

SECTION 1.0 **SCOPE OF WORK**

The works to be included in this Specification are as listed hereunder: -

- a. Supply, deliver, install, test and commissioning of the **COLD WATER, RAINWATER HARVESTING AND SANITARY PLUMBING.**

The Cold Water, Rainwater Harvesting and Sanitary Plumbing Contractor is supply all cold water, rainwater harvesting and sanitary plumbing equipment including accessories for complete installation.

It is the responsibility to the Cold Water, Rainwater Harvesting and Sanitary Plumbing Contractor to ensure that all equipment supplied and installed are acceptable to the various authorities having jurisdiction over the installation and to fill in all notices and requests required to obtain approval from them. The Cold Water and Sanitary Plumbing Contractor shall pay fees in connection with the approval.

1. WATER SUPPLY PLUMBING

1.1 General

The whole of the water supply plumbing and installation shall be executed by a licensed plumber having valid and relevant license issued by the relevant state water authority. The Contractor shall at his own cost be responsible for employing the licensed plumber, and shall be responsible for all the work performed by the licensed plumber.

All water supply plumbing and installation shall be executed in accordance with the relevant state water supply rules and to the approval of the state water authority, notwithstanding any approval given by the S.O.

All pipes, fittings and equipment used for water supply plumbing and installation shall be of the type and make approved by the relevant state water authority.

1.2 Pipework

Pipework for water supply plumbing shall be to the dimensions shown or as specified hereinafter and shall be complete with all bends, tees, sockets, plugs, reducers, brackets, supports and everything else necessary to complete the installation.

Unless otherwise shown or stated in the Drawings, the unplasticized polyvinyl chloride (uPVC) pipes and fittings used in cold water supply pipework in distribution pipes above ground, below ground or concealed, shall be executed in approved Class 7 of MS 762 for sizes 50mm and below. For sizes greater than 50mm, a minimum pressure rating of approved Class 'E' of MS 628 (PN 15) (equivalent to 12 bar derated at 30oC) shall be used. Both Class 7 of MS 762 and Class 'E' of MS 628 uPVC pipes and fittings shall comply with BS 6920 or MS 1583 on their effects on drinking water quality. Solvent cement used for both types of pipes and fittings shall be approved in accordance with MS 628. All uPVC pipes, fittings and solvent cement shall be supplied by the same manufacturers.

Where polyethylene (PE) pipe is shown or stated in the Drawings, the PE pipes and fittings used in cold water supply pipework in distribution pipes above ground, below ground or concealed, unless otherwise stated or shown in the Drawings, shall have a minimum wall thickness and pressure rating of PN 12.5 at 20oC (equivalent to 10 Bar derated working pressure at 30oC) and manufactured to MS 1058 or EN 12201. All PE pipes used shall be marked with SIRIM certification numbers. All metal fittings moulded integrally shall be dezincified brass with BSP threads to CZ132 of BS 2872 or BS 2874 and Nickel & Chromium plated to BS 1224, service condition No. 2, classification number Cu/Ni 10b Crr.

Where Acrylonitrile Butadiene Styrene (ABS) pipe (for cold water applications only) is stated or shown, ABS pipes and fittings used in the water supply pipework in distribution pipes above ground, below ground or concealed, unless otherwise stated or shown in the drawing, shall have a minimum wall thickness and pressure rating of class 9 to MS 1419 or PN 10 to EN 15493.

Where polybutylene (PB) pipe (for cold and hot water applications) is stated or shown, PB pipes and fittings used in the water supply pipework in distribution pipes above ground, below ground or concealed, unless otherwise shown or stated in the Drawings, shall have a minimum wall thickness and pressure rating of PN 12.5 at 20oC (equivalent to 10 Bar derated working pressure at 30oC) and manufactured to EN 12319 or AS/NZS 2642. All metal fittings (in contact with water) moulded integrally shall be dezincified brass with BSP threads to CZ132 of BS 2872 or BS 2874 and Nickel & Chromium plated to BS 1224, service condition No.2, classification number Cu/Ni 10b Crr.

Where polypropylene random co-polymer (PP-R) Type 3 pipe and fitting (for cold and hot water applications) is stated or shown, PP-R Type 3 pipes and fittings used in the water supply pipework in distribution pipes above ground, below ground or concealed, unless otherwise shown or stated in the Drawings, shall have a minimum wall thickness and pressure rating of PN 16 or SDR 7.4 at 20oC, designed for 10 Bar working pressure at 60oC for a minimum operational life of 50 years and manufactured to DIN 8077, DIN 8078 and DIN 16962 Part 5-8. All metal fittings moulded integrally shall be dezincified brass with BSP threads to CZ132 of BS 2872 or BS 2874 and Nickel & Chromium plated to BS 1224, service condition No. 2, classification number Cu/Ni 10b Crr. The minimum wall thickness and pressure rating for cold water system, unless otherwise stated or shown in the Drawings is PN 10 or SDR 11 according to DIN 8077.

Where stainless steel pipe (suitable for cold and hot water) is stated or shown, all service pipes, pump delivery pipe works, plumbing works below and aboveground level shall be welded austenitic stainless steel pipes (using Schedule 40S pipes for sizes ranging ½" to 2" diameter and threaded, and Schedule 10S pipes for 2" to 8" Diameter pipes by way of welding) manufactured according to ASTM A312/A312M together with stainless steel butt-welding fittings manufactured according to ASTM A403/A403M or stainless steel screwed fittings manufactured according to ASTM A351/A351M.

Where mild steel pipe is stated or shown, all service pipes, pump delivery pipe works, plumbing works below and aboveground level shall be welded austenitic stainless steel pipes (using Schedule 40S pipes for sizes ranging ½" to 2" diameter and threaded, and Schedule 10S pipes for 2" to 8" Diameter pipes by way of welding) manufactured according to ASTM A1011/A1018 together with mild steel butt-welding fittings. Pipe shall be bedded and backfilled as per manufacturer's recommendations.

However for pipe work in plumbing above ground level (which include service pipes, pump delivery pipe works), as an option, stainless steel tubes manufactured according to BS4127 specification for light gauge stainless steel tube, primarily for water application, may be used. It shall be made of stainless steel material grade 304 S15 of BS 1449 Part 2. Compression fittings and capillary fittings made in accordance with the following standards shall be used with stainless steel tubes conforming to BS 4127:

- (i) Copper alloy to BS 864
- (ii) Stainless steel to BS 4368 or ISO 8434

Where copper pipe is shown, it shall be to BS EN 1057. Fittings to be used for joining copper pipe shall be to BS 864.

Unless otherwise shown or stated in the Drawings, service pipes and distribution pipes except those buried under ground level, shall be concealed. The Contractor shall execute the work in such a manner so as to avoid cutting into finished work in walls, aprons, beams, etc. where practicable as the work proceeds. Pipework to be buried or concealed shall not be covered or plastered before they are examined, tested and approved by the state water authority, notwithstanding any approval given by the S.O.

Unless otherwise shown or stated in the Drawings, final branches to fittings shall be 12mm diameters and the sizes of feeders from which these branches are taken shall be as follows: -

No. of Fittings Served Diameter of Feeders

1	12mm
2	20mm
3, 4	25mm
5, 6, 7	30mm
8, 9,10,11,12	40mm
13, 14, 15,16,17,18	50mm

The installation and construction of all pipework to storage tanks shall be carried in such a manner that where necessary, flexible rubber joints of approved standards shall be used for connection next to the panel to avoid stress.

Mechanical joints shall also be used for connection between the flexible rubber joints and the pipework.

Flange joints (nozzles) used for the inlet, outlet and scour of storage tanks shall be made of hot dipped galvanised mild steel externally and stainless steel grade 304 or polymeric coated hot-dipped galvanised mild steel internally. Joint gaskets shall be of 5mm thick, medium rubber reinforced with two-ply flexible fabric and complying with BS 5292, or approved silica sealant used in the Glass Reinforced Polyester Panel (GRP)

tanks. All bolts, nuts and washers used for flange nozzles shall be made of stainless steel grade 304 or polymeric coated hot-dipped galvanised mild steel.

Contractor shall provide all the necessary flexible rubber joints and mechanical joints for the proper installation and construction of the pipework to the tank.

1.3 Storage Tank

Storage tank for water supply shall be of the type and capacity shown or stated in the Drawings. The storage tank shall be watertight and properly supported. The storage tank shall be provided with dust and mosquito-proof cover. The cover shall be so constructed that it shall not be airtight. The storage tank shall be provided with a high pressure ball valve to BS 1212 on the inlet and of the same size as inlet pipe. Overflow/warning pipe, scour pipe and outlet tapping shall be in accordance with the relevant state water supply rules. The scour and overflow/warning pipe shall discharge outside the building or to a point shown or stated in the Drawings.

Storage tanks of pressed steel sections shall be of approved type and shall comply with BS 1564 and shall be hot-dipped galvanised to MS 740. Either one of the following liner systems is acceptable:

(A) Hot-dipped Galvanised Pressed Steel Tank With HDPE Liner

The internal surfaces of the storage tank shall be lined with an approved non-toxic potable water quality grade high density polyethylene (HDPE) liner of minimum thickness of 2 mm. All internal cleats and bracings to tank plates, bolts, nuts, washers and internal ladders shall be of stainless steel grade 304 or polymeric coated (cold-applied epoxy AWWA C210 or equivalent) hot-dipped galvanised mild steel. Roof covers and trusses to tank shall be fully hot-dipped galvanised mild steel and polymeric coated internally.

(B) Hot-dipped Galvanised Pressed Steel Tank With Epoxy Resin Liner

The internal surfaces of the storage tank together with the roof covers and trusses shall be treated with a suitable etch primer before applying 2 coats of solvent free, high solid epoxy resin with an approved nontoxic potable water certificate. The overall film thickness shall be not less than 500 microns. All internal cleats and bracings to tank plates, bolts, nuts, washers and internal ladders shall be of stainless steel grade 304.

Application requirement for Epoxy Resin Liner:

- i) The new galvanised pressed steel shall be cleaned with a suitable degreaser to remove grease and other contaminates. The Etch Primer shall be applied by airless spray at a dry film thickness of 15-20 microns. The 2 part epoxy resin liner must be thoroughly mixed at the prescribed ratio with each coat giving a dry film of average 250 microns. Precaution must be taken to prevent contamination between coats.

ii) The minimum bond strength of the coating shall be 1.5 N/mm² to be determined by using an Elcometer adhesion testing machine. The testing requirement is one (1) pull-off test per every 100 m² of tank lining and one (1) pull-off test for tank lining less than 100 m². Any damage to the coating shall be rectified by following the original method statement.

For both the liner systems, beads of non-toxic elastomeric sealant shall be applied to cover all gasket joints. All external bolts, nuts and washers to tank plates, tank support, steel I beams and external ladders shall be hot-dipped galvanised mild steel.

The Contractor shall provide the tank manufacturer's guarantee for the new hot-dipped galvanised pressed steel water tank with any one of the above liner systems for a period of ten (10) years from the date of completion against leakages and all manufacturing, installation and liner's defects.

Storage tanks of stainless steel shall be of approved type and shall be made of stainless steel grade 304 and manufactured to JKR Standard Specification for Stainless Steel Water Tanks No.20200-0041-99.

Storage tanks of fibre glass (FRP) shall be of approved type and shall comply with MS 1241.

Storage tanks of high density polyethylene (HDPE) shall be of approved type and shall comply with MS 1225.

Storage tanks of glass reinforced polyester (GRP) panels shall be of approved type and shall comply with MS 1390.

(C) Polyethylene Cold Water Tank

The water tank shall be designed and manufactured in accordance with MS 1225 and the tank shall undergo and pass all test specified therein. Tank manufactured and tested to other approved Standard shall be acceptable.

All tanks supplied shall be from manufactured approved by JKR, SAMB or any local authorities having jurisdiction to the installation.

1.4 Tank Components and Accessories

Unless otherwise shown or stated in the Drawings, the installation of storage tanks shall include the provision and installation of the following accessories and fittings to the tanks:

- i) Openings for piping connection for inlet, outlet, overflow and drainage pipe connections with positions approved by the S.O.
- ii) Access manholes with cover, the number, locations and details of which shall be approved by S.O.
- iii) Air vents to the tank cover at the positions and as per details approved by the S.O.
- iv) Water tanks of two metres depth or more shall be provided with internal and external ladders. The internal ladder shall be made of aluminium or of stainless steel grade 304 or polymeric coated (cold-applied epoxy AWWA C210: 1994 or equivalent) hot-dipped galvanised mild steel. The external ladder shall be made of hot dipped galvanised mild steel in accordance with MS 740. The ladder width shall not be less than 300 mm and the length shall be suitable for the tank specified.
- v) Suitable type water level indicators and scales graduated in metres to suit the depth of the panel tank.
- vi) All internal cleats and bracings to tank plates, bolts, nuts, washers in contact with water shall be of stainless steel grade 304 or polymeric coated (cold-applied epoxy AWWA C210 or equivalent) hot-dipped galvanised mild steel. All external bolts, nuts and washers shall be of hot dipped galvanised steel. The diameter of all bolts in accordance with BS 4190, shall not be less than 10 mm.
- vii) Sealing material shall be nontoxic and chemically resistant to the water stored. The sealants shall also be able to withstand the prevailing environmental conditions during service.
- viii) The internal supports and reinforcement members for the panels shall be chemically resistant to the water stored. They shall be made of stainless steel. The exterior reinforcement metal parts shall be fabricated from hot dipped galvanised mild steel.
- ix) The exterior of the water storage tanks for the purpose of firefighting shall be painted as required by Jabatan Bomba dan Penyelamat.

1.5 Storage Tank Foundation

- i) Unless otherwise shown in the Drawings, the Contractor shall construct foundations to provide continuous support to all base panel joints in one direction at 1000 mm nominal centres according to panel size. The concrete foundation shall have a width of at least 300 mm and height of at least 500 mm.
- ii) If continuous foundations are used, dwarf walls or steel beams shall be placed between the tank and the base level to allow a minimum clearance of 500 mm to enable ease of tank installation and subsequent bolts tightening and adjustments after installation.
- iii) Whenever recommended by the tank manufacturer, the steel skid base shall be designed and constructed in accordance with the manufacturer's instructions, details and BS 5950 or equivalent. In such cases, the continuous support can be spaced at greater than 1000mm nominal centres as recommended by the manufacturer.
- iv) The steel skid base shall be joined by welding neatly and uniformly flushed with each other to enable the base of tank plate to be placed and sit properly on the skid base. Uneven surfaces of the skid base will be rejected. The skid base shall be rust free.

1.6 Stop Valves

High pressure full way brass screw-down stop valves of the same diameter as the pipe shall be provided and fixed for control in the following positions:

- i) On the service pipe before it enters the building.
- ii) On each branch of the service pipe.
- iii) On the inlet to each storage or feed cistern.
- iv) On the inlet to each flushing cistern.
- v) On the outlet of each storage or feed cistern.
- vi) In other positions on the pipe as shown or indicated, other than on overflow/warning pipe.

All stop valves shall be of the type approved and complied with MS 1022.

1.7 Examination, Test and Approval of Water Supply Plumbing

On completion of all the water supply plumbing and fittings installation, the Contractor shall notify the relevant state water authority that they are ready for examination and test and the Contractor shall carry out the test as required by the state water authority.

Test for water tightness and chlorination of storage tank

- i) After completion, the tank shall be filled with water to the maximum operating capacity level and the level of water surfaces shall be fully recorded. The tank shall be accepted as satisfactory if after a period of 48 hours there is:
 - a) No measurable reduction in water level, due allowance being made for evaporation.
 - b) No visible signs of leakage from any parts of the tank and
 - c) No deformation of any part of the structure.
- ii) If the test results do not satisfy the above conditions of tests, the Contractor shall proceed to locate and rectify all defects and leakages and the test shall be repeated as often as necessary until the structure satisfies the stipulated conditions. The Contractor shall bear all costs and expenses for all tests and remedial works.
- iii) On completion of the water tightness test, the Contractor is required to chlorinate the water in the tank to the satisfaction of the S.O.

Testing of Pipework

- i) The testing of pipework shall be carried out before the pipework are covered up or plastered.
- ii) The Contractor shall at his own cost provide complete plant, including portable hydraulic pumps, blank flanges, "test-end" units fitted with caps or plugs, pressure gauges, all pipe connections and other fittings necessary for the testing of the pipework. All pipes attached to the tank shall be tested to the maximum head which they will attain under normal operating conditions. Only a closed end test shall be required for the valves.
- iii) Pressure Testing

When a pressure test is carried out, it may be necessary to disconnect and cap the water service to isolate it from the water main, fixtures and appliances which may be damaged by the test pressure.

a) For Plastic Pipes (uPVC pipes, PE pipes, ABS pipes, PB pipes, PPR-R Type 3 pipes etc), the pipework shall be filled with water and the system shall be charged to a hydrostatic pressure of 15 bar at ambient temperature $27 \pm 2^{\circ}\text{C}$. For accurate testing, the installation must be filled slowly and be fully ventilated. Calibrated measurement devices, which show pressure changes in steps of 0.1 bar, shall be used for the test. It shall be noted that a temperature change of 10°C causes a pressure change of up to 2 bar, depending on the size of the system.

The pressure test shall be carried out in two stages: i.e. a preliminary test and a main test.

Pressure Testing may take place

- for compression joint, immediately after the last joint has been made.
- for fusion joint, no earlier than 1 hour after the last fusion joint.
- for solvent weld joint, no earlier than 24 hours after the last joint made.

Preliminary test:

The duration of the preliminary test depends on the size of the system, but usually requires about one hour and includes the following activities.

- 1) Measurement devices shall be installed at the lowest point of the piping system, if possible.
- 2) The piping system shall be filled with potable water, thoroughly ventilated and separated from the mains supply.
- 3) Increase pressure with a pressure pump to 15 bar.
- 4) Repeat pumping back up to 15 bar, 2 more times over the next 30 minutes (b) at an interval of 10 minutes.
- 5) After a testing period of another 30 minutes, the test pressure shall not have decreased by more than 0.6 bar (c).

The preliminary test is considered successfully completed when there are no leaks and the pressure drop in the last half hour of the preliminary test does not exceed 0.6 bar.
Main test:

- 6) The main test shall be carried out immediately following the preliminary test. Its duration is two (2) hours. The test pressure after the preliminary test at point (c) shall be recorded.

7) The main test is considered successfully completed, if the test pressure does not drop more than 0.2 bar (d) from the beginning of the main test and if no leakage is detected.

If the pressure drop is more than 0.2 bar during the main test, then the whole test must be repeated. There must not be any leakage in the system.

The results of the pressure test shall be recorded on a log sheet. The test shall be accepted as satisfactory if there are no signs of leakage and pressure drops within the acceptable tolerances in the system. The Contractor shall make good all leakages, replace any defective parts and retest the whole system all at his own expense to the approval of the state water authority.

b) For Metal Pipes (stainless steel pipes, copper pipes etc), the pipework shall be filled with water and the system shall be charged to a hydrostatic pressure of 15 bar and maintained for a period of not less than 30 minutes. The results of the pressure test shall be recorded on a log sheet. The test shall be accepted as satisfactory if there are no signs of leakage and pressure drop in the system. The Contractor shall make good all leakages, replace any defective parts and retest the whole system to the approval of the state water authority all at his own expense.

The Contractor shall obtain a written certification from the relevant state water authority to prove that the examination and test have been satisfactorily concluded. Where the installation is proven to be unsatisfactory, the Contractor shall rectify the works in accordance with written notice of the state water authority all at his own expense. The repair or replacement of a faulty pipe or fitting shall be reported by the Contractor to the relevant state water authority within one week.

1.8 Meter Chamber

Where meter chambers are required, these shall be to the details shown in the Drawings. Unless otherwise shown or stated in the Drawings, connection to the meter, supply of meters and all communication pipes up to the meter point shall be done by the relevant state water authority.

2.0 SANITARY PLUMBING

Furnish and Install the following: -

System Description

The sanitary plumbing system designed based on a pipe fully vented stack system. All soil and waste water discharge shall be routed and discharge to the external underground manholes of the sewerage reticulation network. The sanitary system shall be designed to dispose soil and waste from all plumbing fixtures, through a vented gravity piping system inside the building and discharge to external manhole. Manhole shall be constructed of reinforced concrete base walls of brickwork, complete with heavy duty access covers and frames.

For the kitchen in canteen stalls, grease interceptors shall be provided to kitchen waste pipe shall be made connected to vent pipe.

For chemical labs or other equivalent labs which uses chemicals, neutralization tanks shall be provided. Sanitary piping material should be of Polypropylene pipes.

In addition, all branch connection to stack or main drain shall not be made in a manner which will permit backflow. Horizontal pipework shall be installed to the steep gradient of minimum 1:80.

Piping Material

Item	Pipe Size	Materials	Standards
<u>Above Ground</u>			
i) Soil	All	UPVC	BS4514, 1983 & BS5255
ii) Vent/Anti Syphonage	All	UPVC	BS4514, 1983 & BS5255
iii) Waste / Condensate Drain	All	UPVC	BS 5255,1989
iv) Waste / Condensate Drain	All	Polypropylene	BS EN 12201 BS EN 1451-1:2000
<u>Below Ground</u>			
i) Soil, Waste and Anti-Syphonage	100 - 150Ø. 75 Ø	Unplasticised PVC	BS4660,1989 BS4515,1983
<u>All (across the road/manhole to manhole)</u>		VCP	BS65,1991

All soil, waste and drainpipes, soil and vent stack, floor traps/drains, within each building shown generally in drawings.

All external sewers up to the 1st. manholes from the buildings. Sewer pipes interconnecting the manholes and external manholes are done by others.

Provide labour and materials for the fixing of all sanitary fixtures, floor traps, water closets cisterns, urinals.

- a. Furnish and install clean out and inspection opening for soil, waste and drain pipes at:

Each change of direction of piping.

Base of each soil, waste or vent stack.

Points where drainpipes leave the building.

- b. Plumbing Vent Through Roof

Vent terminals shall be installed in accordance with local plumbing authority requirements.

Terminate not less than 0.914 m above roof with open and protected by copper wire globe

c. Manholes

Manholes to be constructed by others are as shown on the Site Plan drawings to the requirement of the local Health Authorities.

All pipes from the building shall terminate at the first manhole only. First manhole is done by others.

e. Floor Traps

Floor traps in all areas unless otherwise specified shall be with access doors on heels or crown depending on installation conditions and shall fully comply with the relevant BS Specification and shall be of similar materials to the pipe. The square strainer grating shall be of 150mm x 150mm (6" x 6") UPVC and shall be of vandal and vermin proof construction and shall be securely connected to the trap.

f. Gully Traps

Gully traps are to be constructed to the requirements of the local Authorities and as per detail drawings. They shall have a minimum of 150mm thick of reinforced concrete base and brickwork all round respectively.

All gully traps shall be constructed to be water-tight so as to exclude infiltration of any surface or ground water. Gully traps shall be constructed with high alumina cement rendering of minimum 20mm (3/4") thick.

The round cover and frames shall be of 300mm diameter cast iron.

g. Testing

Contractor to carry out air water or smoke tests as well as hydraulic performance as required by the Engineer and the local authorities.

2.1 Fittings

Unless otherwise shown or specified in the Drawings, all fittings including all necessary brackets and accessories shall be as scheduled in Appendix K/1 hereinafter. The Contractor shall be responsible for determining the type of trap required for each fitting. All necessary concrete backing shall be provided to fittings secured to floors.

2.1.2 Vanity Top

Where shown in the Drawings, vanity tops of approved manufacture and colour shall be installed in accordance with the manufacturer's instructions. It shall be moulded as one solid piece with its top sloping gently towards the wash hand basin and having a slight upturn or kerb as its outer edges. It shall be manufactured from non-porous composite product composed of polyester resin and calcium carbonate marble dust with the permanence of stone and an aesthetic appeal of natural marble or granite. The slab surface shall have a glossy finish, and protected by suitable polymer to ensure durability and impermeability. It shall be stain and chemical resistant, and UV stabilised.

2.2 Water Supply Plumbing for Low Pressure W/C Flush Valve and Low Pressure W/C Flushing Cistern

2.2.1 Plumbing for Low Pressure W/C Flush Valve

A separate internal plumbing system shall be provided for low pressure w/c flush valves to have adequate dynamic pressure and flow, to ensure effective operation of each flush valve, i.e. for hydraulics of water closet to function properly.

Alternatively water supply to flush valves for w/c pan shall be derived from a feeder tank which is isolated from the potable water supply main and is not connected in any way with all other fittings serving to basins, sinks, heaters etc. in the building.

The following requirement for each low pressure w/c flush valve as in Table A1 shall be followed in the design of internal plumbing for flush valve system. Table A1 – Low Pressure W/C Flush Valve Requirement W/C Flush Valve

- a) Dynamic/ operating head at the inlet of flush valve 3.25 m
- b) Flow rate 1.8 litres/ sec

2.2.2 Plumbing for Low Pressure W/C Flushing Cistern

An internal plumbing system shall be provided for low pressure w/c flushing cistern, w/c taps, taps for toilet wash hand basins and urinal flush valves as shown in Appendix K/4.

The following requirement for each low pressure w/c cistern, urinal cistern and urinal flush valve as in Table A2 shall be followed in the design of internal plumbing.

Table A2: Low Pressure W/C Cistern, Urinal Cistern and Urinal Flush Valve
Requirement Low Pressure W/C Cistern Urinal Cistern Urinal Flush Valve

- a) Dynamic/ operating head at the inlet of cistern/ valve 3.2 m 2.0m 2.0m
 - b) Flow rate 0.1 litres/ sec 0.1 litres/ sec 0.1 litres/ sec
- 2.2.3 Materials for Pipes, Fittings and Isolating Valves In Pipeworks

a) Pipes and Fittings for Internal Plumbing, Concealed and Buried Pipework

Pipework for water supply plumbing shall be to the dimensions shown or as specified in the Drawings and shall be complete with all bends, tees, sockets, plugs, reducers, brackets, supports and everything else necessary to complete the installation. All the pipes and fittings mentioned in clause 1.2 are suitable for internal plumbing. Galvanised iron pipes and fittings shall not be used for internal plumbing.

b) Pipes and Fittings for Exposed External Pipework

ASTM A312 Schedule 40S stainless steel pipes and ASTM A351 stainless steel pipe fittings or BS 143 & 1256 brass threaded fittings for external pipework shall be used. High strength composite plastic/ metal pipes and fittings may be allowed with the S.O's approval. Galvanised iron pipes and fittings shall not be used for external pipework.

c) Isolation Valves for Internal Plumbing and External Pipework

Valves used for isolating the water supply system shall be of approved full bore brass gate valves (BS5154) or Type B ductile iron gate valves (JKR Standard Specification 20200-0083-00), brass ball valves (BS 6675:1986 or BS 1552:1995) shall be used. All fittings used shall be made of brass, stainless steel or other approved non-corrodible material. Stop valves (stop cocks with reduced flow areas) shall not be used for external pipework and internal plumbing systems for w/c flush valves and flushing cistern.

2.2.4 Operating/ Dynamic Pressure More Than 30 Metres

Unless otherwise instructed by the S.O, air vents and pressure reducing valves of approved type (JKR Standard Specification 20200-0114-01), shall be installed at 30 meters intervals along downpipes in order to restrict the pressure sustained by the fittings to prevent water hammer and other effects.

2.3 uPVC Soil, Waste and Vent Pipes

Unless otherwise shown or specified in the Drawings, approved uPVC soil, waste and vent pipes shall be provided.

uPVC pipes shall conform to MS 978 and MS 1063. The pipes shall be provided, fixed and connected to fittings and sanitary installation complete with all necessary bends, tees, sockets, branches, offsets, inspection pieces, hopper heads, holder bats etc. Pipes shall be joined with approved solvent cement in accordance with the manufacturer's instructions.

2.3.3 Expansion joints (expansion couplings for uPVC pipes)

Where pipework is constructed using solvent welded joints, expansion joints shall be provided to compensate for the linear thermal expansion of uPVC pipes which have a coefficient of linear expansion of 7×10^{-5} mm/mmoC (e.g. for a difference of 10 oC, linear expansion of 3 m length uPVC pipe = $10 \times 3000 \times 7 \times 10^{-5} = 2.1$ mm). Expansion joints must not be placed below ground level. All expansion joints shall be installed with the proper fittings in accordance with the manufacturer's instructions.

Expansion joints shall be provided at a maximum spacing of 6 meters for cold water pipelines and 4 meters for hot water pipelines (e.g. kitchen or etc.) or wherever specified

The permissible maximum length of pipelines between fixed points without an expansion joint or provision for movement is 2 meters for cold water pipelines and 1 meter for hot water pipelines. A fixed point is one at which longitudinal movement of the pipe or fitting is restrained.

An expansion joint shall be constructed with a device or a definite means to ensure the provision of the desired gap for thermal expansion between the two pipes during installation.

Any expansion joint provided shall incorporate a permanent shield to provide protection to the sliding surfaces and rubber ring seal from ingress of dust particles.

Rubber ring seal used in the expansion joint shall be made of natural rubber or mixture of natural and synthetic rubber or synthetic rubber complying with MS 672.

2.4 Cast Iron Soil, Waste and Vent Pipes

Where shown or stated in the Drawings, 100mm diameter cast iron soil and vent pipes internally coated with anti corrosive bituminous coating shall be provided, fixed and connected to the fittings and sanitary system. The pipe shall be jointed with an approved resin with molten lead and well caulked. All necessary bends, branches, offsets, inspection pieces, hopper heads, holder bats shall be provided where necessary.

Vertical stacks shall terminate 600mm above roof level with open ends and provided with approved galvanised balloon grating.

Where shown or stated in the Drawings, 50mm diameter anti siphonage pipes of similar quality as above shall be provided and fixed.

Galvanised wrought iron waste pipes of the same diameter as the outlet served shall be provided and fixed to fittings complete with all necessary bends, tees, sockets, plugs, etc. The waste pipes shall be carried through walls and angled to flow into concrete surface drains or if from upper floors connected to the waste or soil stack as shown in the Drawings. Cast iron waste pipes shall be as specified hereinbefore for soil pipes and shall be of an adequate diameter unless otherwise detailed in the Drawings.

3.0 HYDRO PNEUMATIC BOOSTER PUMP SYSTEM

3.1 GENERAL

The pumps shall be Hydro Pneumatic type pump and shall have a high grade and polished stainless steel impellers fitted to stainless steel or high tensile steel shafts running in standard type ball thrust and roller bearings. The casings shall be of close grained cast iron. The pump shall be direct coupled to its driving motor by flexible type steel couplings and shall be mounted on a rugged steel base with vibration isolators.

The pumps shall be fitted with air corks and two lubricators and suction and delivery branch flange shall be to BS Table D. Drain pipes shall be provided to the nearest drain of floor traps. The speed of the pumps shall not be less than 2,900 rpm. and fitted with mechanical seals.

3.2 ELECTRICAL MOTORS AND STARTERS

All electric motors shall be totally enclosed, fan cooled (TEFC) and fully tropicalised and shall be furnished with Class E insulation to BBS 2757 : 1986 and BS 5000 : Pt 99 : 1973 and suitable for operation on single and three phase 50 Hz power supply.

All electric motors shall be furnished with isolator gears and starter gears which shall be fully tropicalised and comply with BSS 587:1954 incorporating amendments PD 3628 : Jan 1960.

Thermal overload protection devices in all phase, over-current protection devices, and under-voltage releases shall be furnished and incorporated in the circuits of all electric motors.

The AC motor shall also comply to the following:

- (a) Single phase AC motors shall not exceed 1hp and if over ½ hp shall be fitted with a suitable starter designed to limit the starting current and including a no-volt release.
- (b) Three phase AC motors up to and including 10 hp may be of the squirrel cage type. Up to 3 hp direct on line (D.O.L.) starting may be used, and above 3 hp a star-delta or auto-transformer starter shall be provided and a no-volt release provided.

All motors from 2 hp shall have a power factor of not less than 0.9 at 80% load.

3.3 ELECTRICAL SWITCHBOARD

The Sub-contractor shall supply and install a metal wall mounted switchboard which shall house all circuit breakers, starters, contactors, relays, selector switches, voltmeter and ammeter. The metal switchboard shall be fabricated from pressed steel sheets of not less than 16 SWG and shall be of rigidly structural construction with all joints neatly and finish flush and all bare edges turned over or lipped.

The doors of the metal switchboard shall be fabricated from pressed steel sheet of not less than 16 SWG and shall be rigidly reinforced on the inside with all edges finished round. The doors shall be fitted with a handle such that cannot be opened unless that isolator switch or handles are turned to the 'OFF' position thereby cutting off the power supply to the electrical mechanisms on the inside of the metal switchboard. Felt or rubber insert gaskets shall be incorporated in the frames of the metal switchboard to ensure dust-proof locking arrangement. The doors of the metal switchboard shall be fitted on the inside with shelve for storing spare catridge fuses and contacts and electrical circuits diagrams.

All contactors, starters, relays and controllers shall be fitted on insulated panels. All incoming and outgoing circuits and wiring shall be brought to the contactors, starters, relays and controllers via insulated terminal strips mounted within the cubicle and all wiring between terminal strips and equipment inside the control panels shall be neatly run and taped strictly in accordance with the requirements of the Tenaga Nasional Berhad.

3.4 PIPES, VALVES AND FITTINGS

Pipework shall include all pipes, bends, tees, flanges, brackets, belts, nuts, valves, specials, etc. from and including the connection at the suction tank up to the pumps and from the pumps up to and including the connection as specified in the tender drawing.

All pipes and fittings shall be galvanized mild steel tubes conforming to BS 1387:1985 and BS 21:1985, Class C. Pipes flanges shall be complied to BS 10:1962 Table E.

Underground pipe shall be galvanized steel pipe to BS 1387:1985 and BS 21:1985. Sluice valves shall conform to the requirements of BS 5045; Pt. 1:1976 for Class I valves and shall be clockwise closing. They shall be fitted with hand wheels with the direction of opening and closing cast thereon.

The non-return valves shall be of design and quality as will prevent slamming by rebounding water column in the system.

Vibration isolators shall be of wire and fibred moulded high-pressure rubber type. The flange shall be integral with the fittings and shall be clamped in place using split steel flanges for sizes 2" diameter and above and for size below 2" diameter, a similar hose shall be used for connection.

Strainers shall be installed up stream of all pumps. On lines 2" diameter and below, the strainers shall be screwed steel or bronze body types. Otherwise, the strainers shall be of the flanged type. All strainers shall be of flanged steel body type and shall be fitted with permanent magnets and removable bronze screens.

3.5 AUTOMATIC SWITCHES AND CONTROLS

The automatic controls shall be of no-float type using stainless steel electrodes provided at (i) suction tank and (ii) Storage/balancing tank; and shall be able to perform the following automatic action:-

When the water level drops below L.W.L in the storage/balancing tank, the pump shall be switched on and shall remain until the water level reaches T.W.L.

When the water level in the Storage/balancing tank reaches T.W.L. the pump shall be switched off and shall be prevented from being switch on again until the water level falls to L.W.L.

When the water level is at or below the L.W.L. in the suction tank, the pump shall be switched off and shall be prevented from being switched on again until the water level rises to T.W.L.

The L.W.L. and T.W.L. in the suction tank and Storage/balancing tank shall be decided by the S.O. on site.

An auto/manual changeover switch shall be provided. Each pump shall have a pressure gauge fitted on the delivery branch with shut-off cork. Flexible coupling shall be provided at the suction and delivery pipes to prevent transmission of Vibration.

3.6 PAINTING

All pump sets, pipes conduits and hangers and other incidentals item shall be given one coat of primer paint and two coats finishing oil paint.

SECTION 2 SCHEDULE OF TECHNICAL DATA

The tenderer must complete this Schedule of Technical Data as set out below. All information asked for must be given correctly and supported by copies of manufacturer's published technical data for the equipment being offered.

1. PIPEWORK

Description	Type			
	Cold Water Pipe (underground) (Incoming to Tank)	Cold Water Pipe (underground) (from water ret. To canteen)	Cold Water Pipe (aboveground)	Cold Water Pipe (aboveground) (Distribution)
Manufacturer				
Material				
Grade & Thickness				
BS specification				
Manufacturer of pipe fittings				

Description	Type		
	Soil and Vent Stack Piping	Waste and Drain Piping	Waste and Drain Piping (Chemical labs)
Manufacturer			
Material			
Grade & Thickness			
BS specification			
Manufacturer of pipe fittings			

2. VALVES, GAUGES, PIPE FITTINGS ANTI-VIBRATION COUPLING

	Size	Make	Model No.	Materials
Isolating Gate Valve				
Alarm Valve				
Non-Return Valve				
Strainers				
Drain Cocks				
Combined Drain & Test Valves				
Automatic Air Vents				
Anti-vibration Coupling				
Ball Float Valves				
Pressure Gauges				
Water Level Gauges				
Low-level Ball Valves				
Butterfly Valves				
Globe Valve				
Thermometer				
Pressure Reducing Valves Sets				

3. **PAINTING**

Pipe Work	Manufacturer	Type	Detail & Finish
Primer Coat Under Coat Top Coat Anti-corrosion weather proof type for external pipework and metal work and under ground pipework			

4. **WATER STORAGE TANKS**

4.1 **FRP WATER STORAGE TANK**

- a) Manufacturer of _____
- b) Thickness _____
- c) Dimensions _____
- d) Type of level indicator _____

4.2 **POLYETHYLENE STORAGE TANK**

- a) Manufacturer of _____
- b) Thickness _____
- c) Dimensions _____

4.3 STAINLESS STEEL STORAGE TANK

- a) Manufacturer of _____
- b) Thickness _____
- c) Dimensions _____
- d) Type of level indicator _____

5. PNEUMATIC VARIABLE SPEED BOOSTER PUMP SYSTEM**5.1 Electrical Pumpset**

- No. of pump sets provided _____
- Manufacturer of pump _____
- Model of pump _____
- Material of impeller _____
- Material of shaft _____
- Type of seal _____
- Flow rate of pump _____
- Total head of pump _____
- Manufacturer of electric motor _____
- Model of electric motor _____
- Power rating _____
- Rpm of motor _____
- Electrical characteristics (Volts/Frequency/Phase) _____

5.2. Switchboard

Manufacturer _____

Brand name _____

Size of cubicle _____

Thickness of metal sheet _____

5.3. Piping

Manufacturer of pipes _____

Class of pipe _____

Material of pipe _____

5.4. Fittings

DESCRIPTION	MAKE	MAKE
Gate valve		
Sluice valve		
Check valve		
Pressure gauges		
Stainless steel non – float electrodes c/w holder		
Flexible coupling		

6. PAINTING

Pipe Work	Manufacturer	Type	Detail & Finish
Primer Coat Under Coat Top Coat Anti-corrosion weather proof type for external pipework and metal work and under ground pipework			

7. DETAILS OF TOOLS SUPPLIED

- a) _____
- b) _____
- c) _____
- d) _____

SECTION 3 **SCHEDULE OF RATES**

Note: -

The rate quote shall be for the furnished and install, and shall included such incidental accessories as brackets, hangers, unions, flanges, connections, tees, elbows, junction boxes, excavation and backfilling, painting and other fittings.

The alphabet marked in the Rate column shown shall represent the followings: -

- B Pipe material/metre inclusive of hangers, fittings, supports, anchors, bolts, nuts, screws as appropriate and painted.
- C Labour cost/metre of pipe necessary for the installation including hacking for openings and necessary chases in walls as appropriate.

Dia Mm	Soil Pipe Above Ground		Soil Pipe Buried		Pipe Above Ground Class		Pipe Buried Class	
	B	C	B	C	B	C	B	C
15								
25								
32								
40								
50								
60								
80								
100								
150								
200								
250								

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Dia Mm	UPVC Class E pipe		Mild Steel Pipe		ABS pipe	
	B	C	B	C	B	C
15						
25						
32						
40						
50						
60						
80						
100						
150						
200						
250						

VALVES, GAUGES AND PIPE FITTINGS

	Diameter (mm)					
	12	15	25	32	40	50
Isolating Gate Valve						
Isolating Ball Valve						
Globe Valve						
Non-return Valves						
Strainers						
Drain Cocks						
Automatic Air Vents						
Anti-vibration Couplings						
Pressure Gauges c/w Cocks						
Thermometer						
Flow Meter						
Motorised Butterfly Valves						
Spring Load Relief Valves						
Electrode Switches						

Flow Switches						
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	Diameter (mm)					
	12	15	25	32	40	50
Pressure Reducing Valves Sets						
Water Level Gauge						
Thermostat						

1. Excavate through all material except rock and bolder greater than 1 cu. M in volume, cart away or dispose as directed.
 - a) not exceeding 1.525 M per cu. M. RM _____
 - b) not exceeding 3.05 M per cu M. RM _____
 - c) not exceeding 4.573 M per cu M. RM _____
 - d) not exceeding 6.1 M per cu M. RM _____
2. Extra over for excavation on rock per cu M. RM _____
3. Concrete Class A including mixing, placing, compacting, curing and forming but excluding reinforcement. RM _____
 - g. Mild steel bars to BS 4449 in reinforcement for concrete works including all cutting, bending, placing in position and waste. RM _____
 - 6.35 mm dia. per kg. RM _____
 - 9.525 mm dia. per kg. RM _____
 - 12.7 mm dia. per kg. RM _____

- 15.875 mm dia. per kg. RM _____
- 19.05 mm dia. per kg. RM _____
- 3.175 mm dia. per kg. RM _____
- h. 25.4 mm thick high aluminium cement furnish
to concrete works per sq. Meter RM _____
- i. Mass concrete Class C including mixing, placing,
compacting and curing for pipe haunching and
base to concrete works. RM _____
- j. Trenching and backfilling for all pipe works,
Including bracing, shuttering, placing and
Compacting as required. RM _____
- k. 229mm thick standard brickwork, bonded in
cement motor as specified RM _____
- l. Supply of labour, brackets, support and
Accessories for the following plumbing fixture
- a) wash hand basin each RM _____
- b) W.C pan and cistern each RM _____
- c) Wall urinals each RM _____

Signature of Tender _____

Name : _____

Address : _____

Date : _____