country of installation by way of supporting other internationally recognized gateways

J. Commissioning / Service

1. VSDs shall be supplied by manufacturer(s) with own office in Kuwait, having factory-trained personnel, certified by manufacturer to check, test, adjust and commission the equipment

2.09 SERVICE SWITCHES

A. If single motors, fans, pumps etc. are installed outside the room where the feeding switchboard is installed, an all-pole switch or a switch-fuse type isolator (in case of motors with high output) shall be installed close to the motor, so as to enable emergency shutdown. These motors shall be equipped with labels in Arabic and English reading "Caution - Motor starts automatically".

B. Motors which are installed in mechanical rooms more than 20 meters away from the feeding switchboard shall also be fitted with a service switch and an additional label.

2.10 CONTROL PANELS AND MOTOR CONTROL CENTRES – GENERAL

A. Control panels and motor control centres shall be assembled in factory and tested before delivery to the site.

B. Assemblies shall have enclosures to IP 44 as minimum requirement. Thermostatically controlled anti-condensation heaters shall be provided in all panels and MCCs.

C. A diagram of all control circuits and their component parts contained in each section shall be fixed on the side of control panels / MCCs.

D. Start-up push buttons shall be clearly labeled in Arabic and English, indicating the machine they control and the function of various buttons.

E. Ammeters with phase selector switches shall be provided for all out going breakers controlling motors of more than 15 HP.

2.11 MOTOR CONTROL CENTRES FOR WATER DISPLAYS

MCC with single intake, but separate sections for the following:

A. Mains Isolator Section containing the following: Mains isolator (4 pole, fully enclosed type) interlocked with door and power on indicator (red), which shall be lit only when all the three phases are healthy.

B. Pump Control sections: Separate sections for each pump, with the following:

1. Mains isolator (4 pole, fully enclosed type) interlocked with door
2. COELCB with 300 mAmp trip rating
3. Set of HRC fuses and starter contactor with overload trip
4. Hand / off / auto selector switch
5. Pump run (green) and trip (amber) indicators with audible alarm for trip and test and mute facility
6. Timer with 0 - 30 minutes range and 1-minute increment for the sequential starting of the pumps
7. Minimum run timer and relay with 0 - 6 minutes' adjustable range

C. Pump Operation Programming Section shall contain the following:

1. 24 Hour timer with half (½) hour increments for the planned operation of the pumps
2. Set of terminals / relays for controlling the start / stop of the pumps and relays with volt free contacts for remote operation of the systems from the Building Management System
3. Low water cut-out with audio-visual alarm and test and mute facility

D. Auxiliary Power Supply Sections: MCCB with COELCBs for sump pump, filter pump unit, automatic make up assembly and MCCB only for fountain lighting panel and pump room distribution board, all as appropriate.

E. Programmed Operation

1. Pump controls shall be mutually interlocked for sequential operation with a minimum of two (2) minutes delay in between successive pumps starts
2. Controls shall be arranged such that fountain start / stops can be controlled locally (by the timer in MCC) or remotely (from the Building Management System).

2.12 CONTROL PANELS FOR PACKAGED BOOSTER SET

A. Microprocessor controller by the pumps manufacture only, similar to Hydro2000 by GRUNDFOS or Mega control by DP-PUMPS. The description of operation of microprocessor controller as follow:

1. The Microprocessor control unit should be programmed through an operating front with LCD screen to display the system values.
2. The Operating front protection Class IP 54.
3. The total control unit should be reliable at an ambient temperature up to 50oC and RH of 20 – 90% (non-condensing).
4. Password secured the entered parameters.
5. The pump under the VFD shall be change over after each running/stop period.
6. The optimization of "run on time" of each pump by entered the max. starts per hour.
7. When the "under pressure" or "over pressure" reached a signal or alarm is given.
8. Automatic change over in case of a thermal failure of the duty pump.
9. The level control in the storage tank indicating the water level, critical water level, high water level, supply valve (open or closed) and reset run –dry safety device.
10. The operating Front should have a pump information key, which retrieve the Information for all the Pumps in the system. The Pump information should show the operation mode (automatic or manual), running hours, pump starts/hour, failures.

B. The control panel should be of sheet steel enclosure to IP54 protection and shall include the following as a minimum, but not to limit other safety measures required by codes and standards. Control can be carried out on the basis of discharge pressure and regardless the flow.

1. Frequency converter mounted on the standpipe.
2. Main Isolator (4 pole) door interlock.
3. Phase failure relay.
4. MCCB for each motor
5. Set of contractors with over load trip relay for each motor.
6. Microprocessor controller unit
7. Set of termination, wiring and accessories.
8. Emergency stop switch.
9. Set of voltage free contacts for BMS.

PART 3 - EXECUTION

3.01 CONTROL PANELS AND MOTOR CONTROL CENTERS – GENERAL

A. Control panels of packaged pump sets shall be rigidly attached to the base frame with structural steel work. The center line elevation of the panel shall not exceed 1,300 mm above finished floor level.

B. Wall mounted control panels shall be attached by expansion anchors and studs. Panels shall be stiffened with profiled sections welded to the back plate, as required. Additional wall brackets or pedestals shall be used where required. Top of panel shall be at 1,800 mm (max.) above FFL.

3.02 CONDUITS, TRUNKING AND CABLE TRAYS

A. Conduits shall be fixed to walls / ceilings with two-piece clamps, spaced at not more than 1,200 mm.

B. Trunking shall be attached to walls by brass screws in plastic expansion plugs.

C. Cable tray hangers shall be attached to ceilings with expansion anchors and studs. Support vertical cable trays by bolting to steel angles, extending from floor to ceiling.

D. General arrangement of power distribution in the plumbing and fire protection plant rooms shall be as follows:

1. Rise from SMSB to cable trays. Drop to wall mounted / free standing panels, in cable trays
2. Rise from panels to another layer of horizontal network of cable trays. Drop to motors in cable trays

E. Flexible PVC conduits with termination bushes shall be used for connecting valve monitor switches to ceiling roses. Conduit shall be attached to piping with cable ties / metallic straps, where required.

END OF SECTION

SECTION 22 05 16

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Flexible pipe connectors.

B. Expansion joints.

C. Expansion compensators.

D. Pipe alignment guides.

E. Swivel joints.

F. Pipe anchors.

1.02 RELATED SECTIONS

A.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment:
B.	Section 22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
C.	Section 22 11 16	Domestic Water Piping
D.	Section 22 13 16	Sanitary Waste and Vent Piping
E.	Section 22 14 13	Facility Storm Drainage Piping

1.03 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.9 - Building Services Piping.

2. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

1.04 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:

1. Installation Temperature : 50° F (10° C)

2. Domestic Hot Water : 140° F (60° C)

3. Safety Factor : 30%

1.05 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Include shop drawing information for piping expansion compensation in shop drawings for piping system specified in Section 22 11 16 (Domestic water piping) and 22 13 16 (sanitary waste & vent piping)

C. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Data on expansion joint shop drawings shall include maximum allowable temperature and pressure rating, maximum expansion and compression compensation, overall face to face length, convolutions per meter (foot) and per assembly, wall thickness of bellows, maximum allowable lateral deflection.

3. Calculations shall be submitted for selection of expansion compensators and size of field fabricated pipe loops, offsets, and swing joints, to the Engineer.

D. Design Data: Indicate Design criteria and show calculations .Submit sizing methods/calculations sealed by a registered professional engineer.

E. Manufacturer's Installation Instructions: Submit special procedures.

F. Manufacturer's Certificate: Certify if products meet or exceed specified requirements.

G. Welders' Certificate: Include welders' certification of compliance with ASME Section IX. AWS D1.1.

H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.06 CLOSEOUT SUBMITTALS

A. Section 01 92 00 – Closeout Procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with MPW standard.

C. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.09 PRE-INSTALLATION MEETINGS

A. Section 01 31 30 – Project Meetings

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Follow Section 01 60 00 - Product Requirements for Product storage and handling requirements.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 WARRANTY

A. Follow Section 01 88 70 – Product Warranties and Guarantees.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:

1. Metraflex
2. Flexonics
3. Mason

4. MUPRO
5. Kinetics
6. Or other equal and approved under provisions of the general conditions of contract and approved by the Engineer.

2.02 FLEXIBLE PIPE CONNECTORS

A. Furnish materials in accordance with MPW standards and project specification.

B. Steel Piping:

1. Inner Hose: Carbon Steel / Stainless Steel as per requirement.

2. Exterior Sleeve: Single braided / Double braided / stainless steel as required.

3. Pressure Rating: (862 kPa) WSP and (232 degrees C) / (1380 kPa) WOG and (121 degrees C) / (kPa) at (21 degrees C).

4. Joint: Flanged / Threaded / Threaded with Union / Welded as specified in Section 21 05 00 and 22 11 16.

5. Size: Use pipe-sized units.

6. Maximum offset: 20 mm / 25 mm on each side of installed center line.

2.03 EXPANSION JOINTS

A. Steel Piping

1. Up to DN 50 (2 inch): Two (2) ply twin sphere rubber bellows, carbon steel shrouds and threaded / welding ends with anti-torque device and limit stops

2. DN 65 (2½ inch) and above: Two (2) ply twin sphere rubber bellows, carbon steel shrouds and flanged ends with internal flow liners anti-torque device and limit stops

B. Copper Piping

1. Up to DN 50 (2 inch): Two (2) ply phosphor bronze tandem bellows, brass shrouds and threaded / sweat ends with anti-torque device and limit stops

2. DN 65 (2½ inch) and above: Two (2) ply phosphor bronze bellows, brass shrouds and flanged ends. Internal flow liners, anti-torque device and limit stops shall be provided.

C. Plastic Piping

1. Up to DN 50 (2 inch): Two (2) ply phosphor bronze tandem bellows, brass shrouds and threaded / union ends with anti-torque device and limit stops (proprietary products of piping system manufacturer may be used as alternate)

2. DN 65 (2½ inch) and above: Two (2) ply phosphor bronze bellows, brass shrouds and flanged ends with internal flow liners, anti-torque device and limit stops (proprietary products of piping system manufacturer may be used as alternate)

2.04 PIPE ALIGNMENT GUIDES

A. Pipe alignment guides shall be provided on both sides of expansion joints and elsewhere as indicated. These shall be constructed with four-finger spider travelling inside guiding sleeve, with provision for anchoring to building substrate.

2.05 PRESSURE RATING

A. Flexible pipe connectors and expansion compensators shall be suitable for 1,379 / 1,724 kPa (200 / 250 psig) working water pressure at ambient temperature, as appropriate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall examine piping layout and notify Engineer of anchors and expansion joints required to adequately protect the system; by indicating these locations on the shop drawings or otherwise.

B. Contractor shall provide inspection services by expansion joint manufacturer's representative for final installation and provide certification confirming that the installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

3.02 EXPANSION JOINTS

A. Structural work shall be accomplished and required equipment provided to control expansion and contraction of piping; loops, pipe offsets, and swing joints, and provide corrugated bellows type expansion joints where required.

B. Expansion joints shall be installed adjacent to anchors with pipe guide at other end. Additional pipe guides shall be provided at intervals as required, so that movement takes place along axis of pipe only.

C. Expansion joints shall be same size as pipeline except if otherwise noted on the Contract drawings.

D. Anchors shall be located such that the expansion or contraction of the pipe section in between is within the allowable range of a single expansion joint.

E. No more than one bellows shall be installed within each section (Tandem bellows in single assembly excluded).

3.03 EXPANSION LOOPS

A. Expansion loops shall be fabricated as recommended by the piping system

manufacturer, in locations indicated and elsewhere, as determined by Contractor for adequate expansion of installed piping system.

B. Pipe loop shall be subjected to cold spring, which will absorb 50 % of total expansion between hot and cold conditions.

C. Pipe anchors and pipe alignment guides shall be provided, as indicated and elsewhere as determined by the Contractor to properly anchor piping in relationship to expansion loops.

3.04 EXPANSION JOINTS FOR DRAINAGE PIPING

A. At Movement / Expansion Joints in Foundations: Flexible mechanical joints shall be installed on a short length of pipe; the assembly covered with rot proof flexible material like expanded polystyrene to exclude concrete and allow movement.

B. Soffit of Floor Slabs: Flexible mechanical joints shall be installed on a short length of pipe at the building movement joint and the outer pipe ends anchored to the building structure.

END OF SECTION

SECTION 22 05 19

METER AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Thermometers

B. Pressure Gauges

C. Flow meters

D. Fittings and Accessories

1.02 RELATED SECTIONS

A. Division 01 General Requirements

B. Section 22 00 00 Plumbing

C. Section 22 11 16 Domestic Water Piping

D. Section 22 11 23 Domestic Water Pumps

E. Section 22 13 29 Sanitary Sewerage Pumps

F. Section 22 14 29 Sump Pumps

G. Section 22 32 00 Domestic Water Filtration Equipment

H. Section 22 33 00 Electric Water Heaters

1.03 REFERENCE STANDARDS

A. British Standard:

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

1.01 SUBMITTALS

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

1.04 CLOSEOUT SUBMITTALS

A. Refer and Comply with Division 01 – Closeout Submittals: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.05 QUALITY ASSURANCE

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

B. Materials of similar nature shall be products of the same manufacturer. Mixing up products of different standards or those of different manufactures shall not be permitted for the same service

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.07 PRE-INSTALLATION MEETINGS

A. Refer and Comply with Division 01 – Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE AND HANDLING

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

B. Products shall be kept in shipping cartons until the time of installation.

C. Factory calibrated items, which are dropped or subjected to shock otherwise, shall be stored with appropriate labels and a record maintained, for inspection by the Engineer, till completion of the works.

1.09 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

1.10 EXTRA MATERIALS / SPARE PARTS

A. Refer and Comply with Division 01 – Closeout Submittals for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to the compliance with the requirements and as per approval of the Engineer.

B. Acceptable Manufacturers

1. Weiss Instruments Inc., USA
2. Weksler, USA
3. Dwyer Instruments, USA
4. Branner, Sweden
5. Winter, Canada
6. Or other equal and approved under provisions of the General Conditions of Contract.

2.02 GLASS THERMOMETERS

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

B. Connection: Straight form or 90 degree back angle form as required. Adjustable vary-angle type shall also be acceptable.

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

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

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

F. Accuracy: ± One scale division or 1% of scale range.

G. Range:

1. Hot water: 0 to 114°C (30 to 240°F)

2.03 DIRECT READING DIAL THERMOMETERS

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

B. Connection: Bottom or back as required. Adjustable vary-angle type shall also be acceptable.

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

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

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

F. Accuracy: ± One scale division.

G. Range:

1. Hot water: 0 to 114°C (30 to 240°F)

2.04 REMOTE READING DIAL THERMOMETERS

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

B. Connection: Bottom or back as required.

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

D. Capillary: Stainless steel with interlocked stainless steel spiral sheath.

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

F. Accuracy: ± One scale division.

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

H. Range:

1. Hot water: 0 to 114°C (30 to 240°F)

2.05 THERMOMETER WELLS

A. These shall be welding type of carbon steel construction; pressure rated at three times the system working pressure. Length shall be selected to suit the pipe diameter and lagging extension provided, where required. Brass cap and chain attached to the well shall be provided for each well.

2.06 PRESSURE AND COMPOUND GAUGES.

A. Construction: Phenol turret case; phosphor bronze Borden tube; bronze / nickel silver / stainless steel movement; painted aluminium dial and spring secured shatterproof glass front.

B. Connection: DN 15 (½ inch), bottom or back as required.

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

D. Calibration

1. Dual on the pressure side (Bars & Psi) as well as vacuum side (mm & inch of mercury)

2. Figure intervals shall be at 1 Bar (10 psi)) and smallest graduation shall not be more than 0.1 Bar (1 psi).

E. Accuracy: ± One (1) percent.

F. Range:

1. At suction side of pumps: 760 mm - 0 - 4 Bars (30 inches - 0 - 60 psi)

2. At discharge side of pumps: 200 percent of pump shut off head, but limited to 20 Bars (300 psi)

2.07 DIFFERENTIAL PRESSURE GAUGES FOR AIR

A. Construction: Diaphragm actuated, magnetic drive type with die-cast aluminium case; clear plastic facia; painted aluminium dial; rubber pointer stops; over pressure restrictors; external, pointer zero adjustment etc.

B. Connection: DN 6 (¼ inch), high and low pressure taps, at side or back as required.

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

D. Calibration: mm (Inch) of water, with figure intervals at 5 to 10 mm (0.2 to 0.4 inch) and smallest graduation not exceeding 2 mm (0.05 inch).

E. Accuracy: ± Two (2) % of full scale.

F. Range:

1. Across air filters: 0 to 50 mm (0 to 2 inch)

G. Accessories:

1. Static pressure tips (2 #)
2. 1,500 mm (5 feet) long, 6 mm (¼ inch) aluminium tubing (2 #)
3. Vent valves (2 #)
4. Surface mounting bracket

2.08 DIFFERENTIAL PRESSURE GAUGES FOR WATER

A. Construction: Diaphragm actuated, magnetic drive type with forged brass case with separation between dial chamber and fluid; painted aluminium dial; clear plastic facia; rubber pointer stops; over pressure restrictors; external, pointer zero adjustment etc.

B. Connections: DN 6 (¼ inch), high and low pressure taps, at bottom (duplicated at top for air, gas)

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

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

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

F. Range:

1. Across water coils and water filters: 0 to 1 Bar (0 to 35 feet)

G. Accessories:

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

2.09 PRESSURE GAUGE ACCESSORIES: These shall be from the same manufacturer as that of the instrument.

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

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

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

2.10 TEST PLUGS

A. Description: Nickel-plated, brass-body test plug in DN15 fitting.

B. Body: Length as required to extend beyond insulation.

C. Pressure Rating: 3450 kPa minimum.

D. Core Insert: Self-sealing valve, suitable for inserting 3-mm OD probe from dial-type thermometer or pressure gage.

E. Core Material for Air, Water, Oil, and Gas: Minus 7 to plus 93 deg C, chlorosulfonated polyethylene synthetic rubber.

F. Core Material for Air and Water: Minus 35 to plus 136 deg C, ethylene-propylene-diene terpolymer rubber.

G. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.

H. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, pressure gage and carrying case.

1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

2.11 WATER METERS

A. Description: AWWA C700-03 or equivalent BS/EN or equivalent Local Standards, displacement type, bronze case. Registers flow in liters or cubic meters as required by utility.

B. Description: ANSI/AWWA C701-07 or equivalent BS/EN or equivalent Local Standards, turbine type. Registers flow in liters or cubic meters as required by utility.

C. Description: ANSI/AWWA C702-01 or equivalent BS/EN or equivalent Local Standards, compound type, bronze case. Registers flow in liters or cubic meters as required by utility.

D. Description: ANSI/AWWA C703-96 (2004), UL-listed, FM-approved or equivalent BS/EN or equivalent Local Standards, main-line, proportional, detector type; 1035-kPa working pressure; with meter on bypass. Registers flow in liters or cubic meters as required by utility.

1. Bypass Meter: ANSI/AWWA C702-01 or equivalent BS/EN or equivalent Local Standards, compound type, bronze case; size not less than one-half nominal size of main-line meter.

2. Bypass Meter: ANSI/AWWA C701-07 or equivalent BS/EN or equivalent Local Standards, turbine type, bronze case; size not less than one-half nominal size of main-line meter.

E. Description: ANSI/AWWA C703-96 (2004), UL-listed, FM-approved or equivalent BS/EN or equivalent Local Standards, main-line-turbine, detector type; 1200-kPa working pressure; with strainer and with meter on bypass. Registers flow in liters or cubic meters as required by utility.

1. Bypass Meter: ANSI/AWWA C701-07 or equivalent BS/EN or equivalent Local Standards, turbine type, bronze case; not less than DN50.

F. Remote Registration System: Utility's standard; direct-reading type complying with ANSI/AWWA C706-96 (R2005) or equivalent BS/EN or equivalent Local Standards; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly.

G. Remote Registration System: Utility's standard; encoder-type complying with ANSI/AWWA C707-05 or equivalent BS/EN or equivalent Local Standards; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly.

1. Data-Acquisition Units: Comply with utility's requirements for type and quantity.

2. Visible Display Units: Comply with utility's requirements for type and quantity.

H. Water meter provided will be connected to BMS system.

PART 3 - EXECUTION

3.01 SELECTION AND INSTALLATION OF THERMOMETERS

A. Dial type thermometers shall be installed at the following locations:

1. At the inlet and outlet of each boiler and chiller
2. At the inlet and outlet of each heat exchangers
3. At the inlet and outlet of Water Heaters and Hot water buffer tanks,
4. At the inlet and outlet of hot water coils

B. Remote reading dial thermometers shall be installed in control panels, where indicated; tubing selected so as not to require coiling and run between panel and thermometer bulb with adequate supports to prevent kinks.

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

3.02 SELECTION & INSTALLATION OF PRESSURE AND COMPOUND GAUGES

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

B. Compound gauges shall be installed at the following locations:

1. At the suction manifolds of packaged pump sets
2. At the suction / suction header of unit pumps

C. Pressure gauges shall be installed at the following locations:

1. At the discharge manifolds of packaged pump sets
2. At the discharge of unit pumps
3. At the inlet and outlet of heat exchangers
4. At the inlet and outlet of water cooled condensers
5. At the inlet and outlet of hot water pumps
6. At the inlet and outlet of chilled water / hot water coils
7. At the inlet and outlet of pressure reducing valve stations

D. Pressure gauge cocks, with outlet plugged, shall be installed on piping at the following locations (2 # pressure gauges of each type and range shall be furnished to the Owner):

1. At the inlet and outlet of hot water circulating pumps
2. At the interface of water supply system with swimming pools, fountains, landscape irrigation system, etc.
3. On the city water supply connection, in the vicinity of the break tank

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

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

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

3.03 SELECTION & INSTALLATION OF DIFFERENTIAL PRESSURE GAUGES

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

B. Differential pressure gauges (air) shall be installed across each filter section of central station air handling units and central fresh air treatment units.

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

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

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

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

3.04 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to AWWA M6 or equivalent BS/EN or equivalent Local Standards and utility's requirements.

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

2. Install compound-type water meters with shutoff valves on water meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.

3. Install detector-type water meters with shutoff valves on water meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.

3.05 ROUGHING-IN FOR WATER METERS

A. Install roughing-in piping and specialties for water meter installation according to utility's instructions and requirements.

3.06 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:

1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.

2. Connect flow-measuring-system elements to meters.

3. Connect flowmeter transmitters to meters.

B. Make electrical connections to power supply and electrically operated meters and devices.

C. Ground electrically operated meters.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B or equivalent BS/EN or equivalent Local Standards.

D. Install electrical connections for power and devices.

E. Electrical power, wiring, and connections are specified in Division 26 Sections.

3.07 ADJUSTING AND CLEANING

A. Calibrate meters according to manufacturer's written instructions, after installation.

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

C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Gate valves

B. Globe valves

C. Ball valves

D. Butterfly valves

E. Check valves

F. Drain Valve

G. PB Valves for PB Pipes

1.02 RELATED SECTIONS

A.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
B.	Section 22 07 00	Plumbing Insulation
C.	Section 22 11 16	Domestic Water Piping
D.	Section 22 11 19	Domestic Water Piping Specialties
E.	Section 22 11 23	Domestic Water Pumps
F.	Section 22 13 16	Sanitary Waste and Vent Piping
G.	Section 22 13 19	Sanitary Waste Piping Specialties
H.	Section 22 13 29	Sanitary Sewerage Pumps
I.	Section 22 14 13	Facility Storm Drainage Piping
J.	Section 22 14 23	Storm Drainage Piping Specialties
K.	Section 22 14 29	Sump Pumps

1.03 REFERENCES

A. American Society for Testing and Materials:

1. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

2. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

B. CP 312 - Code of practice for plastic pipe work

C. D 1599 - Test Method for Short Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings

D. D 2122 - Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings

E. D 3222 - Standard Specification for unmodified Polyvinylidene Fluoride (PVDF) Molding Materials

F. D 3311 - Standard Specification for Drain, Waste and Vent (DWV) Plastic Fittings Pattern

G. German Institute for Standardization:

1. DIN 8078 -Polypropylene (PP) Pipes, general quality requirements.

2. DIN 8077 -Polypropylene (PP) Pipes, dimensions.

3. DIN 16962- Pipe Joint assemblies and fittings for polypropylene pressure pipes.

4. DIN 16831-4:2003 pipe fittings and joint assemblies for polybutylene pressure pipes

5. DIN 16962 - Pipe Joint Assemblies for Polybutylene Pressure Pipes (ASTM D 2609 / ASTM D 3261).

6. DIN 16968 Polybutylene (PB) pipes - General quality requirements and testing, Category: DIN Standards.

7. DIN 16969 Polybutylene (PB) Pipes – PB 125 dimensions

H. German Welding Society:

1. DVS 2207 - Welding of thermoplastic pipes and fittings

2. DVS 2208 - Welding machines and devices for thermoplastics

I. International Organization for Standardization:

1. ISO 13760:1998. Plastics pipes for the conveyance of fluids under pressure

2. ISO 15876-1:2003 - Plastics piping systems for hot and cold water installations - Part 1: General

3. ISO 15876-2:2003 - Plastics piping systems for hot and cold water installations - Part 2: Pipes

4. ISO 15876-3:2003 - Plastics piping systems for hot and cold water installations - Part 3: Fittings

5. ISO 15876-5:2003 - Plastics piping systems for hot and cold water installations - Part 5: Fitness for purpose of the system

1.04 SUBMITTALS

A. Follow Section 01 33 00 - Submittal Procedures for requirements for submittals.

B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

A. Follow Section 01 92 00 - Closeout Procedures.

B. Project Record Documents: Record actual locations of valves

C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

A. For drinking water service, provide valves complying with NSF 61.

B. Perform Work in accordance with Kuwait MEW standard.

C. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

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

B. Installer: Company specializing in performing work of this section with minimum five years documented experience or approved by manufacturer.

1.08 PRE-INSTALLATION MEETINGS

A. Follow Section 01 31 30 – Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Follow Section 01 60 00 - Product Requirements for requirements for transporting, handling, storing, and protecting products.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

1.10 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

1.11 EXTRA MATERIALS

A. Follow Section 01 77 00 – Closeout Procedures for requirements for extra materials.

B. Furnish two packing kits for each size valve.

1.12 ENVIRONMENTAL REQUIREMENTS

A. Follow Section 01 60 00 - Product Requirements for environmental conditions affecting products on site.

B. Do not install valves underground when bedding is wet or frozen.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS (Plastic valves)

A. George Fischer, Switzerland

B. Crane Fluid, China

C. Thermaflex, Netherlands

D. Nibco, China/Taiwan

E. Or other equal and approved under provisions of the General Conditions of Contract.

2.02 GENERAL REQUIREMENTS

A. Valves from same manufacturer shall be provided throughout the project, where possible.

B. Pressure Rating

1. Valves shall be rated for 1,379 kPa (200 psig) working water pressure at ambient temperature, unless otherwise indicated

2. Contractor shall allow for selecting higher pressure rated valves to meet the valve construction features

C. Valve Operators

1. Hand wheels / operating levers shall be provided for valves as appropriate. Hand wheels for gate and globe valves up to DN 50 (2 inch) shall be non-ferrous metal (die cast zinc / aluminium alloy etc.)

2. One key / wrench of appropriate size shall be provided for each lever operated valve installed

3. Chain operated sheaves shall be provided for valves located more than 2 m (7 feet) above floor. Chains shall be extended to about 1,500 mm (5 feet) above floor and hooked to clips, in order to clear walkways and equipment

4. Geared operators shall be provided for valves, DN 200 (8 inch) and larger in size.

2.03 GATE VALVES

A. Up to DN 50 (2 inch): Bronze body; threaded bonnet, inside screw non-rising stem and solid wedge; union bonnet; threaded ends.

B. DN 65 (2½ inch) and larger: Flanged ends, Iron body, bronze mounted (IBBM); bolted bonnet, non-rising stem, inside screw and solid wedge; renewable seats; flanged ends.

2.04 BALL VALVES

A. Up to DN 50 (2 inch): Bronze 2 piece body, DZR brass/bronze ball, and DZR/bronze stem, lever operated

2.05 CHECK VALVES

A. Up to DN 50 (2 inch): Bronze body, screwed cap, horizontal swing, brass/bronze disc.

B. DN 65 (2½ inch) and larger: Flanged ends, Iron body, bronze mounted (IBBM); bolted cap, horizontal swing, cast iron disc.

2.06 BUTTERFLY VALVES

A. DN 65 (2½ inch) and above: SG iron, fully lugged body with long neck; lever operated, Aluminum bronze disk; EDPM liner; stainless steel shaft with memory stops; suitable for installation between flanges.

2.07 GLOBE VALVES

A. Up to DN 50 (2 inch): Threaded ends, Bronze body; threaded bonnet, inside screw non-rising stem, copper alloy disc, hand wheel operated and solid wedge; union bonnet; threaded ends.

B. DN 65 (2½ inch) and larger: Flanged ends, Iron body, epoxy coated,; bolted bonnet, renewable seat and disc.

2.08 STRAINER

A. Up to DN 50 (2 inch): Threaded ends, Bronze body; screwed on retainer cap with threaded plug and 20 mesh stainless steel screen.

B. DN 65 (2½ inch) and larger: Flanged ends, Iron body, with flanged ends, flanged cover with threaded bronze plug and stainless steel screen.

2.09 DRAIN VALVES

A. Key operated bronze angle globe pattern valve with threaded inlet and hose

connection outlet with cap and chain.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Follow administrative requirements for verification of existing conditions before starting work.

B. Verify piping system is ready for valve installation.

3.02 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install 3/4 inch (20 mm) gate/ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

D. Install valves with clearance for installation of insulation and allowing access.

E. Provide access where valves and fittings are not accessible. [Coordinate size and location of access doors with Section 08 31 00]

F. Refer to Section 22 05 29 for pipe hangers.

G. Refer to Section 22 07 00 for insulation requirements for valves.

H. For installation of valves in domestic water systems refer to Section 22 11 16.

I. For installation of valves in sanitary systems refer to Section 22 13 16.

J. For installation of valves in storm systems refer to Section 22 14 13.

3.03 VALVE APPLICATIONS

A. Install shut off and drain valves at locations indicated on Drawings in accordance with this Section.

B. Install ball/ butterfly or gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball butterfly or globe valves for throttling, bypass, or manual flow control services.

D. Install spring loaded check valves on discharge of water pumps.

E. Install lever and weight/lever and spring check valves on discharge of pumps in pumped sanitary/ pumped storm water piping.

F. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

G. Install ball, butterfly and gate valves in domestic water systems for shut-off service.

H. Install ball and butterfly valves in domestic water systems for throttling service.

I. Install ball, butterfly and gate valves in sanitary systems for shut-off service.

J. Install ball, butterfly and gate valves in storm water systems for shut-off service.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe hangers and supports.

B. Hanger rods.

C. Inserts.

D. Flashing.

E. Formed steel channel.

F. Equipment bases and supports.

1.02 RELATED SECTIONS

A.	Division 01	General Requirements
B.	Division 03	Concrete works
C.	Section 07 84 00	Fire stopping
D.	Section 07 92 00	Joint Sealants
E.	Section 09 91 13	Exterior Paintings
F.	Section 09 91 23	Interior Paintings
G.	Section 22 00 00	Plumbing Services
H.	Section 22 05 00	Common Works Results for Plumbing
I.	Section 22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
J.	Section 22 07 00	Plumbing Insulation
K.	Section 22 11 16	Domestic Water Piping
L.	Section 22 13 16	Sanitary Waste and Vent Piping
M.	Section 22 13 19	Sanitary Waste Piping Specialties
N.	Section 22 13 29	Sanitary Sewerage Pumps
O.	Section 22 14 13	Facility Storm Drainage Piping
P.	Section 22 14 23	Storm Drainage Piping Specialties
Q.	Section 22 14 29	Sump Pumps

1.03 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through Penetration Fire Stops.
4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe

Hangers.

5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

G. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Fire stops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

1.04 SUBMITTALS

A. Refer and Comply with Division 01 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods / calculations sealed by a registered professional engineer.

F. Manufacturer's Installation Instructions:

G. Hangers and Supports: Submit special procedures and assembly of components.

H. Fire stopping: Submit preparation and installation instructions.

I. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

J. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.05 CLOSEOUT SUBMITTALS

A. Refer and Comply with Division 01 – Closeout Submittals and Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors,

expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Pipe hangers and supports shall be in accordance with MSS SP58 (Pipe Hangers and Supports – Materials, Design and Manufacture).

B. All manufactured hangers and supports shall be fully electrogalvanized post manufacture, according to ASTM B633 SC3.

C. For installations where the hangers and supports are expected to be exposed to harsh corrosive conditions, such as areas with high relative humidity or high salt content in the air, these shall be hot dip galvanized, according to ASTM A123.

D. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze and pipe anchor shall be done by a qualified engineer.

E. Detailed seismic force calculations shall be provided to support the recommended design of the seismic bracing system.

F. All gasket used as separation between pipe and hangers shall be manufactured from EPDM only. Third party test certificates shall be furnished to establish the grade of elastomer.

G. Each hanger and support shall have the manufacturer's name, part number and country of manufacture engraved on it.

H. All hangers and supports shall be manufactured at an ISO 9001 certified facility. Manufacturer's ISO certificate, clearly stating Pipe Supports within the scope of registration, shall be furnished.

I. Country of Origin certificate shall accompany supplies, indicating the actual place of manufacture of goods.

J. Pipe hangers and supports for all piping services shall be from the same manufacturer.

K. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

L. Fire Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

M. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

N. Perform Work in accordance with applicable authority / AWS D1.1 for welding hanger and support attachments to building structure.

1.07 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.08 PRE-INSTALLATION MEETINGS

A. Refer and Comply with Division 01- Project Meetings.

B. Convene minimum one week prior to commencing work of this section

1.09 DELIVERY, STORAGE, AND HANDLING

A. Refer and Comply with Division 01- Product Requirements: Requirements for

transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Refer and Comply with Division 01– Closeout Submittals for Spare parts and maintenance products.

1.12 ENVIRONMENTAL REQUIREMENTS

A. Refer and Comply with Division 01 - Environmental conditions affecting products on site.

B. Provide ventilation in areas to receive solvent cured materials.

1.13 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to the compliance with the requirements and as per approval of the Engineer.

B. ACCEPTABLE MANUFACTURERS:

1. Cooper B-Line, USA.
2. MUPRO, Germany
3. Flamco, USA
4. WEICCO
5. Hilti
6. Or other equal and approved under provisions of the General Conditions of Contract.

2.02 GENERAL

A. Hangers for all services shall provide means of vertical pipe level adjustment after installation.

B. Where axial pipe expansion or contraction is indicated on account of thermal changes in the fluid medium, roller based hangers and supports or Teflon based slide assemblies shall be provided for the entire pipe length.
Chilled water or hot water pipe runs of over 20m without changes in direction shall always be supported on roller based or sliding supports.

C. Heavy-duty steel trapezes to support multiple pipes shall be designed for the combined weight of pipe, water and adjacent fittings, and field fabricated from ASTM A36 structural steel channel.

D. Hangers and supports shall be fully electrogalvanized post manufacture as standard, according to ASTM B633 SC3.
For severely corrosive conditions, as determined by the Engineer, provide hot dip galvanized finish according to ASTM A123.provide stainless steel (316 L) as determined by the Engineer,

E. Dielectric Protection – Steel pipe hangers and supports shall be furnished with fitted EPDM gasketing when installed with any type of non-ferrous pipe.

F. For insulated piping, rubber support inserts shall be provided at all pipe support locations to prevent crushing of insulation.

G. Hangers shall closely fit the outer diameter of plain or insulated pipe. Oversized hangers shall not be accepted.

H. Anchors shall be provided as required, in order to localize pipe expansion, resist internal pressure thrust and prevent undue strain on piping connections. Anchor design shall not create a thermal or acoustic continuity from the pipe to the building structure.

I. Hangers and supports shall be selected and installed to ensure thermal pipe movement is axially guided into expansion devices and build up of pipe stress is minimised.

J. Riser piping support system design shall ensure pipe is adequately anchored to resist imposed loads and thrust. Risers shall be guided to prevent buckling, while permitting axial pipe movement. Support system shall isolate the pipe thermally and acoustically from building structure. Anchors and guides specially designed for riser piping shall be installed.

K. Piping shall be braced to resist seismic forces as per the 'Seismic Restraint Requirements' section.

L. Vibration isolators shall be provided at first five pipe hanger and support locations adjacent to isolated rotating mechanical equipment, to minimize transmission of noise and vibration to the building structure.

M. The selected manufacturer shall submit specific technical recommendations with regard to the following key aspects of the overall pipe support system :

   a. Riser piping support system.

   b. Seismic restraint system.

2.03 PIPE HANGERS –HORIZONTAL PIPE SUPPORTS

A. Ferrous piping up to DN 150 (6 inch): Adjustable galvanized steel clevis (UL Listed). Galvanized steel pipe covering shield shall be used for insulated piping, alternatively rubber support inserts shall be installed at support points to prevent crushing of insulation.

B. Ferrous piping over DN 150 (6 inch) - All Plumbing Services: Adjustable galvanised steel clevis complete with galvanized steel pipe covering shield for insulated piping (alternatively rubber support inserts shall be installed at support points to prevent crushing of insulation).

C. Copper piping (non-insulated): Adjustable swivel ring galvanized steel band hanger with EPDM lining.

D. Copper piping (insulated): Adjustable swivel ring galvanized steel band hanger with steel pipe covering shield (alternatively rubber support inserts shall be installed at support points to prevent crushing of insulation).

E. Plastic piping up to DN 150 (6 inch): Split ring type EPDM lined steel pipe clamp with welded suspension nut.

F. Plastic piping over DN 150 (6 inch): Adjustable galvanized steel clevis (Acoustical isolation shall be used at supports for drainage piping). Proprietary products supplied by piping system manufacturer shall be acceptable, where available.

G. Multiple hangers for plumbing pipes up to DN 75 (2 inch): Electro-galvanized U-strap pipe clamp with elastomer lining placed on painted / galvanized steel angle / channel suspended from ceiling.

H. Multiple Hangers for Combination of services: Hot dip galvanized steel, continuous channels cast-in in concrete or suspended from ceiling. Pipe hanger / supports shall be as specified before (make appropriate selection). For piping placed above the cross member, use of U-bolts (B-Line B 510 Series) shall be permitted.

2.04 FLOOR SUPPORTS

A. Ferrous piping up to DN 150 (6 inch): Adjustable pipe stanchion saddle support complete with U-bolt, stand pipe with adjuster and floor flange, use galvanized steel pipe covering shield for insulated piping.(alternatively rubber support inserts shall be installed at

support points to prevent crushing of insulation).

B. Ferrous piping over DN 150 (6 inch): Steel pipe roll with steel base and stand. RCC / structural steel pedestals shall be provided, as appropriate, to locate the base. Rubber support inserts shall be installed at support points to prevent crushing of insulation. Galvanized steel insulation protection shield shall be used outside rubber support inserts on roller based supports.

C. Copper piping (non-insulated): Adjustable pipe stanchion saddle support complete with rubber lined U-Bolt, stand pipe with adjuster and floor flange.

D. Copper piping (insulated): Adjustable pipe stanchion saddle support complete with U-bolt, stand pipe with adjuster and floor flange and galvanized steel pipe covering shield. Rubber support inserts shall be installed at support points to prevent crushing of insulation, as appropriate.

E. Plastic piping same as that of ferrous piping.

2.05 WALL SUPPORTS

A. Multiple hangers for plumbing pipes up to DN 75 (2 inch): Electro-galvanized U-strap pipe clamps with elastomer lining placed on painted / galvanized steel channel attached to wall.

2.06 VERTICAL PIPING SUPPORTS

A. Ferrous piping up to DN 150 (6 inch): Galvanized steel riser clamps and / or offset pipe clamp. Rubber support inserts shall be used at the supports for insulated piping.

B. Ferrous piping over DN 150 (6 inch): Designed and fabricated at site with the following components:

1. Gusset plates with integral bearing plates (minimum thickness equal to that of the pipe) welded to pipe

2. Cross channels resting on permanent construction (floor slab / block work); offset to accommodate piping insulation and attached to each other by steel flats welded at both ends

3. `Z' cleats welded on the cross channels at the ends of the bearing plates to restrict movement

4. Heavy duty vibration isolation pads (50 durometer) placed under bearing plates for vibration / thermal isolation

5. Vapour barrier sealed around the gusset plate with mastic sealant

C. Plastic / copper non-insulated piping up to DN 75: U-bolts with rubber sleeve / or U-strap clamps with rubber lining attached to hot dip galvanised channel sections anchored to wall.

D. Plastic / copper piping over DN 75 (3 inch) - Non-insulated: Galvanised steel offset riser clamp with EPDM lining; resting on steel sections

E. Plastic / Copper piping over DN 75 (3 inch) - Insulated: Galvanised steel offset riser clamps over rubber support inserts installed at support points to prevent crushing of insulation.

F. Plastic piping: Zinc coated clip with internally threaded neck, sleeve, back nut, coach (wood) screw and plastic wall insert

2.07 PIPE ANCHORS

A. Ferrous piping (Horizontal, non-insulated): Galvanized steel anchor chair and U-bolt attached to structural steel framework.

B. Ferrous piping (Horizontal, insulated): Gusset plates (minimum thickness equal to that of the pipe) welded to pipe and bolted to structural steel frame. Vapor barrier shall be sealed around the gusset plate with mastic sealant.

C. Ferrous piping (Vertical, non-insulated): Steel U-Bolt fixed to steel channel. The bolt shall be back welded to the pipe after installation.

D. Ferrous piping (Vertical, insulated): Same as the support of vertical insulated ferrous piping over DN 150 (6 inch); excluding the vibration isolation pad. The bearing plate shall be welded or bolted down to the cross channel.

E. Copper piping (Horizontal): Galvanized steel anchor chair and U-Bolt over rubber support inserts all round, attached to structural steel frame work.

F. Copper piping (Vertical): Galvanized steel offset riser clamps, over rubber support inserts all round.

G. Plastic piping (Horizontal): Galvanized steel anchor chair and U- bolt attached to structural steel framework.

H. Plastic piping (Vertical): Steel U-Bolt fixed to steel channel.

2.08 HANGER RODS AND ACCESSORIES

A. Galvanized steel hanger rods: Galvanized mild steel rods with continuous male thread.

B. Turnbuckles: Galvanized, malleable iron castings with female threaded ends, matching with the threaded hanger rods, shall be provided where required. Back nuts shall be provided on both sides of the turnbuckle after adjustment.

C. Ball hangers: Manufacturers proprietary products shall be provided for allowing angular movement of the hanger rod, where required.

D. Threaded rod couplers: Galvanized steel unit machined from bar stock for joining two lengths of threaded hanger rods. Back nuts shall be provided on both sides of the coupler.

2.09 BUILDING ATTACHMENTS

A. Concrete inserts: Malleable iron or galvanized steel concrete inserts complete with adjustable insert nut, suitable for hanger rods of size 22 mm (7/8 inch) diameter and under. Galvanized steel continuous concrete insert shall be provided at the Contractor's option.

B. Self -drilling type concrete inserts: Galvanized steel self-drilling expansion type concrete inserts for hanger rods up to 12 mm (½ inch) dia., shall be provided at the Contractor's option.

C. Support rails (cast-in type): Electro-galvanized steel sections with anchor lugs and filler strip, complete with hammer head nut or extension pieces.

D. Support rails (surface mounted type): Electro-galvanised steel sections complete with hammerhead nut or extension pieces. The rail shall be single or double as appropriate.

2.10 FLASHING

A. Metal flashing: 0.5 mm (26 gauge) thick galvanized steel.

B. Lead flashing: 24.5 kg/m2 (5 lb/ft2) sheet lead for waterproofing; 5 kg/m2 (1 lb/ft2) sheet lead for soundproofing.

C. Flexible flashing: 1.25 mm (49 mil) thick synthetic sheet, compatible with roof and wall waterproofing.

D. Caps: Galvanized steel, 0.8 mm (22 gauge) minimum; 1.5 mm (16 gauge) at fire resistant elements.

2.11 EQUIPMENT CURBS

A. Factory manufactured sound attenuator curbs shall be provided for Air Handling Units and Fans to suit the building construction.

2.12 RUBBER SUPPORT INSERTS, SHIELDS AND SADDLES

A. Provide rubber support inserts made from molded hard rubber at all hanger and support locations of insulated pipework, to transmit pipe load without crushing the insulation.
The rubber density shall not be less than 1000 kg/m3 and shall not exceed 1200 kg/m3.
The thickness of the inserts shall be same as the insulation, and vapor barrier shall be continuous across the outside of the inserts.
Rubber support inserts shall be manufactured with sufficient width, material control and

molding quality to bear imposed pipe loads.
Usage of steel inserts within the rubber will not be permitted under any circumstance.
Standard width of the inserts shall be as per the following schedule :

Pipe Size	Width
up to 2”	25mm
2½” to 5”	38mm
6” to 14”	50mm
16” to 18”	75mm
20” and above	100mm

B. At locations where insulated pipe is installed on rollers, provide insulation protection shields outside the vapor barrier (MSS Type 40) between the rubber support inserts and roller.
The shields shall have flared ends to prevent cutting into the insulation and shall cover the lower 1800 of the pipe.
The length of the shields shall be as per manufacturer’s standard lengths, unless directed otherwise by the Engineer.

C. Pipe covering protection saddles (MSS Type 39) may be installed at support locations of ferrous hot water piping, instead of rubber support inserts.

D. If pipe covering protection saddles are installed with insulated non-ferrous or chilled water pipe, the surfaces in contact with the pipe shall be fitted with high compressive strength fabric reinforced neoprene sleeves - to avoid forming a thermal bridge (in case of steel chilled water pipe) and contact between dissimilar metals (in case of non-ferrous pipe).

2.13 SEISMIC BRACING

A. The selection, positioning and installation of seismic bracing shall be based on the recommendations of the manufacturer, as approved by the Engineer.

B. Seismic restraint shall be provided by cable sway bracing kits, each comprising a pair of complete assemblies with multi-strand stainless steel cable, fixing brackets, stainless steel thimbles and wire clips.

2.14 ESCUTCHEONS

A. Setscrew type escutcheons, with size sufficient to completely cover exposed penetrations shall be provided at all pipe penetrations. This shall be finished with prime coat where adjoining surface is to be field painted, with baked enamel white finish where adjoining surface is fibre board and chrome finish where adjoining surface is tiled with ceramic, marble, etc.

2.15 FINISH

A. Hangers, supports inserts, shields and saddles shall have galvanised finish.

B. Hangers and supports for copper piping shall be copper or copper plated, when used in direct contact with the copper piping.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Refer and Comply with Division 01– Project coordination Meetings.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive fire stopping.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing/damming materials to arrest liquid material leakage.

D. Obtain permission from Engineer before drilling or cutting structural members.

3.03 INSTALLATION – INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches (100 mm) and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above / flush with top of / recessed into and grouted flush with slab.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1 / ASME B31.5 / ASME 31.9 / ASTM F708 / MSS SP 58 / MSS SP 69 / MSS SP 89.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

D. Place hangers within 12 inches (300 mm) of each horizontal elbow.

E. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

F. Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping / sheet lead packing between hanger or support and piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Section 22 05 29 Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00 Plumbing Insulation.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Section 03 30 00

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members formed steel channel steel pipe and fittings . Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 22 05 48 –Vibration and Seismic control for Plumbing Piping and equipment.

3.06 INSTALLATION – FLASHING

A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead worked 1 inch (25 mm) minimum into hub, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches (250 mm) clear on sides with minimum 36 x 36 inch (910 x 910 mm) sheet size. Fasten flashing to drain clamp device.

D. Seal floor shower mop sink drains watertight to adjacent materials.

E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.07 INSTALLATION-SLEEVES

A. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs. Refer and Comply with section 22 05 00.

3.08 INSTALLATION – FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring fire stopping. Refer and Comply with section 22 05 00.

3.09 FIELD QUALITY CONTROL

A. Refer and Comply with Division 01 - Quality Requirements

B. Refer and Comply with Division 01 - Closeout Submittals or Field inspecting, testing, adjusting, and balancing.

C. Inspect installed fire stopping for compliance with specifications and submitted schedule.

3.10 CLEANING

A. Refer and Comply with Division 01 - Closeout Submittals for requirements for cleaning.

B. Clean adjacent surfaces of fire stopping materials.

3.11 PROTECTION OF FINISHED WORK

A. Refer and Comply with Division 01 - Closeout Submittals for Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROL FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Vibration Isolators

B. Seismic Controls

C. Vibration Isolation Bases

1.02 RELATED SECTIONS

A.	Section 03 30 00	Cast-In-Place Concrete
B.	Section 09 91 00	Painting
C.	Division 22 00 00	Plumbing
D.	Section 22 05 00	Common Work Results for Plumbing
E.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment

1.03 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:

B. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.

C. Submit designs and calculations, certified by a professional engineer, as required by the local authority, for the following:

1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.

2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.

3. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.

1.04 PROJECT SEISMIC DESIGN CRITERIA

A. Seismic Loads (As per ASCE7-16 & IBC 2018)

1.	Risk Category	III
2.	Importance Factor	I=1.25
3.	Seismic Design Category	B
4.	0.2 Sec. Spectral Respouse, Ss	0.298g
5.	1 Sec. Spectral Respouse, S1	0.082g

1.05 QUALITY ASSURANCE

A. Structural integrity shall be ensured by avoiding resonance and by restricting vibration.

B. Allowable noise level of 70 dBA measured at a distance of 1,200 mm (4 feet) from source shall not be exceeded by proper engineering of equipment assemblies.

C. Neoprene rubber acoustical treatment shall be provided to springs to prevent transmission of very high frequency vibration and noise.

D. Plates and housings, not otherwise treated for resistance to corrosion, shall be

coated with epoxy.

E. Perform Work in accordance with ARI 575 / ANSI S12.36

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years [documented] experience.

B. Installer: Company specializing in performing Work of this section with minimum five years [documented] experience [approved by manufacturer].

1.07 CLOSEOUT SUBMITTALS

A. Section 01 92 00 - Closeout Procedures.

B. Project Record Documents: Record actual locations of hangers including attachment points.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 DELIVERY, STORAGE AND HANDLING

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

1.10 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Refer and Comply with Division 01– Closeout Submittals for Spare parts and maintenance products.

1.12 COORDINATION

A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, Plumbing Systems,fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to the compliance with the requirements and as per approval of the Engineer:

2.02 VIBRATION ISOLATORS

A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.

1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of

sufficient stiffness to provide uniform loading over the pad area.

2. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Spring Isolators: Freestanding, laterally stable, open-spring-type 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 1.2 times the 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 a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig.

6. Top Plates: Provide threaded studs for fastening and leveling equipment.

7. Finishes: Manufacturer's standard corrosive-resistant finish.

D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.

1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.

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 0.8 times the rated vertical stiffness.

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

6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.

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

1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 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. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

G. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.

1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 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. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

H. Manufactured Seismic Snubbers: All-directional, double-acting snubbers.

1. Construction: Interlocking steel members restrained by a 3/4-inch thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch clearance in all directions between rigid and resilient surfaces.

I. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.

1. Construction: Welded steel shapes conforming to ASTM A36.

2. Resilient Components: 3/4-inch thick, replaceable, shock-absorbing neoprenes insert.

2.03 VIBRATION ISOLATION BASES

A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.

1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.

2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.

3. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.

4. Factory Finish: Manufacturer's standard corrosive-resistant finish.

2.04 RESILIENT PENETRATION SLEEVE

A. Assembly comprising a sleeve 25 mm (1 inch) larger all-round than that of the penetrating element and fabricated from steel pipe or sheet metal as the condition warrants. Sleeve length shall be 25 mm (1 inch) extra on both sides of the penetrated construction. The annular space shall be filled with resilient material such as Neoprene sponge or type 1 B material and the ends sealed with approved sealant compatible with the resilient material.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.

B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.

C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.

D. Install pipe connectors at connections for equipment supported on vibration isolators.

E. Locations of vibration isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation.

3.02 MAJOR EQUIPMENT

A. Floor mounted major equipment shall be set on 100 mm (4 inch) high concrete housekeeping pads unless otherwise shown or specified. Architectural or structural drawings shall be referred to for details.

B. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as scheduled on the drawings or specified here under.

C. Electrical connections to vibration-isolated equipment shall be flexible, as called for in the project electrical specifications.

D. Snubbers or thrust restraints shall be installed on equipment as called for in the schedule on the drawings or specified here under.

3.03 PIPING

A. Piping shall be anchored at the system side of the flexible connector.

B. Drain piping connected to vibration-isolated equipment shall have a flexible connection at the equipment.

3.04 ISOLATION MOUNTS

A. Vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.

B. Isolators for equipment with bases shall be located on the sides of the bases, which are parallel to the equipment shaft unless this is not possible because of physical constraints.

C. If a housekeeping pad is provided, the isolator base plate shall rest entirely on and the isolators shall bear on the housekeeping pad.

D. Hanger rods for vibration-isolated supports shall be connected to structural beams or joists, not from the floor slab between beams and joists. Provide intermediate support members as necessary.

E. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure so that the hanger housing may rotate a full 360 degrees about the rod axis without contacting any object.

F. Parallel running pipes may be hung together on a trapeze, which is isolated from the building. Isolator deflections must be the largest determined by the provisions for pipe isolation. Do not mix isolated and non-isolated pipes on the same trapeze.

G. No pipes or equipment shall be supported from other pipes or equipment.

H. Resiliently isolated pipes shall not contact the building construction or other

equipment.

I. Installed and operating heights of vibration isolators supporting any equipment shall be identical. Limit stops shall be out of contact during normal operation.

J. Leveling bolts and hanger rod bolts shall be adjusted so that isolated equipment is level and in proper alignment with connecting ducts or pipes.

3.05 BASES

A. Equipment shall not bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.

B. A minimum operating clearance of 38 mm (1½ inch) shall be given between inertia bases or steel frame bases and the floor beneath the equipment, unless otherwise indicated. Isolator mounting brackets shall be positioned and the isolators adjusted such that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

3.06 SEISMIC CONTROL /THRUST RESTRAINTS

A. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

B. Snubbers shall be adjusted to clear the equipment base and to provide lateral restraint during on / off cycling, but be out of contact during normal operation of the equipment.

C. Thrust restraints shall be attached at the centre line of thrust and symmetrically on each of the units. Adjust the restraints to limit equipment movement to the specified limit.

3.07 RESILIENT PENETRATION SLEEVES / SEALS

A. Penetration seals shall maintain an airtight seal around the penetrating element and shall prevent rigid contact between the penetrating element and the building structure.

B. Sleeve shall be fitted tightly to the building construction and sealed airtight on both sides of the penetrated construction with acoustical sealant.

3.08 ADJUSTING AND CLEANING

A. 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 operations.

B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Lettering and Text

B. Colors

C. Pipe Markers

D. Directional Arrows

E. Stencils

F. Plastic Name Plates

G. Signage

H. Valve Identification

I. Warning Grids for Buried Services (Tracer Tapes)

1.02 RELATED SECTIONS

A.	Division-1	General requirements
B.	Section 21 00 00	Fire Suppression
C.	Section 22 00 00	Plumbing Services
D.	Section 32 80 00	Landscape
E.	Section 33 11 13	Water Utility Distribution Piping
F.	Section 33 12 19	Water Utility Distribution Fire Hydrants
G.	Section 33 30 00	Sanitary Sewerage Utilities
H.	Section 33 40 00	Storm Drainage Utilities
I.	Section 33 52 00	Liquid Fuel Distribution

1.03 REFERENCES

A. ASTM International

1. ASTM E 84 - Surface burning characteristics of building materials (also NFPA 255 and UL 723).

B. British Standard:

1. BS 1710 - Scheme for identification of piping systems (ANSI A 13.1).

2. BS 4800 - Schedule of paint colours for building purposes

1.04 SUBMITTALS

A. Product data; samples; shop drawings; coordinated colours schemes; valve schedules indicating service, location and tag number; legend chart for 1tenciling, manufacturer’s installation instructions etc. shall be submitted under provisions of the General Conditions of Contract.

1.05 CLOSEOUT SUBMITTALS

A. Follow Division -1 Closeout Submittals: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Requirements of the following organisations shall be conformed with, as appropriate:

1. Codes; ordinances; rules and regulations of the State of Kuwait and its lawful enforcement agencies

2. British Standard Code of Practice

B. Piping identification materials shall have self-extinguishing characteristic, shall not release toxic by-products in combustion and flame spread / fuel contributed / smoke developed rating shall be in accordance with reference standards.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Follow Division -1 Product Requirements for Product storage and handling requirements.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.09 WARRANTY

A. Follow Division -1 Closeout Submittals for product warranties and product bonds.

B. Requirements of the General Conditions of Contract and Plumbing services section 22 00 00 shall be referred to and complied with as appropriate.

1.10 EXTRA MATERIALS / SPARE PARTS

A. Follow Division -1 – Closeout Submittals for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to the compliance with the requirements and as per approval of the Engineer.

B. ACCEPTABLE MANUFACTURERS

1. Focal Displays Ltd., UK.

2. W. H. Brady and Co., USA.

3. Seton Name Plate Company, USA.

4. Or other equal and approved under provisions of the General Conditions of Contract.

2.02 LETTERING AND TEXT

A. Labelling, warning signs etc. shall be in English and Arabic. Numbering shall be in Indian numerals.

B. Lettering shall not be smaller than 6x10 mm in size; larger size letters used where appropriate.

C. Lettering on plastic and metal plates shall be etched, engraved, embossed or made otherwise in a permanent manner (stencilling on prepared surfaces excluded).

2.03 COLOURS

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

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

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

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

Sl. No.	Colour Names	Abbreviation	BS Colour No.
1	Portland Grey	PG	00 A 01
2	Goose Wing Grey	WG	00 A 05
3	Flint Grey	FG	00 A 09
4	Black	Bk	00 E 53
5	White	Wt	00 E 55
6	Shell Pink	SP	04 C 33
7	Monarch Red	MR	04 D 45
8	Azalia Red	AR	04 E 51
9	Poppy Red	PR	04 E 53
10	Cameo Cream	CC	06 C 33
11	Cinnamon Cream	IC	06 C 37
12	Orange	Or	06 E 51
13	Nectar Cream	NC	06 E 56
14	Yellow Ochre	YO	08 C 35
15	Gold Cup Yellow	GY	08 E 51
16	Aztec Yellow (Primrose)	AY	10 E 53
17	Willow Green	WG	12 B 17

18	Orchard Green	OG	12 C 39
19	Leaf Green	LG	12 D 43
20	Citrine Green	CG	12 E 51
21	Linden Green	NG	12 E 53
22	Garland Green	GG	14 E 51
23	Verona Green	VG	14 E 53
24	Turquoise	Tq	16 E 53
25	Larkspur Blue	LB	18 E 51
26	Regatta Blue	RB	18 E 53
27	Viking Blue	VB	20 C 37
28	Midnight Blue	MB	20 C 40
29	French (Trafalgar) Blue	FB	20 D 45
30	Corn Flower (Light) Light Blue	LB	20 E 51

2.04 PIPE MARKERS

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

B. Water Displays

1	Fountain Supply	Wt / VB / Wt
2	Fountain Return (Pressure)	VB / Wt / VB
3	Fountain Return (Gravity)	Wt / FG / Wt

C. Fire Protection Systems

1	Hose Reel Supply	Wt / AR / Wt
2	Wet Standpipe System	Wt / PR / Wt
3	Sprinkler System	Wt / MR / Wt

D. Plumbing Services

1	City Fresh Water Supply	Wt / LG / Wt
2	Filtered City Water Supply	Wt / VG / Wt
3	City Irrigation Water Supply	Wt / FB / Wt
4	HVAC Make up Water Supply	Wt / Vb / Wt
5	Sanitary Cold Water Supply	Wt / GG / Wt
6	Sanitary Hot Water Supply	Wt / Or / Wt

7	Sanitary Hot Water Return	Wt / SP / Wt
8	Irrigation Water Supply	Wt / CB / Wt
9	Soil and Waste Pipes	Wt / Bk / Wt
10	Vent Pipes	Wt / AY / Wt
11	Rain Water Pipes	Wt / CC / Wt

E. Liquid Fuel (Diesel / Petrol) Systems

1. Requirements of Kuwait National Petroleum Company (KNPC) shall be referred to and complied with as appropriate
2. Requirements of NFPA shall be referred to and complied with as appropriate, as minimum requirement

2.05 DIRECTIONAL ARROWS

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

2.06 STENCILS

A. Clean-cut stencils of appropriate size shall be used for making identification wording on Fire cabinets, Plant rooms etc. Paint used shall be semi-gloss enamel.

B. Identification numbering of equipment shall be stencilled on contrasting background.

2.07 PLASTIC NAME PLATES

A. Three-ply, rigid plastic name plates with black engraved lettering on light contrasting background shall be used for identifying electrical control panels, technical cupboards, plant rooms, and equipment. These labels shall be fixed by adhesives or by metal screws.

2.08 SIGNAGE (FIRE PROTECTION)

A. Aluminium plates, with painted lettering (powder coated epoxy) shall be used for identifying fire protection equipment. These shall be fixed to equipment / walls with screws.

2.09 VALVE IDENTIFICATION TAGS

A. Three-ply, rigid plastic tags with black engraved lettering on light contrasting background shall be used for identifying valves.

B. Valve tags shall have a minimum size of 40 mm (1½ inch) dia., have a drilled hole for attaching to valves with corrosion resistant metallic chain, supplied along with the tag.

2.10 WARNING GRIDS FOR BURIED SERVICES (TRACER TAPES)

A. Coloured (as coded) vinyl tapes of minimum 150 mm (6 inch) width, with the name of the service continuously printed thereon.

B. Metal-coated tapes shall be used for non-metallic pipes to enable tracing by metal detectors.

PART 3 - EXECUTION

3.01 PIPING IDENTIFICATION

A. Pipe markers shall be provided at valves and similar control gear, equipment, access doors, junctions of pipes / ducts etc. Distance between pipe markers on exposed straight runs shall not exceed six (6) meters.

B. Directional arrows shall be provided adjacent to pipe markers.

C. Framed piping identification chart shall be furnished and installed as directed.

3.02 WARNING GRIDS FOR BURIED SERVICES (TRACER TAPES)

A. Continuous warning grids shall be installed over all buried utilities at midway between the finished grade and the pipe crown in order to identify the service and as a safeguard against inadvertent damages.

3.03 VALVES IDENTIFICATION

A. Coded numbers of an established pattern shall be assigned to all valves and included in as built drawings and manuals.

B. Framed valve identification chart shall be furnished and installed as directed.

3.04 EQUIPMENT IDENTIFICATION

A. Equipment shall be numbered and these numbers shall be included in as built drawings and manuals.

3.05 MISCELLANEOUS

A. Name plates shall be provided on doors of all technical premises.

B. Identification codes / numbering shall be stencilled on all pieces of equipment, not covered otherwise.

C. Warning signs shall be provided at controls as appropriate. E.g. “Do not operate”, “Operate in the event of …..”, etc.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Piping Insulation

A. Protective Jackets

B. Accessories

1.02 RELATED SECTIONS

A.	Division-1	General Requirements
B.	Section 09 91 13	Exterior Paintings
C.	Section 09 91 23	Interior Paintings
D.	Section 22 05 53	Identification for Plumbing Piping and Equipment
E.	Section 22 11 16	Domestic Water Piping

1.03 REFERENCES

A. Pipe Insulation – [Type A]

1. ASTM C 534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
2. ASTM C 303 – Density of Insulation.
3. ASTM D 2842 – Test for water absorption of insulation specimen.
4. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
5. ASTM E84 - Surface Burning Characteristics of Building Material.
6. ASTM C 518 - Thermal Conductivity of Materials
7. ASTM G 21 - Resistance to Mould Growth
8. ASTM G-22 - Resistance to Bacteria Growth.
9. ASTM D 1622 - Test methods of density
10. Boeing BSS 7239 - Test procedure for Toxic Gas Generation by Product.
11. NFPA 90A and NFPA 90B - Standard for Installation of Air Conditioning Systems, 2009

12. UL94 - Horizontal flame spread of materials

13. UL 181 - Resistance to Mould Growth.

14. BS 476 Pt 6 – Fire Propagation test to determine a surface spread of flame.

15. BS 476 Pt 7 – Fire Test on Building Materials and Structures, Method of Test for Fire Propagation for Products.

16. BS 476 Pt 12 - Ignitibility of Product by Direct Flame Impingement.

B. Pipe Insulation – [Type B]

1. ASTM C 303 – Density of Insulation

2. EN ISO/IEC 17025 – General requirements for the competence of calibration and testing laboratories

3. DIN 52219 – Noise excitation by satisfactory water flow.

4. DIN EN 14366 – Laboratory measurement of noise from waste water installations.

C. Protective jacketing

1. BS 476 Part 6 – Method of test of Fire propagation for material.

2. BS 476 Part 7 – Fire Test on Building Materials and Structures, Method of Test of surface spread of flame for Products.

3. EN 22286 – Determination of mean mass per unit area of piece.

4. ASTM D5947-06 – Test method of physical dimension of solid plastics specimen.

5. EN ISO 527-1 – Determination of tensile properties of plastics & plastic composite.

6. ASTM D 1938-08 – Standard test method for tear propagation resistance of plastic film & thin sheeting by a single – Tear Method.

7. ASTM E408 – Standard test method for total normal emittance of surfaces.

8. ISO 4589-2 1996 – Determination of burning behavior by oxygen index.

1.04 SUBMITTALS

A. Product data, samples, schedule of application giving type of material(s) and thickness for each service and manufacturer's installation instructions shall be submitted under provisions of the General Conditions of Contract.

1.05 CLOSEOUT SUBMITTALS

A. Follow Division -1– Closeout Submittals: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Works covered by this Section shall be executed by a contractor, specialized in pipe insulation application and engaged in this trade for at least Five (5) preceding years.

B. Test certificates from an independent testing authority shall be submitted.

C. All pipe insulation should be accompanied by Manufacturer's Test Certificate.

D. Product shall be resistant to attack of algae, bacteria, vermin and the growth of moulds and fungi for Type-[A] insulation.

E. Insulation materials and coverings shall have a self-extinguishing characteristic and shall not release toxic by-products in combustion; flame spread / fuel contributed / smoke developed in accordance to the related standards as mentioned hereunder this document.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum Five (5) years documented experience of manufacturing and representation in Kuwait.

B. Applicator: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.08 PRE-INSTALLATION MEETINGS

A. Follow Division -1- Administrative Requirements: Pre-installation meeting.

1.09 DELIVERY, STORAGE AND HANDLING

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

B. Store Insulation in original wrapping and protect from weather and construction traffic

C. Prolonged storage of pipe insulation should be in cool dry place and away from direct sunlight. Store material in original packaging. Follow manufacturer's recommended storage instructions.

1.10 WARRANTY

A. Follow Division -1 – Closeout Submittals for product warranties and product bonds.

B. Requirements of the General Conditions of Contract and Plumbing services section 22 00 00 shall be referred to and complied with as appropriate.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Division -1 – Closeout Submittals for Spare parts and maintenance products.

1.12 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00-Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range.

C. Recommended by manufacturer

D. Maintain temperature before, during, and after installation for minimum period of 24 hours

1.13 FIELD MEASUREMENTS

A. Verify field measurements prior to Installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Nitrile Rubber foam Insulation - Type A

1. Armacell, KSA
2. Isopipe, Greece
3. Aeroflex, USA

B. Acoustic Insulation - Type B

1. Armacell, Poland
2. Isopipe, Greece
3. Aeroflex, USA

C. Protective Jacket

1. Armacell, KSA
2. Sebald ISO Systeme, Germany
3. Klockner Pentaplast, Germany

4. Or other equal and approved under provisions of the General Conditions of Contract.

D. Subject to the compliance with the requirements and as per approval of the Engineer.

2.02 THERMAL INSULATION

A. Type [A]: Elastomeric Closed cell nitrile rubber tubes for upto 4" dia pipe and Self-adhesive sheets/rolls for 5" & above dia pipe insulation with (Anti-Microbial and fungal protection) one side re-enforced with 7-micron aluminum foil scrim cloth, FM or Equal Third party approved, UL listed, Thermal Conductivity (K-value) 0.035/0.036 W/m.K @ 25°C / [46-50]°C, (77°F / [115-122]°F), Water Vapour permeability < 0.05 Perm-inch. Density ≥ 54 kg/m3, Complies with ASTM E-84 / Class"0" BS 476 Part 6, UL 181, ASTM G-21, ASTM G-22, Temperature Range: -183°C to +105°C. (When glued whole pipe surface; maximum temperature shall be ≥ +85°C.)

2.03 ACOUSTIC INSULATION

Type B: Material: Multilayer type consists of an acoustic aluminum barrier of 2 mm thickness and 4.5 kg/m' of weight and a decoupling polyurethane foam of 10mm. All joints and elbows shall be covered by sound absorbing self-adhesive tapes as recommended by manufacturers' acoustic performance.

Colour: Aluminum covering on a black of acoustic barrier combined with a grey foam.

Special feature: Without halogens (chloride, bromide) according to DIN/ VOE 0472, part 815.
Properties: Maximum temperature of 100°C- test according to EN 14708 and EN 14304. Weighted sound reduction index (Rw) and Sound transmission class(STC) shall meet the required sound levels in the space and shall be tested according to EU 6439.

Density: Thickness 12 mm (2 mm barrier of 2500 +/- 500 kg/m3 and 10 mm of polyurethane foam: 25 +/- 1.5 kg/m3) = 4.5 to 5.3 kg/m' as minimum or higher to meet the required acoustic performances.

2.04 POTECTIVE JACKETS

A. For all size of insulated pipes (hot water supply & return, and cold water) exposed to view or inside mechanical rooms shall be protected with the surface covering made from a multi-layer composite film of metallic appearance with Aluminum intermediate layer UV protection with Polymer backing with inbuilt fire retardant.. Material shall be 350µm in thickness, with a total weight of ≥500g/m2, and on pipe section have a permanent curl.

(OR) shall be cladded with aluminum sheet of 0.5mm thickness.

.

B. For all size of insulated pipes (hot water supply & return, and cold water) *exposed to sun or inside the shafts, shall be protected with specified insulation, which shall be cladded with Aluminum sheet of 0.64mm.*

C. Aluminum Pipe Jacket for pipe insulation

1. [ASTM B209M].
2. Thickness: 0.64 mm thick sheet.
3. Finish: Smooth
4. Joining: Longitudinal slip joints and (50 mm) laps.
5. Fittings: 0.4 mm thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: (10 mm) wide; 0.38 mm thick aluminum. 0.25 mm thick

stainless steel.

2.05 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping (40 mm) diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping (50 mm) diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than (150 mm) long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with [aluminum] [stainless steel jacket] single piece construction with self-adhesive closure. Thickness to match pipe insulation.

F. Tie Wire: (1.22 mm) stainless steel with twisted ends on maximum (300 mm) centers.

G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

I. Adhesives: Compatible with insulation, water based non-flammable type as per manufacturer’s recommendation. Adhesives must be provided from the same source.

2.06 PIPE SUPPORT & INSERTS:

1. Inserts shall be NBR based high density load bearing with specific gravity of > 140Kg/m3 suitable for constant working temperature range of -40° to 105°C.

PART 3 - EXECUTION

3.01 CO-ORDINATION

A. Requirements of Section 23 00 00 shall be referred to and complied with in all respects, without prejudice to requirements stated herein.

B. Insulation shall be installed in accordance with manufacturer's instructions and requirements of reference standards.

3.02 PREPARATION

A. Insulation shall be installed only after the pipework has been tested and approved and painted with two coats of approved primer paint, where required.

B. Pipework shall be cleaned of all dirt prior to installation.

3.03 INSTALLATION

A. Insulation materials shall be installed in strict accordance with manufacturer's instructions.

B. Apply insulation only after surface has been cleaned.

C. Ensure no air pockets are present after installation

D. For pipe size up to and including 4” pipe size use preformed pipe sections to insulate the pipe. Apply the glue to the longitudinal edges and the end to end joints. Wait until glue is tack dry and press the surface together to ensure proper joint is achieved

E. For pipe size 4” and above use self-adhesive flat sheets and apply glue to the longitudinal edges, wait until glue is tack dry and press the surface together to ensure proper joint is achieved.

F. All longitudinal laps and butt joints should be sealed with water based glue recommended by manufacturer and 3mm thick self-adhesive NBR based tape shall be applied.

G. Any minor surface cuts should be covered with self-adhesive NBR based tape made up with same material as insulation to ensure to break the thermal and acoustical bridges.

H. Self-adhesive tape recommended by manufacturer must be applied over all kinds of joints of insulation after 36 hours of drying time of adhesive.

I. All the insulation in Plant room if not cladded shall be coated with manufacturer’s recommended protective paints

J. Insulation material around valves and equipment to be easily removable.

K. Adhesives shall be used at all seams and joints of all insulation.

3.04 THERMAL INSULATION FOR PIPING

Piping		Type	Pipe Size mm	Thickness mm (inch)
A.	Sanitary Hot water supply & return			
1.	In partition walls or chases	A	All sizes	9 (3/8)
2.	All other areas	A	Up to 100mm	19 (3/4)
3.	All other areas	A	Above 100mm	25 (1)
B.	Sanitary cold water piping in ceiling Spaces used as HVAC return plenum(s)	A.	All sizes	13(½)

3.05 ACOUSTIC INSULATION FOR PIPING

Piping		Type	Pipe Size mm	Thickness mm (inch)
A.	Drainage Pipes exposed to View/Outdoors	B	All sizes	5 (1/4)
B.	Soil and waste piping in shafts and Ceiling spaces	B	All sizes	5 (1/4)
C.	Storm water drainage piping in shafts and ceiling spaces	B	All sizes	5 (1/4)

END OF SECTION

SECTION 22 08 00

COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Purpose of Plumbing (Water Supply, Water Features; Sanitary and Storm Drainage, Diesel Fuel Supply and Irrigation) Commissioning

B. Commissioning Objectives

C. Plumbing commissioning Task

D. Plumbing Equipment and Systems to Be Commissioned.

E. Contractor responsibilities.

F. Acceptance Test

1.02 RELATED SECTIONS

A.	Section 01 91 00	Commissioning
B.	Section 22 05 00	Common Work Results for Plumbing
C.	Section 22 05 13	Common Motor Requirements for Plumbing Equipment
D.	Section 22 05 16	Expansion Fittings and Loops for Plumbing Piping
E.	Section 22 05 19	Meters and Gages for Plumbing Piping
F.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
G.	Section 22 05 48	Vibration and Seismic Control for Plumbing Piping and Equipment
H.	Section 22 05 53	Identification for Plumbing Piping and Equipment
I.	Section 22 07 00	Plumbing Insulation
J.	Section 22 11 16	Domestic Water Piping
K.	Section 22 11 23	Domestic Water Pumps
L.	Section 22 13 16	Sanitary Waste and Vent Piping
M.	Section 22 13 29	Sanitary Sewerage Pumps
N.	Section 22 14 13	Facility Storm Drainage Piping
O.	Section 22 14 29	Sump Pumps

P. Section 22 32 00 Domestic Water Filtration Equipment

Q. Section 22 33 00 Electric Water Heaters

R. Section 22 40 00 Plumbing Fixtures

S. Division 33 Liquid Fuel Distribution

1.03 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Guideline 0-2005 the Commissioning Process

B. AWWA – American Water Works Association

C. National Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Building Systems Commissioning.

1.04 SUBMITTALS

A. Division 1 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings

C. Product Data

D. Samples

E. Design Data: Indicate Design criteria and show calculations. Submit sizing methods/calculations sealed by a registered professional engineer.

F. Manufacturer's Installation Instructions: Submit special procedures.

G. Manufacturer's Certificate: Certify if products meet or exceed specified requirements.

H. Manufacturer’s Field Reports: Indicate results of inspection by manufacturer’s representative.

1.05 COMMISSIONING SUBMITTALS

A. Division 1 – Commissioning: Requirements for commissioning submittals.

B. Draft Forms: Submit draft of system verification form and functional performance test checklist.

C. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.06 CLOSEOUT SUBMITTALS

A. Refer and Comply with Division 1 – Closeout Submittals: Requirements for submittals.

B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.

C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with Kuwait Ministry of Public Work's (MPW) / Kuwait Ministry of Electricity and Water/Directorate General Civil Aviation (DGCA) standard and Kuwait Fire Department.

B. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.09 PRE-INSTALLATION MEETINGS

A. Refer and comply with Division 1 – Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer and comply with Division 1 – Product Requirements for Product storage and handling requirements.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 WARRANTY

A. Refer and comply with Division 1– Closeout Submittals for product warranties and product bonds.

1.12 EXTRA MATERIALS / SPARE PARTS

A. Refer and comply with Division 1 – Closeout Submittals for Spare parts and maintenance products.

1.13 COMMISSIONING MEETINGS

A. Section 01 91 00 – Commissioning: Requirements for commissioning meetings.

B. Attend initial commissioning meeting and progress commissioning meetings as required by Engineer/Commissioning Authority.

1.14 CONTRACTOR RESPONSIBILITIES

A. Equipment or System Installer Commissioning Responsibilities:

1. Attend commissioning meetings.

2. Ensure testing, adjusting, and balancing department/agency performs assigned commissioning responsibilities as specified below.

3. Ensure testing, adjusting, and balancing department/agency performs assigned commissioning responsibilities as specified.

4. Provide instructions and demonstrations for Owner's personnel.

5. Ensure subcontractors perform assigned commissioning responsibilities.

6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.

7. Develop startup and initial checkout plan using manufacturer's startup procedure and functional performance checklists for equipment and systems to be commissioned.

8. During verification check and startup process, execute plumbing related portions of checklists for equipment and systems to be commissioned.

9. Perform and document completed startup and system operational checkout procedures, providing copy to consultants/owners.

10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.

11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.

12. Provide personnel to assist Project Authority during equipment or system verification checks and functional performance tests.

13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests. Procedures to be approved by the Engineer/owner prior to the commencement of testing, adjusting and balancing.

14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for

startup.

15. Provide factory supervised startup services for equipment and systems specified in Division-1 General conditions of Contract. Coordinate work with manufacturer and Commissioning Authority.

16. Perform verification checks and startup on equipment and systems as specified.

17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.

18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.

19. Conduct Plumbing system orientation and inspection.

20. Ensure all required instruction and demonstrations are provided to the owner's designated operating staff. Coordinate Commissioning effort with Owner and with other trades. Contractor responsible to provide information to the USGBC for a LEED NC 2009 Version

21. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.

22. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.

23. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.15 SCHEDULING

A. Refer and comply with Division 1 – Administrative Requirements 01 32 16 – Construction Progress Schedule Requirements for scheduling.

1. Prepare schedule indicating anticipated start dates for the following:

2. Piping system pressure testing.

3. Piping system flushing, cleaning and disinfection.

4. Equipment and system startups.

5. Automatic temperature control system checkout for Solar water heating systems.

6. Testing, adjusting, and balancing.

7. Plumbing system orientation and inspections.

8. Operation and maintenance manual submittals.

9. Training sessions.

B. Schedule seasonal tests of equipment and systems (for Irrigation systems in summer and for solar water heating systems in winter) during peak weather conditions to observe full-load performance.

C. Schedule occupancy sensitive tests of equipment and systems during conditions of either minimum and maximum occupancy or use.

1.16 COORDINATION

A. Refer and comply with Division 1– Project Meetings.

B. Notify Commissioning Authority minimum of four weeks in advance of the following:

1. Scheduled equipment and system startups.

2. Scheduled automatic temperature control system checkout.

3. Scheduled start of testing, adjusting, and balancing work.

C. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

1.17 PLUMBING EQUIPMENT AND SYSTEM TO BE COMMISSIONED

A. Equipment and Systems to be Commissioned but not Limited to the followings:

1. Fresh and Sanitary Water Tanks

2. Domestic Water Supply Pumps.

3. Piping systems.

4. Variable frequency drives.

5. Constant speed drives

6. Electric water heating systems

7. Cartridge filters

8. Inline filters

9. Terminal filters

10. Sanitary waste water pumps

11. Sanitary fixtures and accessories

12. Plumbing fixtures & accessories

13. Sanitary drain piping

14. Storm water pumps

15. Storm water piping

16. Condensate water piping
17. Non- Potable cold water pumps
18. Hose Bibs
19. Wall Hydrants
20. Meters and gauges
21. Equipment sound control.
22. Diesel Piping
23. Day tanks
24. Master Controllers
25. Equipment vibration control.
26. Electrical interlocking with Mechanical Equipment
27. Testing, Adjusting and Balancing work.
28. Interfacing with building Management system

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 INSPECTION, TESTS, COMMISSIONING AND ADJUSTMENTS

A. During the manufacture (at Contractor's premises only), installation and after completion of works; the system, sections of the system or its components shall be tested by the Contractor / specialist Subcontractor in the presence of the Engineer, as directed below or elsewhere. Contractor shall procure all testing instruments and accessories and bear all costs in connection with the same.

1. Basic materials for conformity with the specified standards
2. Supports and anchors for ability to withstand required loads
3. Piping in general for line, level and slopes
4. Wall mounted sanitary fixtures with a dead weight of 150 Kg
5. Pumping equipment for the specified flow, head, controls, safety interlocks and

alarms; noise criteria, etc.

6. Heat transfer equipment for full load capability, controls, safety interlocks, and alarms and operation of safety valves

7. Filtration equipment for flow, head loss, filtration fineness, controls, alarms, regeneration etc.

8. Control system for operating ranges, tolerances, cut-out, alarms etc.

9. Sanitary fixtures for operation of fittings and proper fixation

10. Water supply systems for required flow and pressure at outlets, simulated peak flow conditions (open sectional control valves with estimated no. of outlets in open condition, in series).

11. Drainage systems for simulated peak-flow conditions and performance of trap seals (by simultaneous discharge of all water closets on the stack or groups).

B. Following items / systems shall be balanced / regulated.

1. Pressure switches for cut in and cut out pressures

2. Float switches for cut-in and cut-out levels

3. Operation and retention periods of timers and time switches

4. Globe valves on pump discharge for design flow

5. Balancing valves in circulating systems for equal or proportionate flow

6. Thermostats for cut in cut out temperatures or range

7. Angle valves on fixture supply for regulated flow

8. Remote Control Valves on Irrigation pipes for regulated flow

9. Basic materials for conformity with the specified standards

10. Controller for start time, operating period and cut off; tolerances, alarms etc.

11. Control valves for water tightness; cut-in and cut-out; discharge pressure and flow

12. Electrical wiring for continuity and dielectric resistance

13. Irrigation program - flow matched with the source capacity

14. Irrigation heads throw and direction

15. All of the above should be completed for Irrigation prior to the planting.

C. Testing of piping systems:

1. Refer to respective sections of Specifications for Water Supply, Water

Features; Sanitary and Storm Drainage, Diesel Fuel Supply and Irrigation

D. Install balancing valves, access doors, test ports, and pressure and temperature taps required by Commissioning Authority

E. Place all Plumbing systems and equipment into full operation and continue operation during each working day of commissioning.

3.02 UTILITYCONNECTIONS

A. Contractor shall co-ordinate with MPW, MEW and other relevant governmental agencies, obtain all necessary information on available utility mains, obtain approvals and permits and pay all fees and expenses in this respect.

1.	Fresh water	MEW Engineering Department
2.	Irrigation water	MEW or MPW
3.	Sewerage	MPW Sanitary Department
4.	Storm Water	MPW Roads Department
5.	Diesel Fuel supply	Kuwait National Petroleum Company (KNPC)

B. Contractor shall prepare coordinated working drawings and application forms with all required information, submit to the relevant authorities and obtain their approval.

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

D. Manholes within and outside the site boundary (on the utility line or otherwise) shall be executed to MPW standards, in all respects.

E. Drop connections shall be executed on the inlet to sewerage manholes and benching shall be provided at the manhole bottom.

F. Drop connections shall be executed at the inlet to storm water manholes, when the drop exceeds 500 mm. Benching shall be provided at the bottom, where required.

3.03 SYSTEM DEMONSTRATIONS

A. Services of a competent engineer shall be provided by the Contractor to supervise the commissioning of all equipment and to train the Company's personnel in all aspects of the same during a five (5) working days’ period, during normal working hours; after substantial completion of the project.

B. System demonstrations shall be conducted only after substantial completion of the project. A minimum of one week's written notice shall be given and the Company's written consent obtained, prior to such demonstrations.

C. Contractor shall co-ordinate with the relevant governmental agencies; prepare / submit application(s) for required services; pay all fees and expenses; facilitate their visit to site; test and demonstrate the system for their approval; obtain approvals and submit the same to the Company.

3.04 ACCEPTANCE TESTING

A. An acceptance test of all the components of Plumbing system shall be performed by the Contractor in the presence of the Owner's representative and the Local Fire Personal. Upon completion of the successful test, the Contractor shall so certify in writing to the Owner and General Contractor.

B. The Contractor shall also utilize all sub-contractors such as sheet metal, balancing, piping, controls and commissioning agent, and other contractors such as electrical HVAC as required to perform this acceptance test.

C. The acceptance test shall be performed to determine that the protective measures required as outlined in NFPA 90A and shall function when needed in order to restrict the spread of fire and smoke.

D. The acceptance test shall include testing the Plumbing systems to determine their full function ability and in compliance with NFPA 90A and the sequence of operation. All controls and equipment shall be modulated throughout their entire ranges and adjustments shall be made for optimum performance.

1. Portions of control or alarm systems are permitted to have standby power or other emergency modes of operation.

2. The tests shall be performed to determine that the system operates under the standby power or emergency operation mode as well as under normal conditions.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Water Supply Pipes, Pipe Fittings and Valves

B. Sanitary Cold, Hot and Hot Water Return Piping Systems

1.02 RELATED SECTIONS

A.	Division 01	General Requirements
B.	Division 08	Openings
C.	Section 22 05 16	Expansion Fittings and Loops for Plumbing Piping
D.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
E.	Section 22 05 48	Vibration and Seismic Control for Plumbing Piping and Equipment
F.	Section 22 05 53	Identification for Plumbing Piping and Equipment
G.	Section 22 07 00	Piping Insulation
H.	Section 22 11 19	Domestic Water Piping Specialties
I.	Section 22 11 23	Domestic Water Pumps
J.	Section 22 30 00	Plumbing Equipment
K.	Section 22 32 00	Domestic Water Filtration Equipment
L.	Section 22 40 00	Plumbing Fixtures

1.03 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI B 2.1- Pipe Threads.
2. ANSI B 16.5- Steel Flanges.
3. ANSI B 16.10- Face to face dimensions of cast iron gate, globe and check valves.
4. ANSI B 16.1 - End flange dimensions of cast iron valves.
5. ANSI B 16.21- Non-metallic Gaskets for Pipe Flanges
6. ANSI B 16.24- End Flange Dimensions of Bronze Valves or BS 5351, BS1560.
7. ANSI B 16.34- Pressure Temperature Ratings for Valves.
8. API 600 - General design specifications for gate, globe and check valves.

B. Deutsches Institute Fuer Normung (DIN)

1. DIN 8078 -Polypropylene (PP) Pipes, general quality requirements.
2. DIN 8077 -Polypropylene (PP) Pipes, dimensions.
3. DIN 16962- Pipe Joint assemblies and fittings for polypropylene pressure pipes.

C. ASTM

1. ASTM D 3212 - Flexible elastomeric joints.
2. ASTM F Electrometric seals (gaskets) for joining plastic pipe

D. AWS

1. AWS A 5.8 - Brazing filler metal
2. AWS D 10.9 - Standard for building services piping

E. British Standard Institute (BS)

1. BS 4375 - PTFE tape for pipe thread sealing application.
2. BS 5556 - General requirements for dimensions and pressure ratings for pipe of thermoplastic materials (Metric Series)
3. BS EN 6920 Materials testing service for manufacturers and suppliers of non-metallic materials used in contact with drinking water within buildings
4. BS 7291-1:2001 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. General Requirements.
5. BS 7291, Part 2 - Thermoplastic pipes and fittings for hot and cold water for domestic purposes: pipes and associated fittings.
6. BS 8010 - Code of practice for pipelines.

F. German Welding Society:

1. DVS 2207 - Welding of thermoplastic pipes and fittings
2. DVS 2208 - Welding machines and devices for thermoplastics

G. International Organization for Standardization:

1. ISO 13760:1998. Plastics pipes for the conveyance of fluids under pressure
2. ISO 15876-1 - Plastics piping systems for hot and cold water installations

1.04 SUBMITTALS

A. Product data including data on pipe materials, fittings, valves and accessories; recommended coating materials; samples and manufacturer's installation instructions or recommendations shall be submitted under provisions of the General Conditions of Contract.

B. Copies of valves ordering schedules shall be submitted for approval prior to placing order.

1.05 CLOSEOUT SUBMITTALS

A. Division 1 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

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

B. 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 adapters, conversion spools, mating flanges and the like, with the written approval of the Engineer.

C. Pipes and fittings used in the works shall bear label, stamp, standard of manufacturer, type, class or rating etc. continuously printed or marked. Materials without such identification shall be rejected. For warranty purposes, all pipes, valves and fittings shall be provided from the manufacturer.

D. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for

E. Plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

G. Piping Materials shall be tested and certified by accredited association / institute such as but not limited to SKZ, DVGW, WRAS.

H. Requirements of Section 22 00 00 shall be referred to and complied with as appropriate.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing work of this section must have to be approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Comply with Division1 - Administrative Requirements Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE AND HANDLING

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

B. Pipes shall be stored not in direct sun light and will be placed on elevated racks and the ends kept closed with factory-manufactured plugs to prevent the entry of foreign matter.

C. Plastic and rubber products shall be stored out of direct sunlight.

1.10 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Comply with Division1- Execution and Closeout Requirements for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Manufacturers: Subject to the compliance with the requirements and as per approval of the Engineer.

B. Acceptable Manufacturers: Polypropylene Pipes, Fittings and Valves

1. George Fischer, Turkey
2. Poloplast/Polymelt, Germany
3. Aquatherm, Germany
4. Or other equal and approved under provisions of the General Conditions of Contract.

2.02 GENERAL

A. All pipes, valves, fittings and support shall be supplied from approved sources as per standards.

2.03 PIPES MATERIAL

Service		Location	Type
A	Sanitary Fresh water; cold and hot water supply and return pipes, all sizes.	All areas above grade	Polypropylene (PPR 100) Faser Composite SDR 7.4 to DIN 8077 & 8078 – PN20
B	Fresh water service connection Up to 50 mm DN (Downstream of MEW water meter)	All areas above or below grade	Polypropylene (PPR 100) Faser Composite SDR 7.4 to DIN 8077 & 8078 – PN20
C	Tanker fill connection	From Meter Cabinet to plant room	Polypropylene (PPR 100) Faser Composite SDR 7.4 to DIN 8077 & 8078 – PN20
D	Water Storage Tanks Overflow	All	Polypropylene (PPR 100) Faser Composite SDR 7.4 to DIN 8077 & 8078 – PN20

2.04 Joints

A. Type of joints for Polypropylene (PPR100)

1. Socket fusion Welding for pipes up to DN50
2. Electro fusion or Butt welding for pipes DN65 and above
3. Electro-fusion welding to be used for pipes installed in tight spaces where socket fusion or butt fusion welding is difficult.

B. Pressure ratings of joints. All figures stated are working water / air pressures (WOG) at

1. 121 deg.C (250 deg.F).
2. PPR pipe: 2000 Kpa (290 psig).

C. Any metal parts inlets (fittings, adapters, Unions, valves) should be brass only, Reference the DIN 50930, (Nickel plated threaded parts are not acceptable) .

D. The polypropylene fittings exposed to direct sunlight should be manufactured with UV protection exterior PP-R layer.

2.05 Flanges, Unions and Couplings

A. For pipe sizes 50 mm (2 inch) nom. dia. and under: Plastic Piping: Unions of respective materials, solvent or fusion ends.

B. For pipe sizes 65 mm (2 1/2 inch) nom. dia. and over: Plastic piping: Flanges of respective materials, solvent or fusion ends.

C. Use compressed fiber gaskets at all flanges

D. Dielectric connections: Use dielectric unions with one end malleable iron threaded and the other end copper solder for pipe sizes 50 mm (2 inch) nom. dia. and under. Use dielectric flanged fittings for pipe sizes 65 mm (2 1/2 inch) nom. dia. and above. Both unions and flanges shall have water impervious isolation barrier certified to withstand a minimum 600 volts on a dry line with no flashover.

E. All flanges, unions and couplings shall be pressure rated as the pipe joints.

F. Provide all pipes and fittings from one manufacturer.

2.06 VALVES

A. Refer and Comply with section 22 05 23 "General- Duty Valves for Plumbing Piping."

B. Pressure Rating

1. All Valves shall be pressure rated as the pipe joints or higher.

2. Contractor shall allow for selecting higher pressure rated valves to meet the valve construction features

C. Valve Operators

1. Hand wheels / operating levers shall be provided for valves as appropriate.

2. One key / wrench of appropriate size shall be provided for each lever operated valve installed

3. Chain operated sheaves shall be provided for valves located more than 2 m (7 feet) above floor and valves DN200 and larger in sizes. Chains shall be extended to about 1,500 mm (5 feet) above floor and hooked to clips, in order to clear walkways and equipment

4. Geared operators shall be provided for valves, DN 200 (8 inch) and larger in size

2.07 WATER SUPPLY PIPING

A. General

1. Polypropylene pipes shall be manufactured from PPR100 grade resin.

2. The Polypropylene pipes shall be SDR-7.4, multi-layer (Reinforced with glass fiber) and comply with standards DIN 8077, DIN 8078, EN ISO 15874, ASTM2389 .

3. The polypropylene pipes exposed to direct sunlight should be manufactured with UV protection exterior PP-R layer.

OR

Protected with insulation and aluminum jacketing

4. The polypropylene pipes should labeled according to standards with the below information:

Outer diameter × wall thickness, Product name, Designation of material, SDR wall thickness ratio, Pipe series S, Dimensional class according to EN ISO 15874, Class of application and admissible operational pressure according to EN ISO 15874, Working pressure, Suitability for drinking water, Impermeability to light, Product standards, Certificates, approvals, Material labelling, Machine number, Date of manufacture & Manufacturer.

5. Furnish all piping, fittings, hangers, etc. to make apparatus and sanitary ware connected, completed, and ready for regular use and operation. Unless otherwise noted, connect all apparatus, equipment and sanitary ware in accordance with manufacturer's standard details, as approved.

B. PP-R Base Material:

1. According to DIN 8078 PP-R pipe is made of polypropylene type 3. The dimensions of PP-R pipes are corresponding to DIN 8077, pipe-series 6 PN 20. The pipes are tested and supervised according to DIN 8078.

C. Processing of the PPR:

1. According to the guidelines for plastic welding (DVS 2207, part 11) all pipe joint assemblies and fittings of the PPR-pipe-system are welded. Continuous-working-pressure up to 20 bar, continuous working temperature up to 80°C.

D. Field of Application:

1. The Faser Composite PPR-pipe-system is used for cold and hot water supply systems.

E. Expansion Compensation

1. In case of open placed PPR pipeline installation, the competent axial motional compensation must be calculated during the planning.
2. In most cases, direction turns can be used for taking the extension in connection with the course of the strand of pipes (bending side).
3. If the extension cannot be included by a bending slide, the extension will be compensated by an expansion loop.
4. Piping expansion and compensations calculations shall be submitted for engineer's approval. Pipe manufacturer recommendations shall be followed for the expansion and compensations requirements.

F. Gliding Clamping

1. Gliding clamping shall make the movement of the pipeline in axial direction possible, without damage to the pipe. This is specially the case within the range of direction turns. The gliding clamping have to be fixed at a stiff solid, so that the transfer of tensions on the pipe system is stopped.
2. The axial movement of the pipeline may not be hindered by a fitting or armature, arranged beside the pipe clamps, also pay attention to a free toe piping.

G. Guidelines for PPR Welding

1. PPR pipe welding has to be carried out according to DIN guidelines and manufacturer's recommendations.

H. Arrangements

1. All pipes shall be free from cuts, dents, or other surface damage. At the time of final inspection, damaged pipe shall be removed and replaced with new pipe.
2. Generally, all internal pipework shall be concealed in ducts or chases in concrete, brick or block walls, unless otherwise shown or specified on the drawings.
3. The contractor is responsible for the correct marking out of the positions of all necessary holes in walls, floors, ceiling, etc. for pipes and pipe supports. No pipe or other apparatus shall be installed in such a way as to interfere in any way with the full swing of the doors.
4. The run arrangement of all pipes shall be approximately as shown on the drawings and as directed during installation. They shall be as straight and direct as possible, but forming right angles or parallel lines with building walls and other pipes and be neatly spaced.
5. Clearance between exposed pipes and the finished surface of wall, partition or ceiling, shall be not less than 50 mm.
6. Where pipe sizes shown or specified differ from the connection sizes of pumps, fixtures, outlets, etc. reducing fittings shall be installed to pumps etc. Bushing will not be allowed unless specifically approved.

I. Sleeves

1. The contractor shall provide heavy duty galvanized steel sleeves large enough to accommodate pipe, to pass entirely through floor, ceiling, wall or partitions.
2. Provide sleeves in roofs and water-proofed floors with integral flashing flanges thoroughly nipped into the water-proofing membrane. The space between caulked with graphite and a suitable plastic and water-proof caulking

compound approved by the Consultant. The sleeves shall extend approximately 100mm above the finished floor and roof.

3. Sleeves through outside walls above the foundation shall be extra heavy cast iron pipe sleeves properly caulked to ensure water tight joints.

J. Flashings

1. All pipes extending through roofs shall be copper or aluminum flashed to make the roof water-tight.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Pipes and tubes shall be cut perpendicular to the axis, with approved cutting tools; the ends reamed and burrs removed.

3.02 SPACING AND LOCATION

A. Piping shall be installed in such a way that conserves building space and not interfering with the use of space.

B. Exposed piping shall be installed parallel or at right angles to the building walls, except where otherwise shown on the Contract drawings.

C. Minimum clearances shall be provided between piping covered by this Section and those of other trades.

D. Adequate clearance shall be provided around the piping for the installation of insulation and access to valves and fittings.

E. Piping shall be grouped at common elevations, wherever possible.

F. Piping shall be installed in such a way that allows for expansion and contraction without stressing pipe joints or connected equipment.

G. Access doors shall be provided where valves and fittings are not exposed. Size and location of access doors shall be coordinated with relevant Sections.

3.03 PIPE FITTINGS

A. Manufacturer’s fittings shall be installed where changes occur in pipe sizes (use of site fabricated fittings or bushings shall not be permitted).

B. Tapered, factory manufactured reducer fittings (eccentric type at suction and concentric type at discharge) shall be installed at pump connections. Eccentric reducer fittings shall be installed with level crown.

C. Factory manufactured fittings shall be installed where changes occur in pipe direction (Bending or forming of piping shall not be permitted without written permission of the Engineer).

D. Connections shall not be made between piping of different services, under any circumstance. Existence of any one such connection in the project, whether temporary or permanent, shall make the Contractor liable for an anti-confusion test for all of the concerned services.

3.04 SLOPES AND INVERTS

A. Water supply piping shall be sloped to facilitate complete drainage of the piping for maintenance purposes.

3.05 PROTECTION DURING CONSTRUCTION

A. Ends of piping shall be kept closed with factory manufactured plugs or blind flanges with integral indicating flags, to prevent the entry of foreign matter, during the progress of the work. Such plugs or flanges shall be removed on completion of the works.

B. Water supply outlets in wet areas shall be kept closed with threaded (uPVC) pipe stub with one end crimped or closed otherwise until the time of installing the outlet fittings.

C. Piping surface shall be protected from splashes of cement, plaster, paint and similar construction materials.

D. Piping shall be blown out using dry compressed air, prior to testing.

3.06 SPECIALITY CONNECTORS

A. Chrome plated brass extension pieces shall be installed at the water supply piping outlets for sanitary fittings in wet areas. These shall be of variable length for making the outlet flush with the wall finish and shall have internal hexagonal waterway for fixation by Allen keys.

3.07 TESTING OF PRESSURISED PIPING

A. Pipes shall be jointed, plugged and shall have been in position for at least 24 hours, before the tests are carried out.

B. Piping shall be tested for line, gradient and water tightness. Contractor shall furnish all labor, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer. A minimum of two (2) # identical pressure gauges shall be installed at extremities of the piping circuit to be tested.

C. Piping shall be filled with clean fresh water, leaving all high points open to allow for purging of air. A soaking period of at least 24 hours shall be allowed for cement-lined pipes.

D. System shall be pressure tested using manual pumps in increments of 25 % of the test pressure. A standing period of 10 minutes shall be allowed after each pressure increment. Pressure testing using motor driven pump shall not be permitted.

E. System shall not be over-pressurized under any circumstance. Calibrated pressure relief valves shall be installed in the tested circuit, where test pressure is close to the maximum permissible working pressure of any of the system components.

F. Valves and control devices shall be kept in the open position, during testing. After completion of pressure test valves shall be closed, one at a time, starting from the pressure release end, so as to ensure tightness of the valve.

G. Piping shall be tested with water to a pressure of 1.5 times the system working pressure, whichever is greater, but limited to 1,724 kPa (250 psig). Pressure shall be maintained for at least 4 hours. Circuit temperature shall be recorded along with the pressure readings and pressure fluctuations due to ambient temperature variations shall be allowed for.

H. Joints shall be checked for leaks by swabbing with a dry tissue. Drop in pressure to the order of 10 kPa (1.5 psig) per hour, but without any visible leaks, shall be considered as acceptable.

I. Sanitary fixture chrome fittings shall not be subjected to the test pressure.

J. Piping shall be tested in segments during the progress of the work. An official log book shall be maintained for recording the tests carried out on sections of piping, including test pressure, date of test and approval signature of the Engineer’s representative.

3.08 PIPE BRACKETS AND SUPPORTS

A. Pipe Brackets and Supports for plastic piping.

1. Proprietary fixings supplied by the pipework manufacturer for specific use with the pipework system.

2. Malleable iron or steel holder bats for building in or bolting, or screwing to the structure.

3. Purpose made supports.

3.09 NOMINAL AND ACTUAL PIPE DIAMETERS

A. Equivalence between sizes as defined on the Drawings and as indicated in the table below:

Nominal Metric Diameter As shown on Drawings	PPR-100 Faser SDR7.4	
	Pipe OD	Pipe ID
mm	mm	mm
15	20	14.4
20	25	18.0
25	32	23.2
32	50	36.2
40	63	45.8
50	75	54.4
65	90	65.4
75 / 80	110	79.8
100	160	116.6

3.10 DISINFECTION OF SANITARY WATER SUPPLY PIPING

A. Recommendations of the piping system manufacturer shall be sought and conformed in respect of disinfection of plastic pressure piping.

B. System shall be checked for completion; flushed and cleaned, prior to the starting of the disinfection work.

C. pH of the water to be treated shall be maintained between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (diluted hydrochloric acid).

D. Disinfectant, free chlorine in liquid, powder, or tablet form, shall be added to obtain 50 to 80 mg/L of residual chlorine.

E. System piping shall be filled with chlorinated water and water shall be bled from a minimum 15 percent of outlets to ensure the even distribution of the disinfectant and test for the disinfectant residual.

F. Disinfectant shall be maintained in the system for 24 hours.

G. Temporary warning signs in both Arabic and English shall be installed at conspicuous places throughout the Project against using the chlorinated water.

H. Treatment shall be repeated if the final disinfectant residual tests less than 25 mg/L, at any outlet.

I. System shall be flushed until disinfectant residual is equal to or less than that of the incoming water or 1.0 mg/L.

J. Samples shall be taken no sooner than 24 hours after flushing, from the remote outlet of each riser and from the water entry and analyzed in accordance with AWWA C 601. Results of the analysis shall be submitted to Engineer for approval.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Suction Strainers

B. In-line `Y' Strainers

C. Backflow Preventer(s)

D. Vacuum breakers

E. Trap Primers

F. Automatic Pressure Reducing Valves

G. Automatic Relief Valves

H. Water Hammer Arresters

I. Hose Bibs and Hydrants

J. Electronic Flow Meters

1.02 RELATED SECTIONS

A.	Section 22 00 00	Plumbing
B.	Section 22 05 00	Common Work Requirements for Plumbing
C.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
D.	Section 22 11 16	Domestic Water Piping
E.	Section 22 13 16	Sanitary Waste and Vent Piping
F.	Section 22 14 29	Sump Pumps
G.	Section 22 40 00	Plumbing Fixtures

1.03 REFERENCES

A. British Standards:

1. BS 729 - Specification for Hot Dip Galvanized Coatings on Iron and Steel articles (ASTM A 123: Zinc Coating [Hot Dip Galvanizing] on Fabricated Steel Products / ASTM A 153: Zinc Coating on Iron and Steel Hardware)

2. BS 1452 - Grey Iron Castings

3. BS 5493 - Code of Practice for protective coating of Iron and Steel Structures against Corrosion

4. BS EN 1825 - Grease Separators

5. BS 497 - Cast Iron Covers and Frames

B. European Standard:

1. EN 124 - Loading Class of Covers and Frames

1.04 SUBMITTALS

A. Product data, samples, installation details, selection criteria and ordering schedule, listing types against use and location under provisions of the General Conditions of Contract.

1.05 QUALITY ASSURANCE

A. Vacuum breakers, trap primers, hydrants etc. shall be tested and certified for conformity with the requirements of ASSE standards.

B. Water hammer arresters shall be tested and certified for conformity with ANSI standards.

C. Pressure relief valves and pressure and temperature relief valves shall be tested and certified for conformity with the requirements of ASME standards.

D. Construction of the specialities shall be of corrosion resistant materials like cast iron, stainless steel or dezincification resistant copper alloys (bronze / brass).

E. Items of similar nature shall be products of the same manufacturer, as far as practicable.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.07 CLOSEOUT SUBMITTALS

A. Refer and Comply with Division-01 - Closeout Procedures

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.08 DELIVERY, STORAGE, AND HANDLING

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

B. Products shall be stored in shipping cartons, on labeled racks, until time of installation.

C. Factory calibrated items like gauges; relief valves etc., which are dropped, subjected to shock or damaged otherwise, shall be stored separately, with appropriate labels; until completion of works. A record of the same shall be maintained for Engineer's inspection.

1.09 WARRANTY

A. Refer and Comply with Division-01– Product Warranties and Guarantees

1.10 EXTRA MATERIALS / SPARE PARTS

A. Refer and Comply with Division-01 - Closeout Procedures for Spare parts and maintenance products.

B. Spare parts shall be 2% or a minimum of 1 of each type and size of specialty used in project

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:

1. Jay R. Smith

2. Limatec
3. Watts
4. Leonard
5. Danfoss/Socla
6. Claval
7. Woodford
8. Geberit
9. ACO
10. Kuwait Foundry
11. Howe Green
12. Zurn
13. Sensus
14. Crane
15. Or other equal and approved under provisions of the general conditions of contract and approved by the Engineer.

B. Manufacturers: Subject to the compliance with the requirements and as per approval of the Engineer.

2.02 GENERAL

A. Water supply speciality items shall be rated for 1,206.5 kPa (175 psig) working water pressure at ambient temperature unless otherwise stated.

2.03 SUCTION STRAINERS

A. Copper piping: Fabricated from line size copper pipes, flanges and straightened pipe fabric used as end caps. Minimum total area of perforations (6 mm size) shall be four (4) times the sectional area of the pipe.

B. Ferrous / plastic piping: Food grade epoxy coated cast iron body with integral flange and 12 mm (½ inch) perforations.

C. Fasteners shall be of corrosion resistant material like stainless steel or high tensile brass.

2.04 IN LINE Y-TYPE STRAINERS

A. Up to DN 50 (2 inch): Bronze body with threaded ends, screwed on retainer cap with threaded plug and twenty (20) mesh stainless steel screen. Blow off connection with valve shall be provided on the retainer cap, where required.

B. DN 65 (2½ inch) and larger: Cast steel body with flanged ends, flanged cover with threaded bronze plug and stainless steel screen. Blow off connection with valve shall be provided where required. Screen shall have 1.5 mm perforations for sizes from DN 65 to 100 (2½ to 4 inch) and 3.0 mm perforations for sizes over DN 100 (4 inch).

2.05 BACK FLOW PREVENTERS

A. Up to DN 50 (2 inch): Bronze body, stainless steel trim with atmospheric vent, complete with strainer, gate valves, test cocks and air gap fitting at vent connection.

B. DN 65 (2½ inch) and larger: Bronze body, stainless steel trim with atmospheric vent, complete with flanged strainer and gate valves, test cocks and air gap fitting at vent connection.

2.06 VACUUM BREAKERS

A. Chrome plated brass, atmospheric type with flat pipette type, rubber discs and hose thread outlet.

B. Bronze body, pressure type with heat resistant disc opening to atmosphere at less than 12mm (½ inch) mercury vacuum.

2.07 TRAP PRIMERS

A. Bronze body with plastic trim and integral air gap to automatically deliver a metered quantity of water at the beginning and end of line flow, to the trap.

2.08 AUTOMATIC PRESSURE REDUCING VALVES

A. Spring Loaded Type

1. Globe pattern valve of bronze construction with renewable stainless steel seat, high temperature resisting diaphragm and watertight cage assembly

2. Assembly shall be complete with strainer, shut off valves and plugged tap-off(s) for installing pressure gauges

3. Pressure reducing valves shall be pre-set and sealed at the factory

B. Pilot Operated Type

1. Globe pattern, single seated, hydraulically operated, pilot controlled, diaphragm type valve of cast iron construction with flanged ends

2. Trim and pilot assembly shall be of brass / bronze / stainless steel and pressure setting shall be made with a single screw, housed in a screwed on, sealed housing

3. Assembly shall be complete with shut off valves, strainer, pressure gauges, size adjustment spools etc.

C. Constant Pressure Valves (for Booster Pump Sets)

1. Globe pattern, single seated, hydraulically operated, pilot controlled, and diaphragm type valve of cast iron construction with flanged ends; for the following functions:

a. Maintain a constant downstream pressure regardless of fluctuating demand

b. Shut off the pump set in the event of very low upstream pressure created by rupture of piping or similar run off conditions

2. Assembly shall be complete with shut off valves, strainer, pressure gauges, size adjustment spools etc.

2.09 AUTOMATIC RELIEF VALVES

A. Pressure Relief Valves: Bronze body, stainless steel spring and trim, with manual (pipette type) actuation lever. Unit shall be pre-set and sealed at the factory. Label shall contain the manufacturer's name, serial no., and maximum working / set pressures.

B. Temperature and Pressure (T&P) Relief Valves: Bronze body, stainless steel spring and trim, one ceramic coated temperature sensing element and pipette type manual actuation lever. The unit shall be rated for relieving the maximum heat input to the water heater and pre-set and sealed at the factory. The label shall contain the manufacturer's name, serial no., maximum working pressure and temperature, set pressure and temperature and relieving capacity in Btuh.

C. Air Relief Valves: Bronze body with non-ferrous float and internal working parts and outlet tapped for connection to drain line. Construction shall be take-apart type for easy maintenance.

2.10 WATER HAMMER ARRESTORS

A. Air Chambers: Fabricated from DN 25 (1 inch) or larger pipes, 300 to 450 mm (12 to 18 inch) long with end cap.

B. Shock Absorbers: Stainless steel shell with stainless steel or elastomer nested bellows and male threaded connection; pre-charged with hydraulic displacement fluid and super pressurized with inert gas. Size shall be selected in accordance with manufacturer's recommendations.

2.11 HOSE BIBS AND HYDRANTS

A. Hose Bibs: Chrome plated brass, globe type with integral vacuum breaker with DN 15 (½ inch) male threaded inlet and DN 20 (3/4 inch) hose thread outlet and wall flange; operated be by handle or loose key as required.

B. Hydrants (Both Wall and Ground hydrants) shall have the following components / features:

1. Chrome plated brass, loose key operated compression stop with extension
2. Integral vacuum breaker
3. DN 15 (½ inch) male threaded inlet and DN 20 (¾ inch) hose thread outlet
4. Stainless steel housing with hinged and lockable cover, suitable for recessed installation
5. Door of the housing shall be lockable with the same key as the hose bib

PART 3 - EXECUTION

3.01 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 / plastic piping.

C. Cast iron suction strainers shall be used for steel piping

3.02 IN-LINE `Y' STRAINERS

A. In-line strainers shall be installed before small pumps, pressure-reducing valves, meters and other sensitive equipment, where indicated on the drawings or otherwise.

3.03 BACKFLOW PREVENTERS

A. These shall be installed at makeup connections to HVAC system;fresh water connections to Irrigation and elsewhere as indicated in drawings.

3.04 VACUUM BREAKERS

A. Vacuum relief valves shall be installed at inlet to central water heaters (install in-line check valves at inlet of wall mounted water heaters).

3.05 AUTOMATIC RELIEF VALVES

A. Pressure relief valves shall be installed on unit electric water heaters.

B. Bypass type pressure relief valves shall be installed between discharge and suction manifolds of pressure controlled booster sets.

C. Automatic temperature and pressure (T&P) relief valves shall be installed on all central electric water heaters.

D. Automatic air vents shall be provided on top of central electric water heaters, as detailed.

E. Automatic air vents shall be provided at system high points, as indicated on drawings.

F. Discharge of water heater relief valves shall be piped to safe locations, to prevent injury to personnel.

3.06 WATER HAMMER ARRESTORS

A. Air chambers shall be installed at the highest junction of cold water, hot water and hot water return risers connected to pressurised systems.

B. Shock absorbers shall be installed in toilets where flush valves are used for water closets or urinals.

3.07 HOSE BIBS AND HYDRANTS

A. Hose bibs shall be selected with operating handles or with loose operating keys as appropriate.

END OF SECTION

SECTION 22 11 23

DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Packaged Cold Water Booster Pump Sets

B. Hot Water Circulating Pumps

C. Transfer Pumps

1.02 RELATED SECTIONS

A.	Division-1	General Requirements
B.	Section 22 00 00	Plumbing
C.	Section 22 0513	Common Motor Requirements for Plumbing Equipment
D.	Section 22 05 19	Meter and Gages for Plumbing Piping
E.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
F.	Section 22 05 48	Vibration and Seismic Control for Plumbing Piping and Equipment
G.	Section 22 05 53	Identification for Plumbing Piping and Equipment
H.	Section 22 12 00	Facility Potable Water Storage Tanks

1.03 REFERENCES

A. American Society for Testing and Materials:

1. ASME B31.9 and UL 778

2. Packaged Booster Pumps listed and labeled by an NRTL as pumping systems

3. Quality standard for performance efficiency – ASHRAE/ IESNA 90.1- 2007

B. National Electrical Manufacturer Association:

1. NEMA 250 -Enclosures for Electrical equipment (1000 volts maximum)

1.04 SUBMITTALS

A. The following submittals are required as specified and as follows:

1. Product data, certified pump performance characteristics with selection plotted for both individual and multiple pump including system curve, data on equipment dimensions, service connections, operating weight and installation drawings and instructions.

2. Manufacturer's / independent laboratory's test certificates confirming that the equipment construction and performance meet or exceed the specified requirements; shall be submitted as required.

3. Warranty: Provide sample copies of manufacturers' actual warranties for all

materials to be furnished under this Section, clearly defining all terms, conditions, and time periods for the coverage thereof.

4. Qualifications Statement: Evidence indicating that the proposed installers are qualified to perform the work. (Recommend to remove this clause since the pumps should be only factory assembled and tested, refer clause 1.06 B. below)

5. Shop Drawings.

6. Manufacturer's original packing list

1.05 CLOSEOUT SUBMITTALS

A. Follow Division -1 - Execution and Closeout Requirement and Closeout procedures to be complied with.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.06 QUALITY ASSURANCE

A. Equipment Manufacturer shall be responsible for checking, testing and commissioning of the Equipment.

B. Packaged pump sets shall be assembled and tested at the manufacturers' or licensees own premises. Furnish copy of manufacturing license along with material submittal, where appropriate.

C. Requirements and recommendations of the following organizations shall be conformed to as appropriate:

1. National Sanitation Federation (NSF) and WRAS

2. American Society of Mechanical Engineers (ASME)

3. International Electro technical Commission (IEC)

D. Equipment shall have labels attached permanently, indicating:

1. Name of Manufacturer

2. Model / Serial numbers

3. Certified Ratings

4. Maximum Operating Parameters

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum Ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum Ten years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Follow Division -1- Administrative Requirements Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original unopened containers of packaging clearly labeled with manufacturer's name, brand name, Instruction for use, all Identifying numbers, and U.L. Labels.

B. Weatherproof covering shall be retained on equipment until commissioning.

C. Store materials in a clean, dry area protected from water and direct sunlight.

1.10 WARRANTY

A. Requirements of the General Conditions of Contract and Plumbing services section 22 00 00 shall be referred to and complied with as appropriate.

B. Contractor shall provide guarantee and warranty for a period of Two (2) years minimum from the date of substantial completion.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Requirements of the General Conditions of Contract Closeout Submittals for Spare parts and maintenance products and Plumbing services section 22 00 00 shall be referred to and complied with as appropriate.

B. Spare parts as listed below shall be furnished, properly packed and labelled with equipment no. / location as below.

1. One set of replaceable elements such as case wearing ring (if used), bearings and seals for each type and size of pumps used in the project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to the compliance with the requirements and as per approval of the Engineer.

B. ACCEPTABLE MANUFACTURERS- Packaged cold water Booster Pump Sets

1. GRUNDFOS, Denmark

2. DP Pumps, Holland

3. Biral, Switzerland

4. KSB, Germany

C. ACCEPTABLE MANUFACTURERS-Hot Water Circulating Pumps

1. Grundfos, Denmark

2. Biral, Switzerland

3. DP Pumps, Holland

4. KSB, Germany

D. Or other equal and approved under provisions of the general conditions of contract and approved by the Engineer.

2.02 PACKAGED PUMP SETS

A. The complete packaged booster pump set and control panel, shall be factory assembled and tested at Manufacturer's facility

B. The pumps shall be equipped with external frequency converter in the control panel adequate to the number of pumps in the set. The system shall maintain a constant pressure through continuous adjustment of the speed of each pumps in operation.

C. Pumps:

1. Vertical multistage, centrifugal type of 2900 rpm speed. Materials of construction shall be as follows:

Impellers	Stainless steel DIN 1.4401 (AISI 316)
Shaft	Stainless steel DIN 1.4462 (AISI 32205) or DIN 1.4401 (ANSI 316)
Stage pieces	Stainless steel DIN 1.4401 (AISI 316)
Base and head	Stainless steel, DIN 1.4401 (AISI 316)
Seal	Mechanical

2. Horizontal, single stage, end suction, centrifugal type Booster Pumps

a. Type - Pumps shall be built in accordance to EN 733 standards single-stage, non-self-priming, long-coupled, centrifugal volute pumps with axial suction port, radial discharge port and horizontal shaft. The pumps shall be of back pull-out design that enables the removal and dismantling of the motor, coupling, bearing bracket, and impeller without disturbing the pump housing or pipe work. The speed shall not exceed 2900 rpm. The pump motor assembly should be assembled, aligned and tested to ISO 9906 standards at the manufacturer's own premises which shall have as a minimum ISO 9001 and ISO 14001 certifications.

The pump material of construction shall be as follows;

Pump Casing:	Stainless Steel, 1.4408 / CF8M standards
Impeller:	Stainless Steel, 1.4408 / CF8M standards
Bearing Bracket:	Cast Iron, EN-GJL-250 standards
Shaft:	Stainless Steel, 1.4401 / 1.4408
Coupling Guard:	Stainless Steel, 1.4301
Shaft Seal:	Mechanical Seal, Burgmann, 1.4401/ AISI 316

Wear Ring: Carbon-graphite-filled PTFE

O Ring: FKM - Viton

b. Casing - The Stainless Steel volute pump casing should have axial suction port and radial discharge port. The suction and discharge flanges shall be of dimensions in accordance with EN 1092-2. The pump case shall have both priming and drain hole closed by plugs.

c. Impeller - The pump impeller shall be closed type with double-curved blades having smooth edges. The impeller shall be statically and hydraulically balanced to compensate for axial thrust. The balancing shall be done to G 6.3 ISO 1940 standards. All impellers shall be trimmed to the duty point required by the customer.

d. Shaft - The shaft shall be made of stainless steel as per one of the EN standards specified. The shaft shall be larger enough to be driven by a belt drive or a diesel engine, if required. For stuffing box version pumps, a stainless steel sleeve shall be provided to protect the shaft from wearing off.

e. Shaft Seal - The shaft seal shall be unbalanced, mechanical shaft seal of silicon carbide with dimensions according to EN 12756.

f. Coupling - The pumps shall be fitted with a spacer coupling of cast iron material grade to EN-GJL-250 standards. The coupling shall enable servicing of the pump without dismantling the motor from the base frame and without removing the pump housing from the pipe work, hence saving the realignment of pump and motor after service.

g. Bearing Bracket - The bearing bracket shall be made of cast iron EN-GJL-250. It shall have two sturdy antifriction, lubricated-for-life bearings. A thrower shall be present in the shaft to prevent liquids from entering the bearing bracket.

h. Pump Motor - The pump shall be fitted with a totally enclosed fan-cooled motor to S1 standards with main dimensions according to IEC 60034-30 standards and DIN EN 1092-2. The motors above shall be of Efficiency Class IE3 and the motor manufacturers shall be online listed in CEMEP (European committee of Manufacturer of Electrical Machines and Power Electronics). Motor enclosure shall be IP 55 in accordance with IEC 34-5 and motor insulation class shall be of Class F in accordance with IEC 85. All motor bearings shall be as standard with angular contact type bearings.

i. Base Frame - Pump and motor are to be mounted as separate units on a common steel base frame designed in accordance with EN 23661 and connected via a spacer coupling.

j. Finishing – The cast iron parts of the pump shall be epoxy coated by cathodic electro-deposition (CED) process from the factory, to improve corrosion resistance to ISO 7253 standards. The entire process shall include alkaline-based cleaning to ISO 2813 standards, pre-treatment with zinc phosphate coating to ISO 2813 standards, cathodic electro deposition to ISO 2808 standards and curing to a dry film thickness 18-22 microns to ISO 2409 standards. The colour code for the finished product is NCS 9000/ RAL 9005.

k. Capacity - Schedules on drawings shall be referred to for types and capacities.

D. System piping: Stainless steel 316 with welded joints. Manifold ends shall be flanged.

E. Valves: All bronze gate valves at suction and discharge of each pump and bronze wafer type self-closing (non-slam) check valve at discharge of each pump.

F. Base frame: Fabricated steel, with resilient mounting for pumps, where required.

G. Pressure Vessel (for pressure controlled sets only): Welded steel construction with polypropylene lining on wetted areas, butyl rubber diaphragm, hooded charging valve etc. suitable for 1600 kPa (232 psig) working pressure, pre-charged with nitrogen. Capacity to be suitable for limiting the number of pump starts to 15 per hour.

H. Pressure relief valve: Stainless steel fitted bronze construction, to be provided between discharge and suction manifolds to prevent pump operation at shutoff head.

I. Accessories: Compound gauge at suction manifold and pressure gauge at discharge manifold, flexible connections at suction side of each pump.

J. Pump motor and control panel: Variable speed drive(s) integrated with the motor with programmable graphical interface microprocessor controller. Requirements of Section 210513 shall be referred to and complied with as appropriate.

K. The motor shall be Efficiency Class IE3 (EFF 3) to IEC 60034-1 regulations. Motor manufacturers shall be online listed in CEMEP (European committee of Manufacturer of Electrical Machines and Power Electronics). The motors should be manufactured and tested according to the Inter-nationally recognized standards IEC 60034-1 and IEC 60072-1/EN 50347. IP 65, class F Insulation with class B temperature rise according to IEC 62114. Motors should have PTC sensors against slow overloading and seizure (IEC 34-11: TP 211) according to DIN 44082 and have maximum ambient temperature 60 °C without de-rating.

L. Pump operation shall be controlled with the following functions:

1. Constant pressure control through continuously variable adjustment of the speed of each pump in operation.

2. The System performance is adapted to the demand through cutting in/out the required number of pumps and through parallel control of the pumps in operation.

3. All the pumps shall be full size pumps.

4. All pumps shall be controlled by the frequency converter in rotation.

5. Pump changeover shall be automatic and depends on load, time & fault to ensure equal operating time for all the pumps.

6. Stop function at low flow.

7. Stop function at low discharge pressure.

8. Stop function at high discharge pressure.

9. In case of failure of variable speed operation, automatic changeover to mains (DOL / Star Delta) operation is accomplished.

M. The control panel of this set shall include the following:

1. Control panel for the pressure boosting pumps shall be from the same manufacturer.
2. The panel shall be offered with test run sheet.
3. Factory supplied VFD drive for each pump mounted inside control panel
4. Pump control unit CU351
5. Thermal overload protection.
6. Earth leakage sensing shall be part of the variable frequency drive.
7. One set of HRC fuses per motor from 30kW and above shall be offered.
8. Motor circuit breakers per motor up to 22kW shall be offered.
9. Panel shall have dedicated pump controller, equipped with built-in software for variable flow demand in pressure boosting system.
10. Controller shall have the following functions:
    a. Cyclic changeover facility.
    b. Automatic cascade control of pumps for optimal efficiency.
    c. Alternative set points influence.
    d. Forced pump changeover facility to influence equal hour run of all pumps.
    e. Dry run protection facility.
    f. Facility to set number of starts per hour.
    g. Test-Off-Auto function for each pump.
    h. Low suction in-let pressure through pressure sensor.
    i. 25 alarm logging facility.
    j. Amps drawn per pump through RS485 port.
    k. Pressure relief facility.
    l. Possibility of Stand-by pumps and Backup Sensor.
11. The controller shall have an extended 300 x 220mm LCD display screen with backlight, which can be mounted on the panel face.
12. The LCD panel shall have a number of buttons to enable manual settings and change of set points in the controller.
13. The LCD display shall be a user-friendly showing the current pump and measuring point status of the system.
14. The LCD display shall have the following displayed on the backlit screen:
    a. Status (Indication of System Status)
    b. Operation (Change of operating parameters such as set-points with password option.)
    c. Alarm (Alarm log for fault finding)

d. Setting (Change of setting with password option.)

15. The panel shall have green indicator light for operating indications and red indicator light for fault indication.

16. Alarm with mute button for dry run protection

17. Extra set of wire terminals/Volt free contacts for connecting to BMS.

a. Finishing: The assembly shall be given two coats of primer and one coat of gloss enamel at the factory.

b. Capacity: Schedules on drawings shall be referred to for types and capacities.

N. Booster pump set will be assembled and tested at the manufacturing facility only.

PART 3 - EXECUTION

3.01 CO-ORDINATION

A. Size of doorways and other accesses to technical areas shall be coordinated to ensure that these are amply sized to allow for the movement of equipment.

B. Hooks, rails or other provisions shall be provided to allow for hoisting or movement of equipment in technical areas.

C. Data on heat loss to surroundings from equipment located in air-conditioned areas shall be furnished to the HVAC trade.

D. Data on the required power supplies shall be furnished to the electrical trade.

3.02 SELECTION

A. Pump motors shall be of efficiency class IE3 (EFF3) and shall be selected for the maximum loading of the selected impeller.

B. Pumps shall be selected with the operating points within 20 % on either side of the maximum efficiency point.

C. Maximum and minimum impeller sizes shall not be selected for unit pumps, as far as possible.

D. Coded colours shall be used for finishing equipment of different services.

3.03 INSTALLATION

A. Clearances shall be provided around equipment for operation, maintenance and ventilation.

B. Manufacturer's installation instructions shall be complied with in all respects.

C. Lifting devices shall be attached to equipment only at designated points. The equipment shall not be dropped or subjected to any kind of shock.

D. Services of manufacturer's specialist representative shall be provided for commissioning

of equipment.

3.04 COMPANY INSPECTION

A. Where third party inspection is stipulated, it shall be obligatory for the contractor to obtain acceptance or inspection prior to releasing the equipment for shipment.

END OF SECTION

SECTION 22 12 00

FACILITY POTABLE WATER STORAGE TANKS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Water Meters and Cabinets

B. Inline Self-cleaning Filters

C. Float Valves

D. Sleeves, Puddle Flanges, Ladders etc.

E. Drainage, Pipe Connections, Ventilation etc.

F. Manufactured Water Storage Tanks and Accessories

G. Water Tank Level Indication and Control System

H. Panel Type GPR Tanks

I. Polyethylene Storage Tanks

J. Fiberglass Aboveground storage tank

K. Control Panel – General Requirements

L. Conduiting and Wiring

M. Water Meter Assembly

N. Tanker Connection Assembly

1.02 RELATED SECTIONS

A.	Section 03 20 00	Concrete Reinforcement
B.	Section 03 30 00	Cast-In-Place Concrete
C.	Section 21 00 00	Fire Suppression
D.	Section 22 00 00	Plumbing
E.	Section 22 07 00	Plumbing Insulation
F.	Section 22 11 16	Domestic Water Piping
G.	Section 22 11 19	Domestic Water Piping Specialties
H.	Section 22 11 23	Domestic Water Pumps
I.	Section 25 50 00	Integrated Automation Facility Controls

1.03 REFERENCES

A. ASTM International:

1. ASTM A 270 - Seamless and Welded Austenitic Stainless Steel Sanitary Tubing
2. ASTM A 403 - Wrought Austenitic Stainless Steel Pipe Fittings
3. ASTM D3299 - Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
4. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
5. ASTM D2584 - Standard Test Method for Ignition Loss of Cured Reinforced Resins
6. ASTM D3567 - Standard Practice for Determining Dimensions of “Fiberglass” (Glass-FiberReinforced Thermosetting Resin) Pipe and Fittings

B. British Standard:

1. BS 8007 - Code of practice for design of concrete structures for retaining aqueous liquids
2. BS 7491 Part 3 - Specification for Sectional Tanks
3. BS 6920 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water
4. BS EN 60529 - Degrees of protection provided by enclosures - IP Codes (NEMA Standard No. 1 CS)
5. BS 4994 - Specification for Design and Construction of Vessels and Tanks in Reinforced Plastics

C. European Standards:

1. EN 124 - Gully tops and manhole tops for vehicular and pedestrian areas; design requirements, type testing, marking

1.04 SUBMITTALS

A. Product data, samples and shop drawings shall be submitted under provisions of the General Conditions of Contract.

B. Co-ordinated positions of water-stops, GRP panel assembly joints etc. in water tank walls shall be indicated in the shop drawings.

C. Wiring diagram(s), details of components and panel construction and mounting details shall be submitted in respect of water tank level control and indication instrumentation.

D. Documented evidence that the tank assembly has been performing satisfactorily in Kuwait for ten (10) immediately preceding years shall be submitted to substantiate its usability.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 92 00 - Closeout Procedures

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Metallic components installed within water tanks shall be of corrosion resistant material of stainless steel 316L.

B. Metallic components (steel framing etc.) used to support assemblies shall be protected against corrosion by hot dip galvanization.

C. Requirements of Section 22 00 00 shall be referred to and complied with as appropriate, in respect of all electrical works.

D. Specifications of the Electrical Works of the project shall be referred to and complied with in respect of ratings, deration factors, fault levels and other similar general criteria. These shall be binding and mandatory for works covered by this Section.

E. Specifications of the Electrical Works of the project shall be referred to and complied with in the selection and application of components such as MCBs, MCCBs, contactors, timers, switches, fuses, earth leakage circuit breakers etc.

F. Electrical assemblies shall have enclosures to IP – 55 as minimum requirements, unless otherwise stated. Thermostatically controlled anti-condensation heaters shall be provided in control panels.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 31 30 – Project Meetings

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE AND HANDLING

A. Products shall be delivered to site, stored and protected under provisions of the General Conditions 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 and a record of the same shall be maintained for inspection by the Engineer.

1.10 GUARANTEES AND WARRANTIES

A. Requirements of the Section 22 00 00 Guarantees and Warranties, and Division-1 Product Warranties and Guarantees shall be referred to and complied with as appropriate.

B. GRP panel tanks complete assembly shall be furnished with Ten (10) years warranty against the following;

1. Leakage of complete water tank assembly.

2. Defects in material, workmanship, and functional components

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Division 1 – Closeout Procedures for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements and as per approval of the Engineer.

2.02 ACCEPTABLE MANUFACTURERS

A. Panel Type GRP Tank

1. Sekisui, Japan

2. Mitsubishi, Japan

3. Hitachi, Japan

4. Samsung, Korea

5. Or Approved Equivalent

2.03 WATER METER(S), ACCESSORIES AND CABINET(S)

A. Water meter shall be as supplied by Ministry of Energy (MOE) or their appointed agents. Meter shall have union / flanged ends to enable easy disassembly.

B. Water meter cabinets shall be fabricated from minimum 2.0 mm (14 gauge) thick stainless steel sheets; suitable for recessed / surface-mounted / freestanding (feeder pillar pattern) installation. Further,

1. Joints shall be fully welded and ground smooth
2. Stainless steel architrave shall be provided on recessed cabinets
3. Doors shall have boxed edges, recessed stainless steel or aluminium handle and installed flush with the cabinet
4. Hinges shall be solid, pin type machined from stainless steel rods and welded to cabinet and door
5. Foam rubber strips shall be adhered to doorframe to prevent rattling and to make the enclosure dust proof

C. Following accessories shall be provided as part of the assembly:

1. Gate valve at the inlet
2. Check valve at the outlet
3. Water tanker inlet connection with ball type isolating valve and male threaded hose coupling

2.04 INLINE SELF-CLEANING FILTERS

A. Type: Permanent media, back-washable type.

B. Function: Dirt / rust removal to 50 microns filtration fineness.

C. Construction: Stainless steel mesh filter with brass sump and body with flanged ends, rated for an inlet pressure of 400 psig.

D. Accessories

1. Automatic back washing (daily) device with 240 v / 1 phase / 50 Hz power supply unit
2. One set of filter elements, furnished as spare

2.05 FLOAT VALVES

A. 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 complete with pilot assembly, type `K' copper capillary lines, mounting plate, plastic float and operating rod, adjustable stops etc. complete.

B. Pressure Sustaining Valve with Level Control: Globe pattern, single seated, hydraulically operated, pilot controlled, diaphragm type, normally closed valve of cast iron construction with flanged ends complete with pilot assembly, type `K' copper capillary lines, mounting plate, plastic float and operating rod, adjustable stops etc. complete.

C. Valve will open when the liquid level reaches a preset position, but maintains a constant upstream pressure to prevent robbing of upper zone (areas supplied by the same system). I.E. the tank is filled only when the upper zone demand is low enough (high upstream pressure).

D. Modulating float valves: Angle / Globe pattern, single seated, hydraulically operated, pilot controlled, diaphragm type, normally closed valve of cast iron construction with flanged ends complete with pilot assembly, type `K' copper capillary lines, mounting plate, plastic float and operating rod, adjustable stops etc. complete.

E. Float Valves: Bronze construction, angle pattern and equilibrium type float valve with flanged inlet; complete with brass / stainless steel float rod and copper float.

2.06 PUDDLE FLANGES

A. General

1. Details on Drawings shall be referred to for minimum dimensions (External diameter of the puddle shall be approximately three [3] pipe diameters – PVC-U excluded)

2. Bolting clearance of minimum 100 mm (4 inch) shall be provided from the rear face of the flange, where used, to the tank wall

3. Integral flanges with studs / cap nuts at wall face and loose, split flanges shall be used to flash tanking membranes at the puddle flange

4. Synthetic membrane flashing of 900 mm (3 ft) diameter shall be provided at puddle flanges installed in the bottom slab of water tanks (Flashing shall be integrated with the tanking, where used)

B. Stainless steel 316L puddle flanges and pipes shall be fabricated from schedule 40 stainless steel pipe and welding neck flanges. The stainless steel 316L puddle flanges and pipes shall be provided for all concrete tanks and concrete water bodies whether it is shown in the drawings or not included in the design.

2.07 LADDERS FOR RCC WATER STORAGE TANKS OR GRP PANEL TANKS

A. Ladder and accessories shall be of stainless steel (type 316) construction. Further:

1. Ladders shall be attached to water tank wall / floor using anchors and studs

2. Waterproofing shall be flashed around fasteners by using neoprene / butyl rubber washers at the wall face, where required

B. Ladder construction shall be as follows:

1. Main rails shall be of 50 x 12 mm (2 x ½ inch) flats

2. Rungs shall be of solid / tubular sections of 20 mm OD, welded to main rails in drilled holes

3. Supports shall be of the same section as main rail, welded to the rail and bend at ends for attaching to wall / floor

4. Safety cages made of 25 x 3 mm (1 x 1/8 inch) stainless steel flats shall be provided for ladders exceeding 2,500 mm (8 ft) in height

5. 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 DN 25 (1 inch) 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).

2.08 ACCESS DOORS FOR RCC WATER STORAGE TANKS

A. On Side Walls

1. Doors and frames shall be fabricated from minimum 1.5 mm thick, stainless steel (ANSI type 316) sheets, boxed to form rigid sections with mitred joints welded full length to give a continuous smooth finish

2. Door frames shall be attached to concrete by nailing / screwing integral purpose made tabs, on the tank side

3. Joints of the frame with concrete shall be filled with sealant on the visible side

4. Door shall be constructed with a rectangular box frame with overlapping outer edge, hung with solid hinges welded to the frame

5. Concealed latch with recessed handle shall be provided to keep the door in closed position

6. Air filter shall be supported on wire mesh backing (3mm wire @ 25 mm both ways) welded to the door framework

7. Single piece, viscous impingement type, synthetic air filter shall be provided to cover the opening in the doorframe with overlap and held in position by another wire mesh facing, welded to an L-section sheet framing attached to the door framework by metal screws

B. On Roof Slabs

1. Double seal, light duty cast iron cover and frame of 600 x 600 mm clear opening; painted inside and out with white food grade epoxy
2. Key holes shall be closed type and suitable soft sealing strips shall be used at the sealing grooves to ensure tightness

C. On Grade Slabs

1. Single leaf, hinged and lockable, fabricated stainless steel access cover of 800 x 800 mm clear opening, suitable for the loading encountered (EN 124 various classes)
2. Frame with unique hidden hinge shall incorporate an unbroken EPDM seal to help prevent the ingress of dirt and moisture, offering near water and airtight sealing
3. Covers shall have anti-slip finish, painted as appropriate and fitted with the following:
    a. Stainless steel (type 316) spring assistance; where weights of the unassisted covers exceed the recommendation of the Manual Handling Operations Regulations 1992, implementing the European Directive 90 / 269 / EEC
    b. Stainless steel slam-action cab-lock, easily opened from inside and key operated from outside
    c. Provision for locking in open position, with a safety hold-open stay, to prevent accidental closure
4. Exposed edges of the covers shall be self-coloured
5. Inner sealing arrangement comprising the following shall be provided under the cover to prevent entry of foul water into the tank:
    a. Steel angle frame with integral studs, embedded in the surrounding concrete
    b. Stainless steel plate with holes corresponding to the studs
    c. Neoprene / Butyl rubber sealing strip bonded to the underside of the sealing plate
    d. Washers and nuts for fastening the sealing plate

2.09 VENTILATION OF RCC WATER STORAGE TANKS

A. General

1. Provision shall be made to allow for free entry and exit of air during filling or emptying of the tank
2. Air passages of the vent shall be covered with copper / fine plastic wire mesh net, attached to the pipe with worm driven hose clamps, to prevent the entry of flies and pests

B. Goosenecks

1. Material of construction shall be the same material as that of the piping, unless otherwise stated
2. Joint of the gooseneck with the tank and / or overflow pipe shall be flanged
3. End of the gooseneck shall form a 135° arc from the horizontal plane, terminated square to the pipe axis
4. Fasteners used shall be of corrosion resistant material like high tensile brass or stainless steel

C. Standpipes

1. Assembly comprising a standpipe with puddle flange and deep protective hood welded to the pipe end with radial fins; fabricated from steel pipes and plates
2. A flange with cap nuts shall be welded to the standpipe and loose split-flange and stainless steel fasteners provided, where membrane flashing is called for

3. The standpipe shall be hot dip galvanized after fabrication

D. Hoods

1. Factory manufactured vent caps of coated cast iron construction with counter flashing collar deep protective hood and recessed securing screws

2. The hood shall be attached to a pipe embedded or installed within a flashing flange on the water tank roof slab

2.10 PANEL TYPE GRP TANKS

A. Tanks shall be assembled from glass-fiber reinforced plastic (GRP) panels with the following properties; manufactured by hot-pressing using matched-metal-die moulding (MMD) or Sheet Moulding Compound (SMC) method using continuous strand glass fibers.

1.	Colour	Ivory, to Munsell value 2.5 Y 9/2
2.	Specific Gravity	1.7
3.	Water Absorption	Below 0.1 %
4.	Barcol Hardness	Over 50
5.	Bending Strength	186.2 ~ 196.0 MPa
6.	Tensile Strength	105.8 ~ 117.6 MPa
7.	Shear Strength	107.8 Mpa
8.	Compression Strength	66.6 Mpa
9.	Impact Strength	78.4 KJ / M2
10.	Coefficient of Thermal expansion	2.0 x 10–5°C
11.	Glass Content	More than 30 %
12.	Light Transmission	Below 0.1 %
13.	Soaking Microbiological Resistance	

B. Panels shall be of 500 x 500 mm, 500 x 1,000 mm, 500 x 1,500 mm 500 x 2,000 mm, 1,000 x 1,000 mm, 1,000 x 1,500 mm and 1,000 x 2,000 mm sizes depending on the tank configuration. Partitions shall be provided in the tank, as indicated in drawings. Panels should have manufacturer identification Code or Model or bar code & Trade Mark.

C.

D. Panels shall be opaque and resistant to damaging effects of ultraviolet radiation. Wetted side of the panel shall be smooth and shall not support the growth of algae or any other micro-organisms.

E. Centre of the panels shall be curved to evenly distribute the stress applied to it. Bottom panels shall be of such construction that permits complete drainage of the tank.

F. Each compartment shall be treated as independent and provided with the following:

1. Hinged and lockable access manhole, one per compartment

2. Internal and external Ladder of Stainless Steel construction (supplied by the tank manufacturer), one per compartment (SS 316L)

3. Vents (two per compartment)

4. Overflow fitting, one per compartment

5. All bronze drain with threaded bottom / side / oblique outlet; secured, low dome; clamp ring and shallow sump with flashing flange (Ref.: Jay R. Smith 1620 series)

6. Float Valve, as specified elsewhere, one per compartment

7. Level indicator / controller, as specified elsewhere

G. Panel joints shall be made with non-toxic, age-proof, Butyl rubber or faumed PVC gaskets

(sealant shall not be used as a substitute or extra over the gasket). Further,

1. Gasket shall cover full width of the flange
2. Gasket shall not deteriorate under repeated changes of temperature for a long time
3. Bolts (minimum 10 mm size), nuts and washer shall be made of stainless steel

H. Bracing: Internal / external Bracing shall be of stainless steel material supplied by manufacturer.

I. Tank assembly shall be built-up on a structural steel base, finished as appropriate, capable of withstanding a deflection of five (5) mm of the base slab without leaks or damage.

J. Materials used in the manufacture of tanks shall be non-toxic and suitable for use in contact with potable water, as approved by the Water Research Centre (WRC), UK.

K. The tank manufacturer shall be submit the structural calculation report by the authorized manufacturer's engineer.

L. The tank roof shall be embossed for ultraviolet resistance and slip resistance of workman.

M. The GRP panel tank assembly details, drawings and calculations shall be submitted by with manufacturer stamp and signature.

N. GRP panel tank manufacturer shall supply all components and material of GRP panel tank assembly.

2.11 WATER STORAGE TANK LEVEL INDICATION AND CONTROL SYSTEM (ONE NUMBER FOR EACH TANK)

A. General: Sensing / indication / control shall be provided for the following:

1. Raw fresh water storage tanks at basement-2 level
2. Filtered fresh water storage tanks (for sanitary purposes) at roof level
3. Irrigation water storage tank at basement-2 level

B. Submersible pressure transmitter, WIKA model LS – 10 / LH – 10 complete with the following shall be installed in all individual compartments:

1. PTFE cable with additional weight, as required
2. Cable box and cable restraining clamp

C. Indicator panel (common for all tanks) in all areas, containing the following:

1. Power supply isolator interlocked with the door and power on indicator (red)
2. Power transformer of appropriate rating
3. Remote, panel mounting digital indicator, WIKA model Tronic Line, with the following features:
    a. Digital onsite programmability
    b. 4 Alram points
    c. Universal input 0 to 20 mA
    d. Analogue output 0 ~ 20 mA, 4 ~ 20 mA or 0 ~ 10 v
    e. Maximum and minimum memory with alarm and alarm switching hysteresis adjustable from – 1999 ~ + 1999
    f. RS 232 serial interface (as required)
    g. Splash-proof input keys for programming
    h. Hold key to memorise reading at the time of entry
    i. Built-in power supply for transmitter

4. Selector switch for compartments in respective sets
5. Alarm buzzer with test and mute facility
6. Externally mounted alarm bell
7. Set of terminals / relays for interconnection with booster pump sets, Building Management System etc.

D. Alarm bell of weather proof construction, mounted on the external wall at 2,500 mm (8 feet) above finished floor level at the outside of the building close to tanker fill point, wired to the indicator panel.

E. System shall be configured to accomplish the following:

1. On-site adjustment of set points
2. Water level indication (dial calibrated in cubic meters and imperial gallons)
3. High / low water audio-visual alarms at the indicator panel / BMS, for
   a. Raw fresh water storage tanks
   b. Sanitary / Fire protection water storage tanks
   c. HVAC Makeup water storage tanks
4. High water audible alarm at the tanker-fill point / BMS, for
   a. Raw fresh water storage tanks
   b. Irrigation water storage tanks
5. Cutting-out of the following pump sets at low water level in respective water tank(s):
   a. Raw fresh water transfer pump sets
   b. Filtered fresh water booster pump sets
   c. HVAC makeup water booster pump sets
   d. Irrigation water booster pump sets
6. Hook up with Building Management System for critical alarms

2.12 CONTROL PANELS - GENERAL REQUIREMENTS

A. Requirements of Section 22 05 13 and Division 26 shall be referred to and complied with as appropriate.

2.13 CONDUITING AND WIRING

A. Requirements of Section 22 05 13 and Division 26 shall be referred to and complied with as appropriate.

B. Heavy duty galvanized iron conduits (surface mounted) and painted sheet steel trunking shall be used for wiring.

C. Stranded copper (1.5 mm2), 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.

PART 3 - EXECUTION

3.01 WATER METER CABINETS

A. Openings in cabinets shall be made by appropriate tools only.

B. Wooden framing of correct size, extending to the plaster finish shall be provided for recessed cabinets. Cabinets shall be secured in the wall by screws, at the wooden frame.

C. Base supports fabricated from steel angles shall be provided for taking up the weight of cabinets installed in shaft walls.

D. Rubber grommets shall be provided at openings to prevent rattling and the entry of dust.

E. Boxed sheet metal stiffeners or external supporting steel framing shall be provided, where required to support components.

F. Feeder pillar type cabinets shall be manufactured and installed to MOE standards.

3.02 INLINE SELF-CLEANING FILTERS

A. Discharge of the flushing line shall be piped to the nearest drain, in a neat and convenient manner.

B. Power supply to the flushing system shall be obtained from the standby power supply system, where possible, in coordination with the Electrical Services

C. Flushing system shall be programmed to operate outside normal operating hours.

3.03 PANEL TYPE WATER STORAGE TANKS

A. Contractor shall co-ordinate with the building works and provide RCC structural base of suitable dimensions, conforming to 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/steel base to suit the tank.

3.04 FLOAT VALVES

A. Modulating type, pilot operated float valves shall be used in the fresh water storage tanks and brackish water storage tank for irrigation.

B. Delayed action, pilot operated float valves shall be used on discharge ends of pressure controlled transfer pump sets.

3.05 WATER STORAGE TANK VENTILATION

A. Standpipes with hoods shall be used for ventilation of above grade water storage tanks of GRP panel construction.

3.06 LADDERS AND ACCESS DOORS

A. Fasteners and cap nuts of corrosion resistant material shall be used for fixing the ladder to the tank walls.

3.07 LEVEL INDICATION AND CONTROL INSTRUMENTATION AND PANELS

A. Requirements of Section 22 05 13 and Division 26 shall be referred to and complied with as appropriate in respect of electrical works.

B. Power supply to the system shall be obtained from the standby power supply network, as far as possible. Conduiting and wiring to the source shall be included in this Section.

C. Relays / volt free contacts in terminal blocks shall be provided for interconnecting with other systems (like BMS).

3.08 CLEANING, TESTING AND COMMISSIONING OF WATER STORAGE TANKS

A. Inside of water storage tank(s) shall be thoroughly cleaned of all dirt, washed down with water and drained prior to filling up with clean fresh water for testing.

B. Blank flanges / plugs shall be temporarily installed on the piping connections to water storage tanks to enable the Plumbing works contractor to test the water tightness of water tanks.

C. Tank(s) shall be disinfected along with water supply piping and samples shall be taken from within the tank(s) and tested for residual chlorine.

D. On completion of tests, tanks shall be filled with clean fresh water from the stipulated source, water samples analysed and results submitted to the Engineer, prior to handing over.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Soil, Waste, Vent Pipes and Pipe Fittings

B. Drainage System for Soil, Waste and Vent

1.02 RELATED SECTIONS

A.	Section 09 91 00	Painting
B.	Section 22 05 16	Expansion Fittings and Loops for Plumbing Equipment
C.	Section 22 05 29	Hangers And Supports for Plumbing Piping and Equipment
D.	Section 22 05 48	Vibration and Seismic Control for Plumbing Piping and Equipment
E.	Section 22 05 53	Identification for Plumbing Piping and Equipment
F.	Section 22 07 00	Plumbing Insulation
G.	Section 22 13 19	Sanitary Waste Piping Specialties
H.	Section 22 40 00	Plumbing Fixtures
I.	Section 33 30 00	Sanitary Sewerage Utilities

1.03 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME Sec. 9 - Welding and brazing qualifications

B. American Society for Testing and Materials:

1. ASTM D 3139 - Joints for plastic pressure pipes using flexible elastomeric seals

2. ASTM D 4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials

C. American National Standards Institute:

1. ANSI B 2.1 - Pipe threads (BS 21)

2. ANSI B 16.21 - Non-metallic gaskets for pipe flanges

D. American Water Works Association:

1. AWWA C 601 - Standard methods for the examination of water and wastewater

E. British Standards:

1. BS 4375 - PTFE tape for pipe thread sealing application

2. BS 4504 - Circular flanges for pipes, valves and fittings (PN designated) (ANSI B 16.1 / B 16.24)

3. BS 5556 - General requirements for dimensions and pressure ratings for pipe of thermoplastic materials (Metric Series)

4. BS 8010 - Code of practice for pipelines (ASTM D 2774)

5. BS 6920 - Sustainability of non-metallic products for use in contact with water.

F. Code of Practice:

1. CP 312 - Code of practice for plastic pipe work

G. German Institute for Standardization:

1. DIN 8074 - HDPE pipes; dimensions
2. DIN 8075 - HDPE pipes; general quality requirements
3. DIN 19535 - HDPE pipes and fittings for hot water resistant waste and soil installations within buildings (ISO 8770 / 8772)
4. DIN 19537 - HDPE pipes and fittings for drainage and sewerage
5. DIN 16962 - Pipe Joint Assemblies for Polybutylene Pressure Pipes (ASTM D 2609 / ASTM D 3261)

H. German Welding Society:

1. DVS 2207 - Welding of thermoplastics
2. DVS 2208 - Welding machines and devices for thermoplastics

1.04 SUBMITTALS

A. Product data including data on pipe materials, fittings, valves and accessories; recommended coating materials; samples and manufacturer's installation instructions or recommendations shall be submitted under provisions of the General Conditions of Contract.

B. Copies of valve ordering schedules shall be submitted for approval prior to placing orders.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 92 00 - Closeout Procedures

B. Project Record Documents: Record actual as-Built drawings with actual routing and pipe sizing and locations of equipment and clean-outs.

C. Operation and Maintenance Data: Submit frequency of treatment required for Grease interceptors

1.06 QUALITY ASSURANCE

A. 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 adapters, conversion spools, mating flanges and the like, with the written approval of the Engineer.

B. Pipes and fittings used in the works shall have the standard of manufacturer, type, class or rating etc. continuously printed or marked otherwise in compliance with the standard of manufacture. Materials without such identification shall be rejected.

C. Requirements of Section 22 00 00 shall be referred to and complied with as appropriate.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Division-1 – Project Meetings

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE AND HANDLING

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

General Conditions of Contract.

B. Pipes shall be stored on elevated racks and the ends kept closed with factory-manufactured plugs to prevent the entry of foreign matter.

C. Plastic and rubber products shall be stored out of direct sunlight.

D. Valves shall be delivered and stored in shipping containers with labelling in place. Plug and ball valves shall be kept in open position and gate / globe valves in closed position to prevent damage to valve seats. Flange / thread protectors shall be retained on the valves, until installation, to prevent damage to the flange faces / threads.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 WARRANTY

A. Follow Section 01 88 70 – Project Warranties and Guarantees.

1.13 EXTRA MATERIALS / SPARE PARTS

A. Follow Section 01 92 00 - Closeout Procedures for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:

B. For HDPE Pipes and Fittings:

1. Geberit
2. Wavin
3. Valsir
4. KAI
5. Al Adasani
6. Approved Equal

2.02 PIPES AND FITTINGS

Service	Location	Type
Soil, Waste and Vent (All Sizes) gravity pipes	All areas above and below grade	HDPE Soil
Water Storage Tank Overflow	All areas above and below grade	Polybutylene PN16
Pumped waste/sewage pipe	All areas above and below grade	HDPE PN 10

2.03 HDPE PIPES AND FITTINGS

A. Raw materials used for HDPE production shall be certified for regression; testing performed on the specific product with a stress life curve per ISO D 96802 and products

shall be designed on a minimum hydrostatic design basis of 11,032 kPa (1,600 psig).

B. Pipes and fittings shall contain no recycled material except that generated in the pipe manufacturing plant from the same resin / raw material of pipes and fittings.

C. Pipes and fittings shall have long-term endurance characteristics recognized by compressed pipe ring environmental stress crack resistance greater than 1,000 hours.

D. Pipes and fittings shall be colour coded for service identification, as follows:

1. Drainage Black

E. Material used for the manufacture of polyethylene pipes and fittings shall be of extra-high molecular weight, high-density ethylene–hexane copolymer PE 80 (for Drainage only) / PE 100 polyethylene resin with the following physical properties and pipe performance requirements:

Property	Standard	Unit	Nom. Range
Designation	ISO 12162	MRS	PE 100
Density	ISO 1183	kg / m3	0.93 ~ 0.96
Melt Flow	ISO 1133	gm / 10 min.	0.5 ~ 1.3
Tensile Strength	ISO 6259	MPa	22
UV Stabiliser	ISO 6964	% C	2.5
Elongation @ Break	ISO 527	% Min.	750
Modulus of Elasticity	ISO 178	MPa	800
Elongation @ Yield	ISO 527	% Min.	8
Coefft. Of Thermal Expansion	DIN 8075	mm / m °C	0.2
Thermal Conductivity @ 20°C	DIN 8075	W / m °K	0.43
Brittleness Temperature	DIN 8075	°C	< 40
Vicat Soft Temperature	DIN 8075	°C	210

F. Fittings - General

1. HDPE fittings shall be standard commercial products manufactured from resin of the same type, grade and cell classification as the pipe, by injection moulding

2. Fittings shall be rated for a working pressure equal to that of the pipe for 50-year service at 20°C with an included safety factor of 2:1 and pressure tested by the manufacturer

3. Minimum “quick-burst” strength of the fitting shall not be less than that of the pipe with which the fitting is to be used

4. Fittings up to and including 63 mm OD shall have integral ears or tabs for fixation purposes

5. Fittings shall have moulded-on identification and product information and supplied with a data carrier card (complying with ISO 7810 / 7811) with barcode and a magnetic strip for data transfer

6. PE couplers and saddles shall be designed to satisfy long-term performance

requirements of respective ISO pipe series

G. Fittings – Electro-fusion Type

1. Heating coil process voltage shall not exceed 39.5 volts and terminal pins shall be of 4 mm diameter with insulated contacts
2. Heating coil provided in fittings shall be so designed that one complete process cycle will be sufficient to complete the joint
3. A limited path style fusion indicator (design preventing escape of fusion melt), acting for each zone as visual indication of completed fusion cycle, shall be incorporated into the body of the fitting adjacent to the terminals
4. Fittings shall be packed in such a way that allows use at site without any cleaning or preparation
5. Couplers in sizes up to and including DN 160 (6 inch) must have an easily removable centre stop, not requiring tools for removal
6. Internally or externally threaded transition adapters in sizes up to and including DN 63 (2 inch) shall be designed with integral collar, not relying on rubber or synthetic seals
7. Threaded adapter bodies shall be modular type of brass or stainless steel, not supplied moulded into electro-fusion fitting socket

H. Electro-fusion saddle with drilling cutter

1. Saddles up to main size DN 250 shall be designed with two separate halves with a single hinge type attachment, which can be correctly processed without specialized tooling
2. Top half of the saddle shall be equipped with an electro-fusion outlet, which can accept modular system components such as tapping tees, adapters, valve tees, caps, stop-off attachments etc. that are simultaneously fused with the saddle-to-main joint in one operation
3. Each branch outlet shall be equipped with an integral clamping device
4. Branch spigot of tapping tee must be long enough to allow a second joint if necessary
5. Pipe saddles above DN 63 (2 inch) shall allow 360° rotation of the branch outlet
6. Safe tapping intro mains shall be possible under stipulated maximum gas or water pressure, at respective pressure and temperature
7. Tapping saddle cutter shall be designed to contain the cut-out coupon (not produce shavings) and seal-off the central passage in the uppermost position
8. It shall be possible to permanently seal-off the top of the saddle with an electro-fused cap in mains of DN 63 (2 inch) and above

I. Joints

1. HDPE Soil: Thermal / electro fusion socket.
2. HDPE Pressure: Thermal / electro fusion socket.
3. Ring seal joints and special adapters may be used for HDPE soil and fusion jointed weldolets (saddles), flanges and special adapters may be used for HDPE pressure pipe work, as appropriate

J. Unions and Flanges

1. Unions shall be of HDPE with socket fusion ends
2. Flanges shall be of HDPE with butt fusion ends
3. Compressed fibre gaskets shall be used at all flanges (rubber gaskets shall not be used)

K. Pressure Rating (Continuous)

1. HDPE Soil: 345 kPa (50 psig)

2. HDPE Pressure: 1,034 kPa (150 psig)

2.04 UNIONS AND FLANGES

A. Unions for Pipe (50 mm) and Smaller:

B. Copper Piping: Class 150, bronze unions with [soldered] [brazed joints].

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

D. PVC Piping: PVC.

E. Flanges for Pipe (65 mm) and Larger:

F. Copper Piping: Class 150, slip-on bronze flanges.

G. PVC Piping: PVC flanges.

H. Gaskets: (1.6 mm) thick preformed neoprene gaskets.

I. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.05 GATE VALVES

A. Furnish materials in accordance with MPW Standards.

B. 50 mm and Smaller: MSS SP 80, [Class 125] [Class 150 bronze body, bronze trim, [threaded] [union] bonnet, [non-rising] [rising] stem, [lock-shield stem] [hand-wheel], inside screw [with back-seating stem], [solid] [split] wedge disc, [alloy seat rings,] [solder] [or] [threaded] ends.

C. 65 mm and Larger: MSS SP 70, [Class 125] cast iron body, bronze trim, bolted bonnet, [rising] [non-rising] stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves (150 mm) and larger mounted over (2400 mm) above floor.

PART 3 - EXECUTION

3.01 SELECTION AND APPLICATION

A. Manufacturer’s recommendations shall be sought and applied as appropriate, in respect of chemical compatibility of piping with agents used for flushing, disinfecting etc.

3.02 EXAMINATION

A. Section 01 31 10 - Project Coordination

B. Verify excavations are to required grade, dry, and not over-excavated.

3.03 PREPARATION

A. Pipes and tubes shall be cut perpendicular to the axis, with approved cutting tools; the ends reamed and burrs removed.

B. Scale and dirt, on inside and outside and weld splatter shall be removed before assembly.

3.04 SPACING AND LOCATION

A. Piping shall be installed in such a way that conserves building space and not interfering with the use of space.

B. Exposed piping shall be installed parallel or at right angles to the building walls, except where otherwise shown on the Contract drawings.

C. Minimum clearances shall be provided between piping covered by this Section and those of other trades.

D. Adequate clearance shall be provided around the piping for the installation of insulation and access to valves and fittings.

E. Piping shall be grouped at common elevations, wherever possible.

F. Piping shall be installed in such a way that allows for expansion and contraction without stressing pipe joints or connected equipment.

G. Access doors shall be provided where valves and fittings are not exposed. Size and location of access doors shall be coordinated with relevant Sections.

H. All concealed (non-accessible) pipes (risers and horizontal runs) shall have adequate wall and floor cleanouts for all turns to facilitate proper maintenance.

3.05 PIPE FITTINGS

A. Tapered reducer fittings shall be installed where changes occur in pipe sizes (use of site fabricated fittings or bushings shall not be permitted).

B. Tapered, factory manufactured reducer fittings (eccentric type at suction and concentric type at discharge) shall be installed at pump connections. Eccentric reducer fittings shall be installed with level crown.

C. Factory manufactured fittings shall be installed where changes occur in pipe direction (Bending or forming of piping shall not be permitted without written permission of the Engineer).

D. Use of main sized saddle branch connections or directly connecting profiled branches (weldolets) to mains in HDPE pressure piping will be allowed if main is two pipe sizes larger than branch. Branch pipes shall not be projected inside the main pipe.

E. Test tees shall be installed in soil, waste and vent pipe risers at minimum 450 mm (18 inch) above the ground floor level, at every alternate level and at other locations as shown on the Contract Drawings.

F. Connections shall not be made between piping of different services, under any circumstance. Existence of any one such connection in the project, whether temporary or permanent, shall make the Contractor liable for an anti-confusion test for all of the concerned services.

3.06 SLOPES AND INVERTS

A. Invert elevations shall be established and drainage pipes sloped to 1 % minimum unless otherwise stated. Minimum gradients, shown on Contract Drawings, shall be maintained.

B. Elevations of buried piping, outside the building, shall be established to ensure not less than 900 mm (3 ft) of cover, especially in areas subject to traffic loading.

C. Crown (or soffit) levels of the pipes shall be matched when joining horizontal drainage pipes of differing sizes, as far as possible. This shall apply to step reducers in drainage piping and connections in manholes (saddle joints in drainage mains excluded).

3.07 UNIONS AND FLANGES

A. Unions or flanges shall be installed downstream of valves and at equipment or apparatus connections.

B. Dielectric unions or flanged fittings shall be used wherever joining dissimilar metals.

3.08 PROTECTION DURING CONSTRUCTION

A. Ends of piping shall be kept closed with factory manufactured plugs with integral indicating flags, to prevent the entry of foreign matter, during the progress of the work. Such plugs shall be removed on completion of the works.

B. Piping surface shall be protected from splashes of cement, plaster, paint and similar construction materials.

C. Piping shall be blown out using dry compressed air, prior to testing.

3.09 SPECIALITY CONNECTORS

A. Fixture waste adapters of rubber or neoprene shall be used to connect tail pipes of sanitary fixtures / drains to the waste piping.

3.10 VALVES

A. Valves shall be installed with stem upright or horizontal, not inverted; except with the written permission of the Engineer, for each location.

B. Valves shall be same size as pipeline, except where shown otherwise on Contract Drawings.

C. Flap type check valves shall be installed on the discharge of wastewater sump pumps and sewage ejectors.

D. Appropriate valve gland packing, sealing and gasket materials shall be selected for the temperature and pressure encountered.

3.11 PIPING – PROTECTION

Following protective coatings / wrappings shall be given to the piping, on completion of the works. Piping above louvered ceilings shall be painted black as further described in architectural finish schedule.

A. Buried drainage piping:

1. Encasement with minimum 100 mm thick, class K 140, plain concrete

2. When pipe work is below raft level, a monolithic concrete channel enclosing the pipe shall be created and waterproofing membrane extended under the same

3.12 TESTING OF PRESSURISED PIPING

A. Pipes shall be jointed, plugged and shall have been in position for at least 24 hours, before the tests are carried out.

B. Piping shall be tested for line, gradient and water tightness. Contractor shall furnish all labour, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer. A minimum of two (2) # identical pressure gauges shall be installed at extremities of the piping circuit to be tested in case of Pressure piping.

C. Piping shall be filled with clean fresh water, leaving all high points open to allow for purging of air.

D. System shall be pressure tested using manual pumps in increments of 25 % of the test pressure. A standing period of 10 minutes shall be allowed after each pressure increment. Pressure testing using motor driven pump shall not be permitted.

E. Valves and control devices shall be kept in the open position, during testing. After completion of pressure test valves shall be closed, one at a time, starting from the pressure release end, so as to ensure tightness of the valve.

F. Pressure Piping shall be tested with water to a pressure of 689 kPa (100 psig) or 1.5 times the system working pressure, whichever is greater, Pressure shall be maintained for at least 4 hours. Circuit temperature shall be recorded along with the pressure readings and pressure fluctuations due to ambient temperature variations shall be allowed for.

G. Joints shall be checked for leaks by swabbing with a dry tissue. Drop in pressure to the order of 10 kPa (1.5 psig) per hour, but without any visible leaks, shall be considered as acceptable.

H. Piping shall be tested in segments during the progress of the work. An official log book shall be maintained for recording the tests carried out on sections of piping, including test pressure, date of test and approval signature of the Engineer’s representative witnessing the test.

3.13 TESTING OF DRAIN, WASTE AND VENT PIPING

A. Pipes shall be joined, plugged and shall have been in position for at least 24 hours before the tests are carried out.

B. Piping shall be tested for line, gradient and water tightness. Contractor shall furnish all labour, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer.

C. Compression type rubber plugs with bleeding caps shall be installed to plug branch risers in horizontal piping. Inflatable pneumatic rubber plugs shall be used for vertical risers and other inaccessible areas.

D. Piping shall be filled with clean fresh water, leaving all the high points open to allow purging of air.

E. Soil, waste and vent piping shall be tested by filling entire system with water to a minimum head of 3.0 m (10 feet) minimum at any part of the system. System shall hold the water level to within 100 mm (4 inch) drop, in 8 hours. Vertical piping shall be tested in sections of two or three floors at a time.

F. Joints shall be checked for leaks by swabbing with a dry tissue.

G. Drainage mains shall be tested by simultaneously flushing all water closets in the system. Drainage branches shall be tested by the simultaneous discharge of filled bathtubs, washbasins etc.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Open End Drains

B. Floor Drains

C. Shower Drains

D. Funnel Floor Drains

E. Area Drains

F. Water Tank Drains

G. Planter Drains

H. Trench Drains

I. Roof Vent Terminals

J. Ground/Floor Cleanouts

K. Manhole Covers and Frames

L. Floor Sinks

M. Rodding Eye

1.02 RELATED SECTIONS

A.	Division-1	General Requirements
B.	Section 22 00 00	Plumbing
C.	Section 22 05 00	Common Work Results for Plumbing
D.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
E.	Section 22 13 16	Sanitary Waste and Vent Piping
F.	Section 22 40 00	Plumbing Fixtures
G.	Section 22 13 29	Sanitary Sewerage Pumps
H.	Section 22 14 29	Sump Pumps

1.03 REFERENCES

A. British Standards:

1. BS 729 - Specification for Hot Dip Galvanized Coatings on Iron and Steel

articles (ASTM A 123: Zinc Coating [Hot Dip Galvanizing] on Fabricated Steel Products / ASTM A 153: Zinc Coating on Iron and Steel Hardware)

2. BS 1452 - Grey Iron Castings

3. BS 5493 - Code of Practice for protective coating of Iron and Steel Structures against Corrosion

4. BS EN 1825 - Grease Separators

5. BS 497 - Cast Iron Covers and Frames

B. European Standard:

1. EN 124 - Loading Class of Covers and Frame

C. Plumbing and Drainage Institute:

1. PDI G101 Standard - Testing and Rating Procedure for Grease Interceptors

1.04 SUBMITTALS

A. Product data, samples, installation details, selection criteria and ordering schedule, listing types against use and location under provisions of the General Conditions of Contract.

1.05 CLOSEOUT SUBMITTALS

A. Follow Division -1 - Closeout Submittal.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Construction of the specialties shall be of corrosion resistant materials like cast iron, stainless steel or dezincification resistant copper alloys (bronze / brass).

B. Castings used in the construction of the drainage specialties shall be of good quality, without blowholes or inclusions and shall be finished smooth by sand or shot blasting. These shall be given appropriate coatings, internally and externally, at the factory.

C. Flashing clamps, where used shall be non-puncturing type and shall be fixed by corrosion resistant fasteners. Drainage flanges shall have seepage holes to conduct away the water collected, unless otherwise indicated.

D. Items of similar nature shall be products of the same manufacturer, as far as practicable.

E. Heavy-duty gratings / covers shall be used in areas subjected to vehicular traffic.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Follow Division -1– Project Meetings

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE AND HANDLING

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

B. Products shall be stored in shipping cartons, on labeled racks, until time of installation.

C. Factory calibrated items like gauges, relief valves etc. which are dropped, subjected to shock or damaged otherwise shall be stored separately, with appropriate labels; until completion of works. A record of the same shall be maintained for Engineer's inspection.

1.10 WARRANTY

A. Follow Division -1 – Product Warranties and Guarantees

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Division -1 – Closeout Procedures for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to the compliance with the requirements and as per approval of the Engineer.

B. ACCEPTABLE MANUFACTURERS

1. Jay R. Smith, USA
2. Zurn, USA
3. Watts, USA
4. Kent Stainless, Ireland
5. Blucher, Denmark
6. Wade, UK
7. ACO, Europe
8. Hauraton, Germany
9. Surespan, UK
10. Gatic, UK
11. Howe Green, UK

12. Kuwait Foundry, Kuwait
13. Or other equal and approved under provisions of the General Conditions of Contract.

2.02 FLOOR DRAINS

A. Type FD - 1: For toilets on grade and toilets with sunken floor slabs

1. Baked epoxy Coated corrosion resistant cast iron body with integral trap and cleaning plug, hubless side outlet and threaded auxiliary inlets (up to 3 # as required)
2. Reversible, secured, cast iron flashing collar with weep holes
3. Adjustable, Stainless steel/satin nickel bronze, 150 mm (6 inch) square top with hinged solid cover having approved etching on it.
4. Secured, Stainless seel/cast bronze, secondary strainer
5. Extension adapters to accommodate deeper floor finish, where required

B. Type FD - 2: For toilets on elevated slabs with fixture waste piping at high level below

1. Baked epoxy Coated corrosion resistant cast iron body with gasket jointed bottom outlet
2. Reversible, secured, cast iron flashing collar with weep holes
3. Adjustable, stainless steel/satin nickel bronze, 150 mm (6 inch) square top with hinged, solid cover having approved etching on it.
4. Secured, stainless steel/cast bronze, secondary strainer
5. Extension adapters to accommodate deeper floor finish, where required
6. Fitting suitable for auxiliary inlet at high level below, P-trap, as appropriate

C. Type FD - 3: For toilets on elevated slabs with fixture waste piping cast in the slab.

1. Baked epoxy Coated corrosion resistant cast iron deep body with up to 4 # threaded auxiliary inlets and gasket jointed bottom outlet
2. Reversible, secured, cast iron flashing collar with weep holes
3. Adjustable, stainless steel/satin nickel bronze, 150 mm (6 inch) square top with hinged, solid cover having approved etching on it.
4. Secured, stainless steel/cast bronze, secondary strainer
5. Extension adapters to accommodate deeper floor finish, where required
6. Fitting suitable for auxiliary inlet at high level below, P-trap, as appropriate

2.03 SHOWER DRAINS

A. Type SD - 1: For showers discharging into floor drains.

1. Baked epoxy Coated corrosion resistant cast iron body with threaded side

outlet

2. Secured, cast iron flashing collar with weep holes

3. Adjustable, stainless steel/satin nickel bronze, 125 mm (5 inch) round or square top

B. Type SD - 2: For showers in toilets on elevated slabs with waste piping at high level below.

1. Baked epoxy Coated corrosion resistant cast iron body with gasket jointed bottom outlet

2. Reversible, secured, cast iron flashing collar with weep holes

3. Adjustable, stainless steel/satin nickel bronze, 125 mm (5 inch) round or square top.

2.04 FUNNEL FLOOR DRAINS

A. Type FFD - 1: For plant rooms with floor finish and waterproofing

1. Baked epoxy Coated corrosion resistant cast iron body with gasket jointed bottom outlet

2. Reversible, secured, cast iron flashing collar with weep holes

3. Adjustable, stainless steel/satin nickel bronze, 150 mm (6 inch) round / square strainer top

4. Round / oval, stainless steel/cast bronze funnel

B. FFD for LSS plant rom areas and areas exposed to salt water with floor finish /concrete finish.

1. Stainless steel 316L body with flashing flange, weep holes and gasket jointed bottom outlet; All wetted areas shall be stainless steel 316L material.

2. Flashing collar (stainless steel 316L)

3. Adjustable, stainless steel/ 316L, 150 mm (6 inch) round / square strainer top

4. Round / oval, stainless steel 316L funnel.

2.05 AREA DRAINS

A. Area Drains for LSS plant room areas and areas exposed to sea water with floor finish /concrete finish.

1. Stainless steel 316L body with flashing flange, weep holes and gasket jointed bottom outlet; All wetted areas shall be stainless steel 316L material.

2. Flashing collar(stainless steel 316L)

3. Stainless steel 316L sediment bucket

4. Secured, 215 mm (8½ inch) square, Stainless steel 316L frame and grate.

B. Type AD - 1: For internal areas with floor finish and waterproofing

1. Baked epoxy Coated corrosion resistant cast iron body with gasket jointed bottom outlet

2. Reversible, secured flashing collar with weep holes

3. Adjustable, secured, stainless steel/satin nickel bronze, 150 mm (6 inch) square strainer

C. Type AD - 2: For external areas with floor finish and waterproofing

1. Baked epoxy Coated corrosion resistant coated cast iron body with gasket jointed bottom outlet

2. Reversible, secured flashing collar with weep holes

3. Adjustable, secured, reinforced, nickel bronze, 150 / 200 mm (6 / 8 inch) round / square strainer

D. Type AD - 3: For internal / external areas with concrete finish and waterproofing

1. Baked epoxy Coated corrosion resistant coated cast iron body with flashing flange and gasket jointed bottom outlet

2. Flashing clamp with weeping holes

3. Sediment bucket

4. Adjustable, heavy duty ductile iron 215 mm (8½ inch) round strainer top

E. Type AD - 4: For internal / external areas car Parking areas with concrete finish, without waterproofing/

1. Coated cast iron body with gasket jointed bottom outlet

2. Sediment bucket

3. Heavy duty, ductile iron 215 mm (8½ inch) round strainer top

2.06 FIXTURE WASTE ADAPTERS

A. Wash Basins and Sinks

1. Rubber or Neoprene ring suitable for DN 50 (2 inch) waste pipe; with ribbed wiper seals on the outer face; concentric, tight fit inner bore suitable for the waste pipe and integral wall plate

2. Assembly shall cover the wall pipe externally and enclosed in the escutcheon plate of the waste assembly and create an air and water tight joint on installation

B. European Water Closets

1. Moulded plastic adapter ring suitable for DN 100 (4 inch) soil pipe; with ribbed wiper seals on the outer face; concentric / eccentric inner bore with wiper seals for the tail pipe of water closet and floor / wall flange

2. Assembly shall cover the floor / wall outlet externally and create an air and water tight joint on installation

2.07 OPEN END DRAINS

A. Type OED - 1: For drinking water cooler

1. DN 40 / 50 (1½ / 2 inch) white polypropylene tubular trap with funnel top and escutcheon, suitable for exposed installation.

Ref. : Geberit 152.392.01 / 152.393.01

B. Type OED - 2: For washing machine / dishwasher drainage

1. DN 40 / 50 (1½ / 2 inch) polypropylene tubular trap with compression nut and seal for flexible hose, suitable for surface mounted installation.

Ref. : Geberit 152.702.01 / 152.704.01

C. Type OED - 3: Fixed air gaps for process waste

1. Epoxy coated cast iron body; free inlet with setscrew lock and threaded / spigot outlet; for exposed installation

Ref. : Jay R. Smith 3950 series

Ref. : Jay R. Smith 3371 and 3380

2.08 TRENCH DRAINS

A. Type TD - 1: For use near Dish washer(s) in Central Kitchen

1. 300 mm wide (length as appropriate) stainless steel sump with outlet at centre / end, integral frame for grating, bell trap, basket strainer etc.

2. Anti-splash, non-skid grate of Stainless steel grate of 33 x 22 mm spacing

3. Support lugs and flashing clamp shall be provided as appropriate

Ref. : Model Riviere Drainage Channels - LRV series by Limatec, France

B. Type TD - 2: For use in public areas, LSS plant areas and all areas exposed to sea water.

1. Cast polymer concrete body (width and depth as shown on drawings) with hubless, bottom outlet

2. Medium / heavy duty, GRP/FRP grate; complete with end plates, locking bars, fasteners etc.

Ref. : ACO Drain /Hauraton

2.09 ROOF VENT TERMINAL

A. Type VTR

1. Coated cast iron vandal proof hooded vent cap with counter flashing collar, deep protective hood and recessed securing screws; complete with flashing sleeve at the roof level

Ref. : Jay R. Smith 1748 series with 1760 series

2.10 FLOOR CLEANOUTS

A. Type FCO - 1: For internal areas with medium traffic

1. Baked epoxy Coated corrosion resistant coated cast iron ferrule with gasket connection; bronze plug and seal; adjustable, ABS access housing; and secured, 150 mm (6 inch) square scoriated, Stainless steel/ nickel bronze top

B. Type FCO - 2: For internal areas with heavy traffic.

1. Baked epoxy Coated corrosion resistant coated cast iron ferrule with gasket connection; bronze plug and seal; adjustable, cast iron access housing; and secured (by set screw), round, scoriated, stainless steel/nickel bronze top

2.11 GROUND CLEANOUTS

A. Type GCO - 1: For paved areas with medium / heavy duty traffic

1. Baked epoxy Coated corrosion resistant coated cast iron ferrule with gasket connection; bronze plug and seal; adjustable, cast iron access housing; and secured (by set screw), round, scoriated, Ductile iron/cast iron top

Ref. : Jay R. Smith 4231 series

B. Type GCO - 2: For unfinished areas

1. Galvanized cast iron body with gasket jointed connection and bronze plug with seal; heavy duty, loose set housing and secured, scoriated, round cast iron tractor cover set in concrete pad

Ref. : Jay R. Smith 4250 series

2.12 PIT / TRENCH DRAINS & GRATINGS

A. For use in public areas

1. Cast polymer concrete body (200 mm nom. width and 100 mm depth) with hubless, bottom outlet

2. Medium / heavy duty, GRP / resin composite grate; complete with end plates, locking bars, fasteners etc.

Ref. : ACO Drain model N 200 H / Hauraton

B. For use in technical areas and areas with Medium/high wheel loading

1. Cast polymer concrete body (300 mm nom. width and 200 mm depth) with hubless, bottom outlet

2. Medium / heavy duty, GRP / resin composite grate; complete with end plates, locking bars, fasteners etc.

Ref. : ACO Drain / Hauraton

C. Fabricated Stainless steel/Steel grating and frame for use in Public rooms, kitchens etc.

1. Grating made of 25 or 32 x 6 mm (1 or 1¼ x ¼ inch) steel flats spaced at 25 mm (1 inch) centre-to-centre with 12 mm (½ inch) round bars driven through in a symmetrical spacing not exceeding 150 mm (6 inch); in standard lengths of 600 or 1000 mm (24 or 40 inches)

2. Frame fabricated from steel angles of appropriate size with mitred joints and anchor lugs

3. Assembly (frame and grating) shall be stainless steel 316L grade.

2.13 MANHOLE COVERS AND FRAMES

A. Manhole Covers for use in all Waste/Sewage Sump pits, manholes use in all technical areas, LSS plant rooms and Public/General areas, Covers used for all Interceptors and pits.

1. Single / double seal FRP/GRP/Composite frame and cover of stated dimensions with medium duty loading.

2. FRP/GRP/Composite Manhole covers shall be tested as per BS EN 124 & AASHTO M306 standards for drainage and utility services. Manhole covers shall meet all the requirements of the codes and standards.

3. A set of securing / lifting keys shall be furnished with each manhole cover.

Ref. : Thermodrain

B. Manhole Covers for Recessed, Infill Covers and Frames for use in public areas, Technical areas.

1. Single / double seal stainless steel 316L frame and cover of stated dimensions suitable for receiving finishing materials used in adjoining areas or otherwise; with stainless steel show edges, socket headed securing bolts and double sealing strips

2. Stainless steel frames with continuous profiled lugs at the outside, corners to have 320 Grit Polished Satin Finish.

3. A set of securing / lifting keys shall be furnished with each manhole cover

Ref. : Howe Green

PART 3 - EXECUTION

3.01 DRAINS – GENERALLY

A. Location of floor drains in tiled areas shall be coordinated, so as to attain an

acceptable pattern of cutting the tiles. Square tops shall be accommodated in one tile and round tops centrally at tiling junctions.

B. Floor drain / clean out tops shall be installed true to finished grade. Where box outs are provided for installation of floor drains non-shrink type concrete mix shall be used for filling the same. The architectural / landscape drawings shall be referred to and complied in respect of locations and top levels.

C. Fixture waste adapters of rubber or neoprene shall be used to connect tail pipes of sanitary fixtures / drains to the waste piping.

D. Damages to shop coats of drains shall be repaired with factory-supplied coatings, prior to installation. The surfaces of exposed metallic surfaces shall be protected from damage by covering with PVC tapes or similar material, after installation, until commissioning.

E. Drains shall be kept plugged, by appropriate means, throughout the construction period to prevent closure by cement slurries, paint and similar construction wastes. These shall be removed prior to commissioning.

F. Localised slopes shall be provided at parking area drains and similar items installed in level finished areas.

G. Drains with auxiliary inlets shall be ordered with specific instructions to drill and tap the required openings only.

3.02 DRAINS - CONNECTION WITH PIPING

A. Contractor shall study the specified connection(s) of drains for suitability with the drainage piping and suggest changes, where required, as appropriate; at no additional cost.

B. Where drains are not installed at the time of casting the concrete, due to any reason; provision shall be made for trimming of pipe stub(s) to accurate dimensions.

3.03 DRAINS – FLASHING

A. Requirements of Section 22 05 29 shall be referred to and complied with as appropriate, in respect of flashing; especially where membranes are not used for waterproofing of the floors.

3.04 GREASE INTERCEPTORS

A. Extension pieces / enclosures shall be ordered to accurate dimensions, as established at site.

B. Grease interceptors shall be installed within RCC chambers (poured around the steel enclosure), when installed outside buildings.

3.05 GRATINGS

A. Frames shall be fabricated from sections of suitable material, finish and strength to suit the details of construction and match the finish of the grating.

B. Frames shall be suitably anchored to take up the tilting forces and to attain good alignment.

3.06 MANHOLE / ACCESS COVERS

A. Manhole covers shall be sealed by appropriate means against entry of surface water into the manholes, especially where such entry may result in flooding and / or damage to property.

B. Sufficient numbers of securing / lifting keys of appropriate type and size shall be furnished to the Owner for each type of access / manhole cover.

END OF SECTION

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Storm Water Pipes and fittings

1.02 RELATED SECTIONS

A.	Section 09 91 00	Painting
B.	Section 22 05 16	Expansion Fittings and Loops for Plumbing Piping
C.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment.
D.	Section 22 05 48	Vibration and Seismic Control for Plumbing Piping and Equipment
E.	Section 22 05 53	Identification for Plumbing Piping and Equipment
F.	Section 22 07 00	Plumbing Insulation
G.	Section 22 13 19	Sanitary Waste Piping Specialties
H.	Section 22 14 29	Sump Pumps
I.	Section 22 40 00	Plumbing Fixtures
J.	Section 33 40 00	Storm Drainage Utilities

1.03 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME Sec. 9 - Welding and brazing qualifications

B. American National Standards Institute:

1. ANSI B 16.21 - Non-metallic gaskets for pipe flanges

C. American Water Works Association

1. AWWA C 601 - Standard methods for the examination of water and wastewater

D. British Standards:

1. BS 5556 - General requirements for dimensions and pressure ratings for pipe of thermoplastic materials (Metric Series)
2. BS 4504 - Circular flanges for pipes, valves and fittings (PN designated) (ANSI B 16.1 / B 16.24)
3. BS 8010 - Code of practice for pipelines (ASTM D 2774)
4. BS 6920 - Sustainability of non-metallic products for use in contact with water.

E. Code of Practice:

1. CP 312 - Code of practice for plastic pipe work

F. German Institute for Standardization:

1. DIN 8074 - HDPE pipes; dimensions
2. DIN 8075 - HDPE pipes; general quality requirements
3. DIN 19535 - HDPE pipes and fittings for hot water resistant waste and soil installations within buildings (ISO 8770 / 8772)

4. DIN 19537 - HDPE pipes and fittings for drainage and sewerage

G. German Welding Society:

1. DVS 2207 - Welding of thermoplastics

1.04 SUBMITTALS

A. Product data including data on pipe materials, fittings, valves and accessories; recommended coating materials; samples and manufacturer's installation instructions or recommendations shall be submitted under provisions of the General Conditions of Contract.

B. Copies of valve ordering schedules shall be submitted for approval prior to placing orders.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 92 00 - Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Uniformity shall be maintained in respect of connection standards throughout. Where this is not practical due to justifiable reasons; compatibility shall be ensured by using appropriate adapters, conversion spools, mating flanges and the like, with the written approval of the Engineer.

B. Pipes and fittings used in the works shall have the standard of manufacturer, type, class or rating etc. continuously printed or marked otherwise in compliance with the standard of manufacture. Materials without such identification shall be rejected.

C. Requirements of Section 22 00 00 shall be referred to and complied with as appropriate.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 31 30 – Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE AND HANDLING

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

B. Pipes shall be stored on elevated racks and the ends kept closed with factory-manufactured plugs to prevent the entry of foreign matter.

C. Plastic and rubber products shall be stored out of direct sunlight.

1.10 WARRANTY

A. Follow Section 01 88 70 – Product Warranties and Guarantees.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Section 01 92 00 - Closeout Procedures for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:

B. For HDPE Pipes and Fittings:

1. GeberitWavin
2. CoestilenValsir
3. KAI
4. Al Adasani
5. Approved Equal

2.02 PIPES AND FITTINGS

Service	Location	Type
Storm Water Drainage gravity pipe	All areas above and below grade	HDPE Soil
Storm Water Drainage Pumped Pressure pipe	All areas above and below grade	HDPE PN10

2.03 HDPE PIPES AND FITTINGS

A. Raw materials used for HDPE production shall be certified for regression; testing performed on the specific product with a stress life curve per ISO D 96802 and products shall be designed on a minimum hydrostatic design basis of 11,032 kPa (1,600 psig).

B. Pipes and fittings shall contain no recycled material except that generated in the pipe manufacturing plant from the same resin / raw material of pipes and fittings.

C. Pipes and fittings shall have long-term endurance characteristics recognized by compressed pipe ring environmental stress crack resistance greater than 1,000 hours.

D. Pipes and fittings shall be colour coded for service identification, as follows:

1. Drainage Black

E. Material used for the manufacture of polyethylene pipes and fittings shall be of extra-high molecular weight, high-density ethylene–hexane copolymer PE 80 (for Drainage only) / PE 100 polyethylene resin with the following physical properties and pipe performance requirements:

Property	Standard	Unit	Nom. Range
Designation	ISO 12162	MRS	PE 100
Density	ISO 1183	Kg / m3	0.93 ~ 0.96
Melt Flow	ISO 1133	gm / 10 min.	0.5 ~ 1.3
Tensile Strength	ISO 6259	MPa	22
UV Stabiliser	ISO 6964	% C	2.5

Property	Standard	Unit	Nom. Range
Elongation @ Break	ISO 527	% Min.	750
Modulus of Elasticity	ISO 178	MPa	800
Elongation @ Yield	ISO 527	% Min.	8
Coefft. Of Thermal Expansion	DIN 8075	mm / m °C	0.2
Thermal Conductivity @ 20°C	DIN 8075	W / m °K	0.43
Brittleness Temperature	DIN 8075	°C	< 40
Vicat Soft Temperature	DIN 8075	°C	210

F. Fittings - General

1. HDPE fittings shall be standard commercial products manufactured from resin of the same type, grade and cell classification as the pipe, by injection moulding
2. Fittings shall be rated for a working pressure equal to that of the pipe for 50-year service at 20°C with an included safety factor of 2:1 and pressure tested by the manufacturer
3. Minimum “quick-burst” strength of the fitting shall not be less than that of the pipe with which the fitting is to be used
4. Fittings up to and including 63 mm OD shall have integral ears or tabs for fixation purposes
5. Fittings shall have moulded-on identification and product information and supplied with a data carrier card (complying with ISO 7810 / 7811) with barcode and a magnetic strip for data transfer
6. PE couplers and saddles shall be designed to satisfy long-term performance requirements of respective ISO pipe series

G. Fittings – Electro-fusion Type

1. Heating coil process voltage shall not exceed 39.5 volts and terminal pins shall be of 4 mm diameter with insulated contacts
2. Heating coil provided in fittings shall be so designed that one complete process cycle will be sufficient to complete the joint
3. A limited path style fusion indicator (design preventing escape of fusion melt), acting for each zone as visual indication of completed fusion cycle, shall be incorporated into the body of the fitting adjacent to the terminals
4. Fittings shall be packed in such a way that allows use at site without any cleaning or preparation
5. Couplers in sizes up to and including DN 160 (6 inch) must have an easily removable centre stop, not requiring tools for removal
6. Internally or externally threaded transition adapters in sizes up to and including DN 63 (2 inch) shall be designed with integral collar, not relying on rubber or synthetic seals
7. Threaded adapter bodies shall be modular type of brass or stainless steel, not supplied moulded into electro-fusion fitting socket

H. Electro-fusion saddle with drilling cutter

1. Saddles up to main size DN 250 shall be designed with two separate halves with a single hinge type attachment, which can be correctly processed without specialized tooling
2. Top half of the saddle shall be equipped with an electro-fusion outlet, which can accept modular system components such as tapping tees, adapters, valve tees, caps, stop-off attachments etc. that are simultaneously fused with the saddle-to-main joint in one operation
3. Each branch outlet shall be equipped with an integral clamping device
4. Branch spigot of tapping tee must be long enough to allow a second joint if necessary
5. Pipe saddles above DN 63 (2 inch) shall allow 360° rotation of the branch outlet
6. Safe tapping intro mains shall be possible under stipulated maximum gas or water pressure, at respective pressure and temperature
7. Tapping saddle cutter shall be designed to contain the cut-out coupon (not produce shavings) and seal-off the central passage in the uppermost position
8. It shall be possible to permanently seal-off the top of the saddle with an electro-fused cap in mains of DN 63 (2 inch) and above

I. Joints

1. HDPE Soil: Thermal / electro fusion socket / butt welded joints
2. HDPE Pressure: Thermal / electro fusion socket / butt welded joints
3. Ring seal joints and special adapters may be used for HDPE soil and fusion jointed weldolets (saddles), flanges and special adapters may be used for HDPE pressure pipe work, as appropriate

J. Unions and Flanges

1. Unions shall be of HDPE with socket fusion ends
2. Flanges shall be of HDPE with butt fusion ends
3. Compressed fibre gaskets shall be used at all flanges (rubber gaskets shall not be used)

K. Pressure Rating (Continuous)

1. HDPE Soil: 345 kPa (50 psig)
2. HDPE Pressure: 1,034 kPa (150 psig)

PART 3 - EXECUTION

3.01 SELECTION AND APPLICATION

A. Manufacturer’s recommendations shall be sought and applied as appropriate, in respect of chemical compatibility of piping with agents used for flushing disinfecting etc.

3.02 PREPARATION

A. Pipes and tubes shall be cut perpendicular to the axis, with approved cutting tools; the ends reamed and burrs removed.

B. Scale and dirt, on inside and outside and weld splatter shall be removed before assembly.

3.03 SPACING AND LOCATION

A. Piping shall be installed in such a way that conserves building space and not interfering with the use of space.

B. Exposed piping shall be installed parallel or at right angles to the building walls, except where otherwise shown on the Contract drawings.

C. Minimum clearances shall be provided between piping covered by this Section and those of other trades.

D. Adequate clearance shall be provided around the piping for the installation of insulation and access to valves and fittings.

E. Piping shall be grouped at common elevations, wherever possible.

F. Piping shall be installed in such a way that allows for expansion and contraction without stressing pipe joints or connected equipment.

G. Access doors shall be provided where valves and fittings are not exposed. Size and location of access doors shall be coordinated with relevant Sections.

H. All concealed (non-accessible) pipes (risers and horizontal runs) shall have adequate wall and floor cleanouts for all turns to facilitate proper maintenance.

3.04 PIPE FITTINGS

A. Tapered reducer fittings shall be installed where changes occur in pipe sizes (use of site fabricated fittings or bushings shall not be permitted).

B. Tapered, factory manufactured reducer fittings (eccentric type at suction and concentric type at discharge) shall be installed at pump connections. Eccentric reducer fittings shall be installed with level crown.

C. Factory manufactured fittings shall be installed where changes occur in pipe direction (Bending or forming of piping shall not be permitted without written permission of the Engineer).

D. Use of main sized saddle branch connections or directly connecting profiled branches (weldolets) to mains in HDPE pressure piping will be allowed if main is two pipe sizes larger than branch. Branch pipes shall not be projected inside the main pipe.

E. Test tees shall be installed in rainwater pipe risers at minimum 450 mm (18 inch) above the ground floor level, at every alternate level and at other locations as shown on the Contract Drawings.

F. Connections shall not be made between piping of different services, under any circumstance. Existence of any one such connection in the project, whether temporary or permanent, shall make the Contractor liable for an anti-confusion test for all of the concerned services.

3.05 SLOPES AND INVERTS

A. Invert elevations shall be established and drainage pipes sloped to 1 % minimum unless otherwise stated. Minimum gradients, shown on Contract Drawings, shall be maintained.

B. Elevations of buried piping, outside the building, shall be established to ensure not less than 900 mm (3 ft) of cover, especially in areas subject to traffic loading.

C. Crown (or soffit) levels of the pipes shall be matched when joining horizontal drainage pipes of differing sizes, as far as possible. This shall apply to stepped reducers in drainage piping and connections in manholes (saddle joints in drainage mains excluded).

3.06 UNIONS AND FLANGES

A. Unions or flanges shall be installed downstream of valves and at equipment or apparatus connections.

B. Dielectric unions or flanged fittings shall be used wherever joining dissimilar metals.

3.07 PROTECTION DURING CONSTRUCTION

A. Ends of piping shall be kept closed with factory manufactured plugs with integral indicating flags, to prevent the entry of foreign matter, during the progress of the

work. Such plugs shall be removed on completion of the works.

B. Piping surface shall be protected from splashes of cement, plaster, paint and similar construction materials.

C. Piping shall be blown out using dry compressed air, prior to testing.

3.08 SPECIALITY CONNECTORS

A. Fixture waste adapters of rubber or neoprene shall be used to connect tail pipes of drains to the storm water piping.

3.09 PIPING – PROTECTION

Following protective coatings / wrappings shall be given to the piping, on completion of the works. Piping above louvered ceilings shall be painted black as further described in architectural finish schedule.

A. Buried storm water piping:

1. Encasement with minimum 100 mm thick, class K 140, plain concrete

2. When pipe work is below raft level, a monolithic concrete channel enclosing the pipe shall be created and waterproofing membrane extended under the same

3.10 TESTING OF PRESSURISED PIPING

A. Pipes shall be jointed, plugged and shall have been in position for at least 24 hours, before the tests are carried out.

B. Piping shall be tested for line, gradient and water tightness. Contractor shall furnish all labour, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer. A minimum of two (2) # identical pressure gauges shall be installed at extremities of the piping circuit to be tested in case of Storm water pressure piping.

C. Piping shall be filled with clean fresh water, leaving all high points open to allow for purging of air.

D. System shall be pressure tested using manual pumps in increments of 25 % of the test pressure. A standing period of 10 minutes shall be allowed after each pressure increment. Pressure testing using motor driven pump shall not be permitted.

E. Valves and control devices shall be kept in the open position, during testing. After completion of pressure test valves shall be closed, one at a time, starting from the pressure release end, so as to ensure tightness of the valve.

F. Piping shall be tested with water to a pressure of 689 kPa (100 psig) or 1.5 times the system working pressure, whichever is greater, Pressure shall be maintained for at least 4 hours. Circuit temperature shall be recorded along with the pressure readings and pressure fluctuations due to ambient temperature variations shall be allowed for.

G. Joints shall be checked for leaks by swabbing with a dry tissue. Drop in pressure to the order of 10 kPa (1.5 psig) per hour, but without any visible leaks, shall be considered as acceptable.

H. Piping shall be tested in segments during the progress of the work. An official log book shall be maintained for recording the tests carried out on sections of piping, including test pressure, date of test and approval signature of the Engineer’s representative witnessing the test.

3.11 TESTING OF STORM WATER DRAIN PIPING

A. Pipes shall be joined, plugged and shall have been in position for at least 24 hours before the tests are carried out.

B. Piping shall be tested for line, gradient and water tightness. Contractor shall furnish all labour, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer.

C. Compression type rubber plugs with bleeding caps shall be installed to plug branch

risers in horizontal piping. Inflatable pneumatic rubber plugs shall be used for vertical risers and other inaccessible areas.

D. Piping shall be filled with clean fresh water, leaving all the high points open to allow purging of air.

E. Storm piping shall be tested by filling entire system with water to a minimum head of 3.0 m (10 feet) minimum at any part of the system. System shall hold the water level to within 100 mm (4 inch) drop, in 8 hours. Vertical piping shall be tested in sections of two or three floors at a time.

F. Joints shall be checked for leaks by swabbing with a dry tissue.

G. Drainage mains shall be tested by simultaneously flushing all water closets in the system. Drainage branches shall be tested by the simultaneous discharge of filled bathtubs, washbasins etc.

END OF SECTION

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Roof Drains

B. Rain Water Shoes

C. Clean-outs

D. Manhole Covers and Frames

E. Trench Drain

F. Gutter Drain

1.02 RELATED SECTIONS

A. Section 22 00 00 Plumbing

B. Section 22 11 16 Domestic Water Piping

C. Section 22 40 00 Plumbing Fixtures

1.03 REFERENCES

A. British Standards:

1. BS 729 - Specification for Hot Dip Galvanized Coatings on Iron and Steel articles (ASTM A 123: Zinc Coating [Hot Dip Galvanizing] on Fabricated Steel Products / ASTM A 153: Zinc Coating on Iron and Steel Hardware)

2. BS 1452 - Grey Iron Castings

3. BS 5493 - Code of Practice for protective coating of Iron and Steel Structures against Corrosion

4. BS EN 1825 - Grease Separators

5. BS 497 - Cast Iron Covers and Frames

B. European Standard:

1. EN 124 - Loading Class of Covers and Frame

1.04 SUBMITTALS

A. Product data, samples, installation details, selection criteria and ordering schedule, listing types against use and location under provisions of the General Conditions of Contract.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 92 00 - Closeout Procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Construction of the specialties shall be of corrosion resistant materials like cast iron, stainless steel or dezincification resistant copper alloys (bronze / brass).

B. Castings used in the construction of the drainage specialties shall be of good quality, without blowholes or inclusions and shall be finished smooth by sand or shot blasting. These shall be given appropriate coatings, internally and externally, at the factory.

C. Flashing clamps, where used shall be non-puncturing type and shall be fixed by corrosion resistant fasteners. Drainage flanges shall have seepage holes to conduct away the water collected, unless otherwise indicated.

D. Items of similar nature shall be products of the same manufacturer, as far as practicable.

E. Heavy duty gratings / covers shall be used in areas subjected to vehicular traffic.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 31 30 – Project Meetings

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE AND HANDLING

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

B. Products shall be stored in shipping cartons, on labeled racks, until time of installation.

C. Factory calibrated items like gauges, relief valves etc. which are dropped, subjected to shock or damaged otherwise shall be stored separately, with appropriate labels; until completion of works. A record of the same shall be maintained for Engineer's inspection.

1.10 WARRANTY

A. Follow Section 01 88 70 – Product Warranties and Guarantees

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Section 01 92 00 - Closeout Procedures for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:

1. Jay R. Smith
2. Wade
3. ACO
4. Zurn
5. Kuwait Foundry
6. Watts
7. Approved Equal

B. Manufacturers: Subject to the compliance with the requirements and as per approval of the Engineer.

2.02 ROOF DRAINS

A. Type RD - 1: For normal roofs, not used for activity

1. Cast Iron with shallow sump; bottom outlet cast iron dome grate

B. Type RD - 2: For normal roofs, used for activity

1. Cast Iron body with shallow sump; bottom outlet; flat and stainless steel grating

C. Type RD - 3: For balconies

1. Baked epoxy Coated corrosion resistant coated cast iron body with threaded bottom / side / oblique outlet as appropriate; secured, low stainless steel/polyethylene dome and bronze clamp ring and shallow sump with flashing flange

Ref. : Jay R. Smith 1620 series

D. Type RD - 4: For large sheet metal gutters for metal roofs (Gutter Drains)

1. Baked epoxy Coated corrosion resistant coated cast iron body with shallow sump; gasket jointed, bottom outlet

2. Combined flashing clamp and gravel stop

3. Polyethylene dome

Ref. : Jay R. Smith 1330 series

2.03 RAIN WATER SHOE (RWS)

A. Type RWS

1. Cast bronze/stainless steel, smooth profiled down spout nozzle with threaded inlet; complete with loose set wall flange with anchor lugs

Ref. : Jay R. Smith 1770 series

2.04 GROUND CLEANOUTS

A. Type GCO - 1: For paved areas with medium / heavy duty traffic

1. The cleanouts are to be of cast iron
2. Slip Resistant Cover Plate.
3. Damp Proof Membrane.
4. Square shaped profile.

B. Type GCO - 2: For unfinished areas

1. The Cleanouts are to be of cast iron.
2. Slip Resistant Cover Plate.
3. Round shaped profile.

2.05 TRENCH DRAINS

A. Type TD - 1: For use in Central Kitchen

1. 300 mm wide (length as appropriate) stainless steel sump with outlet at centre / end, integral frame for grating, bell trap, basket strainer etc.

2. Anti-splash, non-skid grate of Stainless steel grate of 33 x 22 mm spacing

3. Support lugs and flashing clamp shall be provided as appropriate

Ref. : Model Riviere Drainage Channels - LRV series by Limatec, France

B. Type TD - 2: For use in public areas

1. Cast polymer concrete body (width and depth as shown on drawings) with hubless, bottom outlet

2. Medium / heavy duty, GRP/FRP grate; complete with end plates, locking bars, fasteners etc.

Ref. : ACO Drain /Hauraton

C. Type TD - 3: For use in technical areas, Parking areas and Ramps where it is concrete trench body and areas with high wheel loading

1. Heavy duty, Ductile Iron grate; complete with end plates, locking bars, fasteners with square holes (Matching sections shall be assembled to form full length of the trench)

Ref. : Jay R. Smith 2885 series

PART 3 - EXECUTION

3.01 DRAINS – GENERALLY

A. Clean out tops shall be installed true to finished grade. Where box outs are provided for installation of floor drains non-shrink type concrete mix shall be used for filling the same. The architectural / landscape drawings shall be referred to and complied in respect of locations and top levels.

B. Damages to shop coats of drains shall be repaired with factory-supplied coatings, prior to installation. The surfaces of exposed metallic surfaces shall be protected from damage by covering with PVC tapes or similar material, after installation, until commissioning.

C. Drains shall be kept plugged, by appropriate means, throughout the construction period to prevent closure by cement slurries, paint and similar construction wastes. These shall be removed prior to commissioning.

D. Localized slopes shall be provided at Roof drains and similar items installed in level finished areas.

3.02 DRAINS - CONNECTION WITH PIPING

A. Contractor shall study the specified connection(s) of drains for suitability with the drainage piping and suggest changes, where required, as appropriate; at no additional cost.

B. Where drains are not installed at the time of casting the concrete, due to any reason; provision shall be made for trimming of pipe stub(s) to accurate dimensions.

3.03 DRAINS – FLASHING

A. Requirements of Section 22 05 29 – Hangers and Supports shall be referred to and complied with as appropriate, in respect of flashing; especially where membranes are not used for waterproofing of the floors.

3.04 GRATINGS

A. Frames shall be fabricated from sections of suitable material, finish and strength to suit the details of construction and match the finish of the grating.

B. Frames shall be suitably anchored to take up the tilting forces and to attain good alignment.

3.05 MANHOLE / ACCESS COVERS

A. Manhole covers shall be sealed by appropriate means against entry of surface water into the manholes, especially where such entry may result in flooding and / or damage to property.

B. Sufficient numbers of securing / lifting keys of appropriate type and size shall be furnished to the Owner for each type of access / manhole cover.

END OF SECTION

SECTION 22 14 29

SUMP PUMPS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Waste Water Sump Pumps

B. Sanitary Sewage Sump Pumps

C. Mounting Brackets and Rails

D. Electrical Works

1.02 RELATED SECTIONS

A. Section 03 30 00 Cast-in-Place Concrete

B. Section 22 00 00 Plumbing

C. Section 22 05 13 Common Motor Requirements for Plumbing Equipment

D. Section 22 14 13 Facility Storm Drainage Piping

1.03 REFERANCES

A. Enclosures for Electrical equipment (1000 volts Maximum)

B. American Society of Mechanical Engineers:

1. ASME A112.14.1 - Backwater Valves.

2. ASME B31.9 - Building Services Piping.

C. American Society for Testing and Materials:

1. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

2. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).

3. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

4. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).

5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

6. ASTM C478M - Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).

7. ASTM D2241 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

3. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.

4. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.

5. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.04 QUALITY ASSURANCE

A. Equipment supplied shall have local agents certified by the manufacturer to check, test, adjust and commission the equipment.

B. Packaged pump sets shall be assembled and tested at the manufacturers' or licensees own premises. Furnish copy of manufacturing license along with material submittal, where appropriate.

C. Requirements and recommendations of the following organizations shall be conformed to as appropriate:

1. National Sanitation Federation (NSF)
2. American Society of Mechanical Engineers (ASME)
3. International Electro Technical Commission (IEC)
4. American Society for Testing and Materials (ASTM)

D. Equipment shall have labels attached permanently, indicating:

1. Name of Manufacturer
2. Model / Serial numbers
3. Certified Ratings
4. Maximum Operating Parameters

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.06 SUBMITTALS

A. Product data, certified pump performance characteristics with selection plotted, data on equipment dimensions, service connections, operating weight and installation drawings and instructions shall be submitted under provisions of the General Conditions of Contract.

B. Manufacturer's / independent laboratory's test certificates confirming that the equipment construction and performance meet or exceed the specified requirements shall be submitted, as required.

C. Closeout Submittals

1. Refer to Section 01 92 00 - Closeout Procedures to be complied with.
2. Project Record Documents: Record actual locations of valves and equipment.
3. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals

1.07 DELIVERY, STORAGE AND HANDLING

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

B. Weatherproof covering shall be retained on equipment until commissioning.

1.08 GUARANTEES AND WARRANTIES

A. Requirements of the Section 01 88 70 - Product Warranties and Guarantees and Plumbing services section 22 00 00 shall be referred to and complied with as appropriate.

B. Owner shall be furnished with guarantee and warranty certificates, duly registered with the manufacturer.

1.09 EXTRA MATERIALS / SPARE PARTS

A. Follow Section 01 92 00 - Closeout Procedures for Spare parts and maintenance products.

B. Following spare parts shall be furnished, properly packed and labelled with equipment # and location:

1. One set of seals (stuffing box / mechanical seal) for each type / size of pumps
2. One set of bearings for each type / size of pumps
3. One set of coupling insert for each type / size of pumps

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:

1. EBARA
2. KSB
3. Homa
4. Sulzer
5. Tsurumi
6. Zenit
7. Approved Equal

2.02 SUMP PUMPS (FREE STANDING PUMP)

A. Type: Quick-connect, submersible centrifugal pump of speed not exceeding 2900 rpm with integral float switch, suitable for directly plugging into mains. Materials of construction shall be as follows:

1. Impeller Stainless steel semi open
2. Shaft Stainless steel
3. Casing Cast Iron
4. Seal Mechanical

B. Discharge Piping: PN 10 HDPE with flanged ends, up to the manifold.

C. Valves: External lever and weight type (manufacturer's proprietary products acceptable as alternate) self-closing check valve and OS&Y type gate valve, all of IBBM construction.

D. Access manhole for pit: Fabricated steel frame and reinforced checker plate cover with sealing gaskets, locking bolts and recessed lifting handle.

E. Pump motor and control panel: Motor shall be designed for IE3 Premium Efficiency in accordance with IEC 60034-30 with IP68 enclosure, Class H insulation; class A or B temperature rise, Section 22 05 13 shall be referred to and complied with as appropriate.

F. Control panels for Sump Pumps shall have the following:

1. Mains isolator (// 4 pole // 3 pole //, fully enclosed type) interlocked with door and power on indicator (red), which shall be lit only when all the three phases

are healthy

2. Starter contactor (DOL / star-delta) with overload trip and set of HRC fuses for each pump
3. Manual / off / automatic selector switch for each pump
4. Pump run (green) and trip (amber) indicators for each pump with audible alarm for trip and test and mute facility
5. Start / stop push buttons for manual operation of pumps
6. Automatic sequence inverter for changing lead pump on alternate starts
7. Set of terminals / relays with volt free contacts for interconnection with other systems
8. Set of mercury float switches for the following:
   a. Start pump No. 1
   b. Start pump No. 2
   c. Stop pump/s
   d. High water alarm
9. Minimum run timer and relay with 0 to 6 minutes' range

G. Finishing: Two (2) coats of primer and two coats of coal tar enamel shall be applied to all metallic parts within the sump.

H. Capacity: Schedule on drawings shall be referred to for types and capacity ratings.

I. Finishing: Two (2) coats of primer and two coats of coal tar enamel shall be applied to all metallic parts within the sump.

J. Capacity: Schedule on drawings shall be referred to for types and capacity ratings.

PART 3 - EXECUTION

3.01 CO-ORDINATION

A. Size of doorways and other accesses to technical areas shall be coordinated to ensure that these are amply sized to allow for the movement of equipment.

B. Hooks, rails or other provisions shall be provided to allow for hoisting or movement of equipment in technical areas.

C. Data on heat loss to surroundings from equipment located in air-conditioned areas shall be furnished to the HVAC trade.

D. Data on the required power supplies shall be furnished to the electrical trade.

3.02 SELECTION

A. Pump motors shall be selected for the maximum loading of the selected impeller.

B. Pumps shall be selected with the operating points within 20 % on either side of the maximum efficiency point.

C. Maximum and minimum impeller sizes shall not be selected for unit pumps, as far as possible.

3.03 INSTALLATION

A. Clearances shall be provided around equipment for operation, maintenance and ventilation.

B. Manufacturer's installation instructions shall be complied with in all respects.

C. Lifting devices shall be attached to equipment only at designated points. The equipment shall not be dropped or subjected to any kind of shock.

D. Services of manufacturer's specialist representative shall be provided for commissioning of equipment.

END OF SECTION

SECTION 22 32 00

DOMESTIC WATER FILTRATION EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. In-Line Self Cleaning Filter

B. Central Cartridge Filters

C. Terminal Filters (For Drinking Water)

D. Pressure Sand Filters

E. Self-Cleaning Screen Filters (Irrigation)

1.02 RELATED SECTIONS

A.	Section 01 35 14	Special Conditions for Project in Kuwait Area
B.	Section 22 00 00	Plumbing
C.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
D.	Section 22 05 48	Vibration and Seismic Control for Plumbing Piping and Equipment
E.	Section 26 00 00	Electrical

1.03 REFERENCE STANDARDS

A. American Welding Society:

1. AWS D 10.9 - Standard for building services piping

B. British Standards:

1. BS 5378 - Safety signs and colors

C. European Standards

1. EN 97/23/EC - Pressure Equipment

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical equipment (1000 volts Maximum)

1.04 SUBMITTALS

A. Manufacturer's / independent laboratory's test certificates confirming that the equipment construction and performance meet or exceed the specified requirements shall be submitted, as required.

1.05 CLOSEOUT SUBMITTALS

A. Refer to Section 01 78 00 – Closeout Submittals to be complied with.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.06 QUALITY ASSURANCE

A. Equipment Manufacturer shall be responsible for checking, testing and commissioning of the Equipment.

B. Requirements and recommendations of the following organizations shall be conformed to as appropriate:

1. National Sanitation Federation (NSF)

2. American Society of Mechanical Engineers (ASME)

3. International Electro Technical Commission (IEC)

C. Equipment shall have labels attached permanently, indicating:

1. Name of Manufacturer

2. Model / Serial numbers

3. Certified Ratings

4. Maximum Operating Parameters

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

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

B. Weatherproof covering shall be retained on equipment until commissioning.

1.10 WARRANTY

A. Follow Section 01 78 00 – Closeout Submittals for product warranties and product bonds.

B. Requirements of the General Conditions of Contract and Plumbing services section 22 00 00 shall be referred to and complied with as appropriate.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Section 01 78 00 – Closeout Submittals for Spare parts and maintenance

products.

1.12 EXTRA MATERIALS / SPARE PARTS

A. Requirements of the General Conditions of Contract and Section 22 00 00 shall be referred to and complied with as appropriate without prejudice to requirements stated herein.

B. Spare parts as listed below shall be furnished, properly packed and labeled with equipment no. / location:

1. One full set of spare element for all in-line filters used in the project.

2. One full set of change of media for all media filters used in the project.

3. One full set of cartridges for all central cartridge filters / terminal filters used in the project.

4. One full set of change of media for all types of filters used in the project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS: Subject to the compliance with the requirements and as per approval of the Engineer.

2.02 IN-LINE SELF CLEANING FILTER

A. Type: Permanent media, self-cleaning type.

B. Function: Dirt / Rust Removal to 20 microns Filtration Fineness.

C. Construction: Stainless Steel Mesh Filter with Brass Sump and Body with union connections, rated for an inlet pressure of 2,757 kPa (400 psig) wwp.

D. Accessories: Automatic back-washing (daily) device with 24 v / 1 ph / 50 Hz power supply unit. One set of filter elements shall be supplied as spare.

2.03 PRESSURE SAND FILTERS

A. Type: Permanent media, pressure.

B. Function: Dirt / rust removal to 10 microns filtration fineness in once through application.

C. Construction: ASME rated welded steel shell with dished end, welded inlet and outlet pipes with flanged ends, steel / ABS distribution and collection pipes and laterals, access manhole with synthetic gasket and external locking bar, integral jack supports and lifting lugs.

D. Protective Coatings: Food-grade epoxy internally and rust inhibiting primer and one coat of enamel externally.

E. Face Piping: Welded steel / ABS.

F. Valves: Hydraulically operated diaphragm type, steel body with flanged ends.

G. Controls: Electrically operated (240 v / 1 phase / 50 Hz) semi-automatic controller (mounted on the filter body) to perform back wash, rinse and put the filter to service; once initiated manually.

H. Accessories: Air bleed valve, pressure gauge manifold, automatic flow controls

I. Working Pressure: 10 Bar (150 psig) minimum

2.04 CENTRAL CARTRIDGE FILTERS

A. Type: Pressure with synthetic, disposable media.

B. Function: Dirt / rust removal to 5 micron filtration fineness in once through application.

C. Construction ASME rated 316 stainless steel shell, dished cover with quick release clamp and air release valve port, welded inlet and outlet pipes with flanged threaded ends and ports for differential pressure gauge, ports for clean and dirty water sampling cocks and integral supports.

D. Accessories: Air bleed valve, differential pressure gauge etc.

2.05 TERMINAL FILTERS (for drinking water)

A. Function: Taste and odors removal and sub-micron filtration of dirt and bacteria.

B. Stainless steel body and cover with quick release clamp and threaded inlet and outlet ports

C. Filter element: Ceramic cartridge with activated carbon fills.

D. Capacity: 7 lpm (approx.).

2.06 SELF-CLEANING SCREEN FILTERS (For Irrigation System)

A. Type: Welded mesh screen cartridge type with automatic backwash. The filtration system shall remove suspended solids down to 75 microns (depending on screen mesh selection) from the water source. The filter system is shipped unassembled and shall include filters, interconnecting piping, valves, gauges, fittings and optional automatic controls.

B. Filter Cartridge: Corrosion resistant assembly made up of stainless steel profile wire, polymeric frame, sealing gaskets etc. available in 40, 80, 100, 150, and 200 mesh sizes and maximum pressure drop at rated flow not exceeding 0.2 bar (3 psig). Further,

1. Cartridge shall feature a pre-filter chamber (for removal of course materials) and a fine mesh filtration chamber

2. Dirty and clean areas of the cartridge shall be sealed with an "O" ring

3. Fine filtration mesh shall be polymeric material

4. Screen mesh shall be replaceable through manual disassembly of the cartridge (no tools required)

5. Fine mesh screen shall be supported in the cartridge by use of a polyethylene intermediate weave for optimum screen mesh utilization (use of total screen surface)

6. Where coarse filtration objectives are established fine mesh filtration may be substituted with 1/16" or 1/32" perforated stainless steel cartridge construction.

C. Housing: Modular, welded stainless steel (type 316) shell with cartridge aligners, easy access (safety lock lid) closure assembly at ends, 15 mm (½ inch) air vent port and groove type connections; rated 125 psig and 200 gpm flow rate. Filter housing shall be passivized after fabrication for enhanced corrosion protection.

D. Headers: Welded stainless steel pipe sections with jacklegs and grooved type connections.

E. Back-flush System: “Thru-Flush" action of the filter for dirt removal without the use of moving parts, comprising:

1. Solid-state automatic controller, capable of unattended automatic back-flush on a time selected interval, for a period of 30 seconds or less

2. Optional, automatic pressure differential override safety circuit to activate the backwash cycle when source water quality vary and pressure differential develop to a preset limit prior to the backwash time

PART 3 - EXECUTION

3.01 CO-ORDINATION

A. Size of doorways and other accesses to technical areas shall be coordinated to ensure that these are amply sized to allow for the movement of equipment.

B. Hooks, rails or other provisions shall be provided to allow for hoisting or movement of equipment in technical areas.

C. Data on heat loss to surroundings from equipment located in air-conditioned areas shall be furnished to the HVAC trade.

D. Data on the required power supplies shall be furnished to the electrical trade.

3.02 SELECTION

A. Pump motors shall be selected for the maximum loading of the selected impeller.

B. Pumps shall be selected with the operating points within 20% on either side of the maximum efficiency point.

C. Maximum and minimum impeller sizes shall not be selected for unit pumps, as far as possible.

D. Coded colors shall be used for finishing equipment of different services.

3.03 INSTALLATION

A. Clearances shall be provided around equipment for operation, maintenance and ventilation.

B. Manufacturer's installation instructions shall be complied with in all respects.

C. Lifting devices shall be attached to equipment only at designated points. The equipment shall not be dropped or subjected to any kind of shock.

D. Services of manufacturer's specialist representative shall be provided for commissioning of equipment.

END OF SECTION

SECTION 22 33 00

ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Unit Electric Water Heaters

B. Electric Water Heaters

C. Thermostatic Mixing Valves

1.02 RELATED SECTIONS

A.	Division-1	General Requirements
B.	Section 22 00 00	Plumbing
C.	Section 22 05 00	Common Work Results for Plumbing
D.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment
E.	Section 22 05 48	Vibration and Seismic Control for Plumbing Piping and Equipment
F.	Section 22 11 16	Domestic Water Piping
G.	Section 22 11 23	Domestic Water Pumps
H.	Section 26 00 00	General Provisions for Electrical Installation

1.03 REFERENCE STANDARDS

A. American Society of Heating, Refrigerating and Air Conditioning Engineers:

1. ASHRAE 90.1 – Energy Standard for Buildings Except Low – Rise Residential Building.

B. American Society of Mechanical Engineers:

1. ASME Sec VIII - Boiler and Pressure Vessel Code

2. ASME PTC 25 – Pressure Relief Devices

C. American Society for Testing and Materials:

1. ASTM A 167 - Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and strip

D. British Standards:

1. BS EN 60529 - Specification for degree of protection provided by enclosures - IP code (NEMA 250)

E. National Electrical Code - NEC

F. National Electrical Manufacturer Association:

1. NEMA 250 - Enclosures for Electrical equipment (1000 volts Maximum)

G. Underwriters Laboratories:

1. UL 174 - Household Electrical Water Heaters

1.04 SUBMITTALS

A. Product data, certified pump performance characteristics with selection plotted, data on equipment dimensions, service connections, operating weight and installation drawings and instructions shall be submitted under provisions of the General Conditions of Contract.

B. Manufacturer's / independent laboratory's test certificates confirming that the equipment construction and performance meet or exceed the specified requirements shall be submitted, as required.

1.05 CLOSEOUT SUBMITTALS

A. Follow Division -1 - Closeout Submittals to be complied with.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.06 QUALITY ASSURANCE

A. Equipment supplied shall have local agents certified by the manufacturer to check, test, adjust and commission the equipment.

B. Requirements and recommendations of the following organizations shall be conformed to as appropriate:

1. National Sanitation Federation (NSF)

2. American Society of Mechanical Engineers (ASME)

3. International Electro technical Commission (IEC)

4. American Society for Testing and Materials (ASTM)

C. Equipment shall have labels attached permanently, indicating:

1. Name of Manufacturer

2. Model / Serial numbers

3. Certified Ratings

4. Maximum Operating Parameters

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Follow Division -1 – Project Meetings

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

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

B. Weatherproof covering shall be retained on equipment until commissioning.

1.10 GUARANTEES AND WARRANTIES

A. Owner shall be furnished with guarantee and warranty certificates, duly registered with the manufacturer.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Division -1 – Closeout Proceduress for Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Unit Electric Water Heater

1. A.O. Smith, USA

2. Patterson Kelly, USA

3. Bradford White, USA

B. CENTRAL Electric Water Heaters

1. Ecotherm, Austria

2. IMI Rycroft, UK

3. Ormandy, UK

C. Thermostatic Mixing Valves

1. Spirax Sarco, USA

2. Leonard, USA

3. Watts, France

4. Honeywell, USA

2.02 UNIT ELECTRIC WATER HEATERS

A. Type: Vertical / Horizontal, wall mounted, storage type.

B. Storage Section: ASME rated (125 psig), glass lined steel shell insulated with minimum 25 mm (1 inch) thick high density fiber glass or polyurethane foam, enclosed in sheet metal jacketing.

C. Connections: Bronze nipples for cold water inlet, hot water outlet, T and P relief valve and drain valve.

D. Anodic protection: Extruded magnesium anode attached to shell.

E. Recovery Section: Immersion type element assembly with screw in type, copper faced heat resistant plastic base. Heating element shall be made of nickel chromium wire embedded in magnesium oxide and sheathed in copper / incolloy tubes. Watt density shall not exceed 7.75 / 11.63 watts / sq.cm (50 / 75 watts / sq.inch) copper / incolloy.

F. Thermostat: Immersion type with an operating range of 20 to 90^{o}C.

G. Accessories: Temperature and pressure relief valve, high temperature limit cut-out, drain valve etc.

H. Capacity: Schedules on drawing shall be referred to for details of section and capacity ratings.

2.03 CENTRAL ELECTRIC WATER HEATERS (High Capacity Water / Water Heaters)

A. Type: Horizontal/Vertical

B. Storage Section: TUV rated and certified (Test Pressure 13 Bars), stainless steel (AISI 316 Ti) shell insulated with 90 mm (31/2 inch) thick hard polyurethane foam in Aluminium jacket.

C. Connections: Stainless steel nipples for cold water inlet, hot water outlet; threaded T & P relief valve and drain valve ports; flanged connection for element plate.

D. Anodic Protection: Two (2) # extruded magnesium anodes attached to shell.

E. Recovery Section: Ceramic heating elements, installed within closed tubes welded to the shell; construction facilitating field replacement of elements, without draining the tank. Load shall be balanced on the three (3) phases and watt density shall not exceed 4 ~ 6 per cm2 (25 ~ 38 per inch2).

F. Thermostats: Immersion type for each group of elements (3 phase) with variable setting for cascaded operation. High limit cut-out with manual reset, factory set at 90oC, shall be provided for each thermostat.

G. Accessories: Dial thermometer, temperature and pressure relief valve, vacuum relief valve, drain valve and set of isolating and check valves as indicated in details.

H. Control Panel: The boiler shall be supplied with a control panel installed at the factory containing all the required safety control and provide the additional volt free contacts to B.M.S system .

I. Capacity: Schedules on drawings shall be referred to for details of selection and capacity ratings.

2.04 THERMOSTATIC MIXING VALVES

A. Thermostatically adjustable mixing valves with cold and hot water inlets and tempered water outlet, suitable for and accessories for concealed installation for supplying areas where tempered water is required.

B. Bath / Shower Thermostatic Mixing Valve:

Concealed body with temperature control trim set, integral isolating valves for servicing, integral non return valves, accessible strainers, outlets top and bottom suitable for showers, baths and multi outlets

PART 3 - EXECUTION

3.01 CO-ORDINATION

A. Size of doorways and other accesses to technical areas shall be coordinated to ensure that these are amply sized to allow for the movement of equipment.

B. Hooks, rails or other provisions shall be provided to allow for hoisting or movement of equipment in technical areas.

C. Data on heat loss to surroundings from equipment located in air-conditioned areas shall be furnished to the HVAC trade.

D. Data on the required power supplies shall be furnished to the electrical trade.

3.02 INSTALLATION

A. Clearances shall be provided around equipment for operation, maintenance and ventilation.

B. Manufacturer's installation instructions shall be complied with in all respects.

C. Lifting devices shall be attached to equipment only at designated points. The equipment shall not be dropped or subjected to any kind of shock.

D. Services of manufacturer's specialist representative shall be provided for commissioning of equipment.

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Water Closets

B. Wash Basins

C. Pantry / Kitchen Sinks

D. Janitor/Service Sinks

E. Lavatory Sink

F. Shower Tray

G. Water Coolers

H. Eye Wash

I. Drinking Fountains and Water Coolers

1.02 RELATED SECTIONS

A.	Division-1	General Requirements
B.	Section 06 42 00	Architectural Woodwork
C.	Section 07 92 00	Joint Sealants
D.	Section 09 30 00	Tiling
E.	Section 10 28 00	Toilet, Accessories
F.	Section 22 00 00	Plumbing
G.	Section 22 05 00	Common Work Results for Plumbing
H.	Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment

1.03 REFERENCE STANDARDS

A. ASME International:

1. ASME A 112.18.1 M - Plumbing Fixture Fittings
2. ASME A 112.19.2 M - Vitreous China Plumbing Fixtures
3. ASME A 112.19.6 - Hydraulic Requirements for Water Closets and Urinals

B. British Standards:

1. BS 3402 - Specification for quality of vitreous china sanitary appliances
2. BS 5503 - Vitreous china wash-down WC pans with horizontal outlets
3. BS 5504 - Wall hung WC pan
4. BS 5505 - Specification for bidets
5. BS 5506 - Specification for washbasins

6. BS 6340 - Shower units
7. BS 7015 - Specification for cast acrylic sheet for baths and shower trays for domestic purposes
8. BS EN 232 - Baths - connecting dimensions
9. BS EN 251 - Showers - connecting dimensions
10. BS EN 246 - Sanitary tap ware - general specifications for flow rate regulators
11. BS EN 248 - Sanitary taps - general technical specifications for electrodeposited nickel chrome coatings
12. BS 1206 - Specification for fire clay sinks - dimensions and workmanship
13. BS 1244 - Metal sinks for domestic purposes

1.04 SUBMITTALS

A. Product data, samples and roughing in details shall be submitted under provisions of the General Conditions of Contract.

B. Colour schemes and samples shall be submitted in co-ordination with the tiling works contractor.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 78 00 – Closeout Submittals: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Fixtures of the same manufacturer and same range shall be used in any one group to ensure matching of profiles, colour, etc.

B. Fixtures supplied shall be certified FIRST QUALITY products of the manufacturer. These shall be free of defects like warping, cracks, chipping, discoloration, etc.

C. Fixtures supplied shall have true roughing in dimensions, as in published catalogues.

D. Chrome fittings of the same range and manufacture shall be used in any one group. Copper alloys used in the manufacture of chrome fittings shall be dezincification resistant.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.08 PRE-INSTALLATION MEETINGS

A. Follow Division -1 – Project Meetings.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE AND HANDLING

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

B. Sanitary fixtures and chrome fittings shall be stored in shipping cartons / crates until time of installation. Protective wrappings shall be retained until commissioning.

C. Damaged and rejected fixtures shall be stored with appropriate labelling and maintained for inspection by the Engineer, till completion of the project

1.10 WARRANTY

A. Follow Division -1 – Closeout Submittals for product warranties and product bonds.

B. Requirements of the General Conditions of Contract and Plumbing services section 22 00 00 shall be referred to and complied with as appropriate.

1.11 EXTRA MATERIALS / SPARE PARTS

A. Follow Division -1 – Closeout Submittals for Spare parts and maintenance products.

B. Requirements of the General Conditions of Contract / Section 22 00 00 and 22 05 00 shall be referred to and complied with as appropriate without prejudice to requirements stated herein.

C. Spare parts as listed below shall be furnished, properly packed and labelled with equipment no. / location:

1. 2 sets of water closets complete with all accessories of each type and size used in the project.
2. 2 sets of Flush valves complete with all accessories of each type and size used in the project.
3. 2# WC washing doucher assembly and WC seat covers of all types used.
4. 2 Sets of Wash Basins and Washing Sinks of each type used in the project.
5. 2 Sets of wash basins and wash sink mixers of each type used in the project.
6. 2 Sets of Shower mixers of each type used in the project.

1.12 WATER CONSERVATION

A. With the view of conserving water, the following flush rates and flow rates shall be strictly ensured for each fixture selected.

Water closets	All Areas	1.28 Gallons per Flush
Public Lavatory faucet	All areas	0.5 GPM flow rate
Private Lavatory faucets	All areas	0.5 GPM flow rate
Kitchen sink	All areas	1.5 GPM flow rate
Shower	All areas	1.5 GPM flow rate

PART 2 - PRODUCTS

2.01 MANUFACTURERS: Subject to the compliance with the requirements and as per approval of

the Engineer.

2.02 GENERAL

A. Architectural documents shall be referred to and complied with for colour schemes, which may vary from one group to another.

B. Colour of sanitary fixtures shall be finalised in co-ordination with other finishing elements in respective wet areas.

C. Full set of specified products may not be (are not) available in the product range of any single manufacturer listed and hence products from a second manufacturer are listed in some cases.

D. Type, profiles and colour of sanitary fixtures listed as reference shall be used for comparison while selecting alternatives.

E. All sanitary fixtures supplied from any one manufacturer shall be manufactured in a single production facility in the listed country of origin.

F. Architectural documents shall be referred to for details of toilet and bathroom accessories; which are part of the finishing works, covered by Section 10800.

G. All fittings for fixtures in Public Places shall be self-closing, electronic water saver devices.

H. All Sanitary Fixtures, faucets, fittings and accessories shall be as per Architects/Engineers approval. All samples shall be submitted for approval.

2.03 WATER CLOSETS

A. European, Wall Mounted Type: White vitreous china, back outlet, closet elongated bowl, siphon jet, 11/2 inch rear spud, 1.28 Gallons per flush which results in 20% water savings over standard 1.6 gallons per flush, bowl complete with the following:

1. Flush Valve
2. WC Carrier/Brackets floor supported type and accessories for fixation
3. Doucher as specified elsewhere and shown in drawings.

Ref 1 : For all General Toilets in all locations:

a. Wall mounted type, with seat and cover

b. Toilet seat: Stronghold anti-microbial elongated open front toilet seat with check hinge and integrated handle that allows the user to rise and lower the ring-white.

c. Flush valve - Concealed Flush valve, solar Powered, sensor activated.

d. Carrier

Ref 2 : For all Handicapped Toilets:

a. Elongated wall hung bowl with 11/2 inch rear spud, 1. 28 gpf –white

b. Toilet seat: Stronghold anti-microbial elongated open front toilet seat with check hinge and integrated handle that allows the user to rise and lower the ring-white

c. Flush valve - Concealed Flush valve, solar Powered, sensor activated.

d. Carrier

B. Eastern Type: White vitreous china wash-down squat bowl not less than 600 x 450 mm with integral foot rest and back inlet with adapter complete with the following:

1. Loose P-trap
2. Chrome plated brass flush valve, concealed type, with stainless steel access cover with extended pipe to suit Eastern type.
3. Doucher as specified elsewhere and shown in drawings.
4. Flush Valve: Concealed Flush valve, electric powered, sensor activated.

C. Doucher: Assembly comprising the following:

1. Washing spray with high pressure CP 1250 mm long metal flexible hose, brass/CP trigger control, wall holder and angle valve with escutcheon plate

2.04 WASH BASINS

A. Under Counter vanity Type (All places): White vitreous china, oval, self-rimming type of not less than 432 mm x356 mm (17inch x 14 inch) mm size complete with the following:

1. Chrome plated brass pop-up waste set;, lavatory grid drain without overflow
2. Chrome plated brass bottle trap/P-trap min/m 11/4 inch with escutcheon plate and waste adapter
3. Chrome plated brass, electronic sensor operated mixer with aerator and integral capillary tail pipes
4. Chrome plated brass, lock-shield angle valves with escutcheon plates
5. Fixation accessories

B. Wall hung Type (All places): White vitreous china basin of not less than 550 x 480 mm size, complete with the following:

1. Chrome plated brass pop-up waste set
2. Chrome plated brass bottle trap/P-trap 11/4 inch; with escutcheon plate and waste adapter
3. Chrome plated brass, electronic sensor operated mixer with aerator and integral capillary tail pipes
4. Chrome plated brass, lock-shield angle valves with escutcheon plates
5. Carrier and / or wall supports
6. Fixation accessories.

C. With mixing device and pop up waste fitting For Handicapped Wash Basins:

1. Chrome plated brass pop-up waste set
2. Chrome plated brass bottle trap/P-trap 11/4 inch; with escutcheon plate and waste adapter
3. Chrome plated brass, electronic sensor operated mixer with aerator and integral capillary tail pipes
4. Chrome plated brass, lock-shield angle valves with escutcheon plates
5. Carrier and / or wall supports

6. Fixation accessories.

2.05 SHOWERS

A. Shower Tray Set: White vitreous china shower tray of 900 x 900 mm size and height not exceeding 80mm (for flush with floor installation) complete with the following:

1. Chrome plated brass waste connector with grid, trap and extension
2. Chrome plated brass mixer with diverter, spout and overhead shower column,– Flow-wise shower head 1.5 GPM flow

2.06 KITCHEN / PANTRY / UTILITY SINKS

A. Stainless steel, double bowl, single drain board, countertop type of not less than 1200 x 490 mm size(to match counter dimensions shown on Dwgs), complete with the following:

1. Plastic waste connector with stainless steel grid
2. Plastic, tubular P trap with chain and plug, overflow connection, escutcheon and waste adapter
3. Chrome plated brass swivel spout with pull down kitchen faucet, flow 1.5 GPM complete with two integral check valves, Colony soft single control kitchen faucet
4. Fixation accessories
5. Terminal filters as specified elsewhere

B. Stainless steel, single bowl, single drain board, countertop type of not less than 800x 490 mm size,(to match counter dimensions shown on Dwgs), complete with the following:

1. Plastic waste connector with stainless steel grid
2. Plastic, tubular P trap with chain and plug, overflow connection, escutcheon and waste adapter
3. Chrome plated brass swivel spout with pull down kitchen faucet, flow 1.5 GPM complete with two integral check valves, Colony soft single control kitchen faucet
4. Fixation accessories
5. Terminal filters as specified elsewhere.

C. Stainless steel, single bowl, countertop type of not less than 600x 500 mm size,(to match counter dimensions shown on drawings), complete with the following:

1. Plastic waste connector with stainless steel grid
2. Plastic, tubular P trap with chain and plug, overflow connection, escutcheon and waste adapter
3. Chrome plated brass swivel spout with pull down kitchen faucet, flow 1.5 GPM complete with two integral check valves.
4. Fixation accessories
5. Terminal filters as specified elsewhere.

2.07 SERVICE SINKS (for Janitor rooms)

A. White vitreous china, floor mounted, floor outlet, wash-down bowl with back inlet complete with the following:

1. Stainless steel wire grid
2. Cast Iron, acid resistant enamel finish, floor mounted Corner sink, 28inchx28 inch with all other accessories like:
   a. Removable Service sink Grid strainer of brass construction, CP finish.
   b. Exposed Yoke wall mount utility faucet of cast brass construction, ceramic disc valve cartridges; vacuum breaker, Integral supply stops ,Top brace, all in CP finish, ,3/4 inch threaded hose end, ½ inch NPT female inlets
3. Chrome plated brass lock shield angle valve and capillary tube at inlet to cistern
4. Waste and flush pipe adapters and fixation accessories.
5. Doucher as specified elsewhere

2.08 EYE WASH

A. Eye wash stations are required in accordance with OSHA standards whenever workers are exposed to corrosive materials.

B. Eye wash station shall be Plumbed type with continuously available filtered cold water.

C. Water must be within a temperature range of 600 F(15.60 C) to 1000 F(37.70 C)

D. The water shall be continuously circulating with supply & return piping to avoid Build-up of bacteria and other contaminants.

E. Eye wash station shall be in compliance with ANSI STANDARD Z358-1-2009

F. One single motion must activate unit in one second or less.

2.09 DRINKING WATER COOLERS

A. General

1. Design Conditions:
   a. Water inlet temperature 32°C (90°F)
   b. Water outlet temperature 7°C (45 °F)
   c. Cooling capacity 4000 Btu/Hr:
2. Compressor: Life time Lubricated Hermetic type 7 sealed compressor; with adjustable thermostat, capillary tube and dehydrator 3.Refrigerant: HFC 134a (Tetrafluoroethane -CH2FCF3)
3. Toxicity Control: Parts of the system coming in contact with water shall be certified as non-toxic (free from lead and other known contaminants) Type:. Suitable for in wall or Utility/janitor closets, space saving for pure chilled Food grade water; equipped with Taste Master Purifier on water supply line. All water contact surfaces shall be lead-free, stainless steel. Details of construction shall be as follows:
4. Cooling Tank: Tank welded stainless steel with immersion coil evaporator, tested at 200 psi for 125 psi working pressure, insulated with closed cell thermoelastemer with a 3.7 R value ; capacity 14 Gallon/Hr (53 L/Hr)

5. Thermostat adjustable range --- 40^0 F(4^0 C) to 55^0 F (13^0 C)
6. Cabinet: 18 gauge enamelled aluminium
7. Filter with Bio-Degradable element
8. Built-in sterilizer

2.10 DRINKING WATER FOUNTAINS

A. Type: Non recessed, High/Low Drinking fountain

B. Material: 16 Gauge Stainless steel

C. Finish: Satin type

D. Bubbler: “Hands free” photocell activation featuring automatic shutoff (30 Second); should include batteries; should prevent vandalism and waste of water

PART 3 - EXECUTION

3.01 COORDINATION

A. Fixtures shall be located in a manner that enhances the usage of each fixture. Following minimum spacing shall be allowed between fixtures, unless otherwise stated:

1.	Edge of bathtub to centre line of washbasin	300 mm
2.	Centre line of wash basin to centre line of water closet	600 mm
3.	Centre line of washbasin to wall	450 mm
4.	Centre line of bidet / water closet to wall	450 mm

B. Supply angle valves, hose bibs, fixture traps etc. shall be fixed at wall tile lines. These shall be installed symmetrically on the fixture centre lines.

C. Shower edges shall be recessed into the wall finish. Tiling must start over the edge of these fixtures.

3.02 INSTALLATION

A. Schedules on drawings shall be referred to and complied with in respect of roughing in details.

B. Fixtures shall be fixed firmly to the floor / wall with accessories supplied by the manufacturer. Chrome plated brass cap nuts shall be provided for fixation screws.

C. Ferrous accessories used for the installation of sanitary fixtures shall have anti-rust treatment given at the factory.

D. Chrome plated brass escutcheon plates shall be provided on chrome fittings fixed on the wall.

E. Fixtures shall be fixed at the following heights above FFL, unless otherwise dictated by selection.

1.	Water closet	380 mm to top of bowl rim
2.	Bidet	380 mm to top of bowl rim
3.	Washbasin	780 mm to top of bowl rim
4.	Flush valves	280 mm above top of bowl rim 5.

5.	Vertical guide rail	Centre line at 1600 mm above FFL
6.	Shower mixing valve	900 mm above FFL

3.03 CLEANING AND ADJUSTMENT

A. Fixture trim shall be connected to water supply only after the system has been flushed.

B. Protective wrapping shall be removed, as directed by the manufacturer, on completion of works.

C. Fixtures, aerator / strainer, traps, interceptors, trenches and sediment pits etc. shall be cleaned prior to handing over.

3.04 TESTING AND COMMISSIONING

A. Sanitary fixtures shall be checked for installation true to the intended level (rims of wash basins and water closets etc.) and plumb (wall mounted urinals etc.) at the appropriate location.

B. Wall mounted sanitary fixtures shall be tested with a dead weight of 150 Kg.

C. Floor mounted sanitary fixtures shall be tested for movement and good bearing on the floor.

D. Service valves / angle valves shall be regulated to attain splash free flow at outlets.

END OF SECTION

Division 23

Heating, Ventilating, and Air-Conditioning (HVAC)