

**CONSTRUCTION OF**  
**NEW-OSS CENTER**  
**PROJECT**

---

**TECHNICAL SPECIFICATIONS**

---

**C: "SANITARY WORKS"**

## 1. GENERAL

### 1.1. Authoritative Standards and Codes of Practice

The authoritative standards referred to in this Specification are the British Standards and Codes of Practice in Conjunction with the Ethiopian Building Code of Practice.

Should the contractor wish to substitute any other Authoritative Standards or Codes of Practice for any referred to in the Specification, he must submit details of any such standard or Code of Practice with two copies of the document for approval of the Engineer. Approval will only be given to use an alternative Standard or Code of Practice if the Engineer considers the proposed Standard or Code of Practice will produce work of a standard equal or better than that of the specified Standard or Code of Practice.

The whole of the plumbing works is to be executed by a registered plumber and drain layer in strict accordance with the Regulations of the Local Authorities and to the satisfaction of the Engineer.

### 1.2. Working Drawings

For all work within building the Contractor shall produce drawings showing details of his proposals. The drawings shall be submitted to the Engineer for his approval and no work shall commence until the drawings have been approved.

### 1.3. As Constructed Drawings

On completion of the works, when required by the Contract, the Contractor shall prepare drawings showing the work as constructed. The drawings shall be submitted to the Engineer for his approval. When the drawings have been approved, copy negatives shall be provided by the Contractor to the Client for his retention.

## 2. Materials

### 2.1. Galvanised Mild Steel Pipework

All galvanized mild steel pipe work up to 65mm nominal bore shall be manufactured in accordance with B.S 1387 medium grade with tapered pipe threads in accordance with B.S. 21. All fittings shall be of malleable iron and manufactured in accordance with B.S. 143.

All galvanized mild steel from 80 mm nominal bore up to 150 mm nominal bore shall be manufactured in accordance with screwed and bolted flanges for the jointing of pipes to valves and other items of plant. The flanges shall comply with the requirements of B.S.10.

### 2.2. Copper Tubing

All copper tubing used shall be manufactured in accordance with B.S. 2871 from C106 "Phosphorus De-oxidized Non-Arsenical Copper in accordance with B.S 1172."

Joints in pipe work and connections to equipment shall be made with soldered capillary fittings and connection in accordance with B.S 864.

### 2.3. Cast Iron Pipework Above Ground

For internal pipework used above ground, cast iron pipework and fittings shall comply with B.S.416 medium grade with spigot and socket joints. Inspection covers on branches, tees, elbows, etc., shall comply with the requirements of B.S.1211.

#### 2.4. P.V.C. Pressure Pipework

All P.V.C pipes for cold water services shall comply with the requirements of B.S 3505 and all fittings shall comply with B.S.4346.

P.V.C pipes and fittings shall be solvent welded using the pipe manufacturer's approved cement.

#### 2.5. P.V.C Soil Pipework

P.V.C soil pipework and fittings shall comply with the requirements of B.S.4514.

#### 2.6. Penstocks and Headstocks

All penstocks, headstocks and brackets, spindles and other fittings shall be to the pattern specified and from an approved manufacturer.

#### 2.7. Stop-cocks, Taps and Stop Valves

Stop cocks for underground use shall be plug cock pattern or screw down pattern complying with the requirements of B.S.2580.

Taps and stop valves shall be screw down pattern and shall comply with the requirements of B.S 1010 fitted with washers complying with B.S. 3457. Hose taps and hose connections shall have outlet noses screwed in accordance with the requirements of B.S 1010 14.

#### 2.8. Check Valves

Check valves of 65 mm diameter and under shall comply with the requirements of B.S 5154, with copper alloy body and cover, gun metal doors with leather facing discs and screwed female.

All gate valves up to 65 mm nominal bore shall be of bronze construction and shall be in accordance with B.S. 1952.

#### 2.9. Ball Valves

All ball valves for use in connection with hot and cold water services shall be of Ports mount type in accordance with the requirements of B.S. 1212 and constructed of bronze or other non-corrosive material.

#### 2.10. Fixing Valves

Mixing valves for shower fittings and other appliances shall comply with the requirements of B.S. 1415 and shall be of bronze or other corrosion resistant material.

#### 2.11. W.C. Pans and Washbasins

Shall be of vitreous China to B.S 3402. Unless otherwise specified the colour shall be white.

2.12. W.C. Seats

Shall be heavy duty plastics to B.S 1254. Unless otherwise specified, the colour shall be white.

2.13. Cisterns

Polythene or polypropylene cisterns shall comply with the requirements of B.S. 4213.

Galvanised cisterns shall comply with the requirements of B.S. 417 grade 'A'. Vitreous China cisterns shall comply with the requirements of B.S. 3402.

2.14. Bath Tubs

Baths shall be of porcelain enameled steel to B.S. 1344.

2.15. Pressed Steel Storage Tanks

Pressed steel storage tanks shall comply with the requirements of B.S. 1564 and shall be complete with cover, access manhole, ventilators, overflow, and drain. The whole of the tank steelwork and plates shall be galvanized before dispatch. After completion of erection the tank shall be painted with an approved etching primer and two coats of bitumen based aluminium paint externally and two coats of non-toxic bitumen paint internally.

2.16. Waste Fitment Traps

Where standard or deep seal traps are specified they shall be of non-ferrous material in accordance with B.S.1184 or P.V.C.

**3. WORKMANSHIP**

**3.1. Water Service Installation**

All work shall be carried out in accordance with C.P. 342 and C.P 310 and to the approval of the Engineer.

The pipes shall be supported in their final position and adjusted before any joints are made. Pipes in buildings shall be positioned as close as practicable to walls, ceilings and columns.

Sufficient drain points and automatic air vents shall be provided to ensure the system functions correctly. Valves and other user equipment shall be installed with adequate access for operation and maintenance. Where it is unavoidable to install valves and other operational equipment beyond normal reach or in such a position as to be difficult to reach, extension spindles with brackets shall be provided.

Allowance shall be made for expansion and contraction of pipework, precautions being taken to ensure that any forces produced by pipe movements are not transmitted to valves or equipment of plant. All screwed joints to piping and fittings shall be made with P.T.F.E tape.

**3.2. Sanitary Service Installation**

Soil, waste and vent pipe systems shall be installed in accordance with B.S 5572 and to the approval of the Engineer. All sanitary appliances shall be installed in accordance

with B.S. 6465. All waste fittings shall discharge into a gully trap before passing to a sewer by way of a manhole.

Rodding and inspection facilities shall be provided within the draining system in positions where they are easily accessible. Where rodding facility is not in a position such that access is not easily available, a branch shall be extended so as to provide suitable rodding eye. Rodding eyes shall be provided at the bottom of stacks.

Vent stacks shall be terminated above level and shall have a plastic or galvanized steel guard at the top.

### **3.3. Pipe Support for Suspended Pipework**

Pipe runs shall be secured by pipe clips connected to pipe hangers, wall brackets, or trapeze type supports. U-bolts shall not be used as a substitute for pipe clips without the approval of the Architect.

The maximum permissible vertical spacing of supports in meters shall not exceed one and a half times the distance given for horizontal runs.

For cast iron and asbestos cement spigot and socket jointed pipes, the pipes shall be generally supported at every socket joint by means of either holder bats secured rigidly to the structure, or purpose made straps for attachment to rigid steel support brackets. Where holder bats are used, they shall comply with the requirements of B.S.416.

The maximum permissible horizontal spacing of supports in metres for steel and copper pipe and tube is given in the following table:-

<b>Size Normal Bore</b>	<b>Copper Tube to B.S.2871</b>	<b>Steel Tube to B.S.1387</b>
15 mm	1.25 m	2.0 m
20 mm	2.0 m	2.5 m
25 mm	2.0 m	2.5 m
32 mm	2.5 m	3.0 m
40 mm	2.5 m	3.0 m
50 mm	2.5 m	3.0 m
65 mm	3.0 m	3.5 m
80 mm	3.0 m	3.5 m
100 mm	3.0 m	4.0 m
125 mm	3.5 m	4.5 m
150 mm	4.5 m	5.5 m

### **3.4. Underground Pipelines**

The Contractor shall construct the pipelines using the designs of pipe, bed haunch, and surround as detailed on the drawings.

'Rigid pipes' shall mean pipes of cast or spun iron, concrete, asbestos cement, clay or similar materials.

'Flexible pipes' shall mean pipes of steel, PVC or other plastic, pitch fibre, ductile iron or similar materials.

'Rigid joints' shall mean joints made by bolting together flanges integral with the barrels of the pipes by caulking sockets with non-deformable material, such as cement, run lead or by similar techniques.

'Flexible joint' shall mean joints made with factory made jointing materials, loose collars, rubber rings etc. and which allow some degree of flexing, however small, between adjacent pipes.

### **3.5. Jointing Pipes**

Joints shall be made strictly in accordance with the manufacturer's instructions. The Contractor shall make use of the technical advisory services offered by manufacturers for instructing pipe jointers in the methods for assembling joints.

Where manufacturers recommend the use of special jointing tackles, the Contractor shall use these for assembly of all joints to pipes. Sockets shall be laid looking uphill unless otherwise approved.

Before making any jointing all jointing surfaces shall be thoroughly cleaned and dried and maintained in such condition until the joints have been completely made or assembled.

Notwithstanding any flexibility provided in the pipe joints, pipes must be securely positioned to prevent avoidable movement during and after the making of the joint.

The space between the end of the spigot and the shoulder of the socket of flexibility jointed pipes when jointed shall be as recommended by the manufacturer or as ordered by the Engineer.

After flexibly jointed pipes, other than PVC pipes have been jointed the gaps between the barrel of the pipes and the internal face of the socket shall be sealed with puddle clay, uncaulked rope yarn or other approved material. The rope yarn or other material must have been treated so as not to support bacterial growth.

Where loose collars are used to join pipes cut for closers, special tools shall be employed to keep the inside of the pipes flush and the collar concentric with the pipe while the joint is being made.

Pipes provided with spigot and socket joints of the self centering, instantaneous joint type, such as the rubber ring push fit joint, shall be laid and jointed strictly in accordance with the maker's instructions. Generally the joint ring shall be cleaned and inspected for cuts and defects, and socket and spigot examined to ensure freedom from oil, grease, tar and grit. The maker's recommended lubricant will be used.

### **3.6. Cast Iron Joint Fittings**

Cast iron detachable joint collar and flanges shall be tested by striking lightly with a spanner immediately before they are placed and if they fail to ring true shall be set aside and not incorporated in the work until proven sound.

The flanges shall be correctly positioned and the component parts including any insertion ring cleaned and dried.

Insertion rings shall be fitted smoothly to the flange without folds or wrinkles. The face and bolt holes shall be brought fairly together and the joints shall be made gradually and evenly tightening bolts in diametrically opposed positions. Only standard length spanners shall be used to tighten the bolts. The protective coating, if any, of the flange shall be made good when the joint is completed.

Bolt threads shall be wrapped with PTFE tape where directed before use. No washers shall be used on flanged pipework to be laid below ground. Bolts shall be as specified and shall be of the correct length, leaving a maximum of two threads exposed.

### **3.7. Solvent Welded Joints**

Only the solvent cement recommended by the manufacturer for his pipe joint system shall be used and his instructions on the making of the joint shall be closely followed.

Excess solvent cement shall not be applied to the inside of the pipe socket and all surplus solvent shall be removed from the joint and the pipe. Any solvent falling on the trench formation shall be removed by excavating the contaminated soil.

Solvent welded pipes jointed outside the trench shall not be lowered into the place until the elapse of time recommended by the manufacturer. The time allowed for curing shall be increased with lower temperature.

### **3.8. Connection of Tubing to Cold Storage Tanks, Hot Water Cylinders and Sanitary Fittings.**

Each connection of tubing to cold water storage tanks shall be made by drilling a hole in the tank side and using a long screw, union and two back nuts all well screwed up in non-toxic approved jointing compound (red-lead shall not be used). Joints of tubing to flanged and bossed connections of hot water cylinders shall be made with boiler screw, union and back nut screwed up in jointing compound.

Connections to sanitary fittings shall be made with 450 mm length copper tubing bent to shape as required with copper to iron couplings at each end, and joint to union of fittings and tubing.

### **3.9. Fixing Sanitary-ware and Fittings**

All sanitary-ware and fittings shall be left in a clean and good condition to the satisfaction of the Engineer.

All fittings shall be fixed in accordance with the manufacturer's instructions.

Lavatory basin brackets shall be cut and pinned to walls in cement mortar including making good, rendering, tiling or plastering, etc.

### **3.10. Cutting Pipes**

Cutting iron pipes shall be by a method and with apparatus which provides a clean square cut of the pipe and of the lining, if any, without damage to pipe or lining.

All cut or trimmed ends, and the parts of any pipe on which the coating may have suffered damage shall be recoated with bitumen before the pipes are laid. The external area at cut spigot ends of ductile iron pipes shall be ground for a distance of at least 124 mm.

Asbestos-cement pipes shall be cut by hacksaw or other approved means to a square and even finish without splitting or fracturing the wall of the pipe. A percentage of the pipes ordered shall be supplied with fully turned barrels and these pipes will be set aside for use in cutting specific lengths. When no fully turned pipes are available a hand operated turning machine shall be used to prepare the ends of cuts of cut pipes for Johnson Couplings, barrel joints or collar joints.

Pitch-impregnated fibre pipes shall be cut by a saw and where necessary the end shall be filled or machined to the required 2 degrees taper.

Concrete pipes shall be cut to a square and even finish without splitting or fracturing the wall of the pipe. Reinforcement shall be cut back flush with the concrete and bare metal protected with bituminous paint or cement grout as directed.

Only steel pipes supplied rounded throughout their length shall be used as cut pipes to form closures. The cutting shall be done by an approved method and apparatus which provides a clean square cut, without separation of the lining from the pipe wall. Minor damage to the lining may if permitted, be repaired on site in accordance with the manufacturer's instructions. Where in the opinion of the Engineer the damage is serious the pipe shall be returned to the manufacturer for reconditioning.

### **3.11. Pipes Built into Structures**

The outside surface of all pipes and special castings to be built into structures shall be thoroughly cleaned immediately before installation. Where ordered protective coating to metal pipe shall be removed from the sections to be built in while the external surfaces or fireclay and concrete pipes shall be roughened to form a key for concrete or mortar. Sheathing to steel pipes shall be cut away from the sections to be built-in and after erection the protection shall be completed by applying approved bituminous material around the barrels of pipes at the junctions with structures.

Pipes passing through water retaining walls and floors shall, where possible, be built into the structure in-situ. Shuttering shall be formed closely to the outside of the pipes, and concrete shall be placed and compacted thoroughly round pipe and puddle flange, if any.

Where fixing in the course of construction is not possible, temporary openings in structures, formed to the dimensions shown by the Engineer shall be left where indicated or directed to accommodate the subsequent erection of pipes and special castings.

In water retaining structures, they shall taper to a smaller dimension towards the external faces of structures and shall include where indicated a water stop. In basements, dry chambers at pumping stations etc., temporary openings shall taper to a smaller dimension towards the internal faces of structures and shall also include, where indicated a water stop.

Prior to in-fitting, all surfaces against which fresh concrete is to be placed shall be prepared as specified, while the external surfaces of pipework shall be prepared as described in this clause.

### **3.12. Setting Valves**

Care must be taken to prevent damage to all valves, fibre, hydrants and the like, and their ancillary equipment. Valves etc., and ancillary apparatus shall be stored in clean conditions and in a manner that excludes all water. Where directed, head-stocks, motors, gearing or indicators shall be removed, adequately labeled for identification, stored carefully in weather-proof premises and be reconnected after erection of the valves. Electrical equipment shall be protected from damp and the damp-proofing seals shall remain intact until the electrician is ready to connect up the equipment.

The gunmetal faces and seats of all valves must be kept clean. No valve shall be closed without first wiping the faces with a clean cloth. The cavity beneath the valve door shall be thoroughly cleaned by hand. In the event of accident, fouling matter shall be either dissolved or carefully removed by methods that do not involve scraping of gunmetal faces.

All valves shall be set so that operating spindles are truly vertical unless otherwise detailed or directed.

Every stuffing box shall be examined when the main is charged with water and leaking boxes shall be adjusted or repacked with square plaited lubricated hemp packing of approved manufacture. The stuffing box shall not be so tightly packed as to materially affect the friction of the packing on the spindle.

No air valve shall be stored before erection in the open sunlight, or upside down to expose the balls and air cavities. Air valves shall be checked before the main is charged to ensure that the balls and faces are not scored or split and that there is no dirt or other deleterious materials in the cavities of the body. All air nozzles shall be probed to see that they are clean.

Fire hydrants, frost plugs and similar fittings shall be checked before being incorporated in the line and before the main is charged to ensure that they are clean.

The direction of opening of the valve shall be indicated on the headstock and on the underside of hydrant covers.

### **3.13. Testing of Pipelines –General**

The contractor shall provide all water, fittings, pipe stoppers, test pumps, pressure gauges and the necessary labour and tools for the hydraulic testing of pressure pipelines and air testing of drains and sewers.

The equipment must be maintained in good order and the gauges shall be tested to the satisfaction of the Engineer.

The cost of providing all equipment and labour required shall be included in the price quoted by the Contractor for pipe laying.

Trenches must be kept dry until the pipes have been passed by the Engineer.

Water for all testing must be obtained from an approved source.

The Contractor shall give the Engineer not less than 24 hours notice of his intention to test a section of pipeline.

### **3.14. Testing Pressure Pipelines**

Pipelines shall be tested hydraulically in sections during the course of construction.

Testing shall be applied to prove the structural soundness of the various units in the line, including pipes, valves and anchorages, and to prove the water tightness of the line.

Tests shall be applied to sections of pipelines not exceeding 1000 metres in lengths or such lesser length as may be required, and pipe joints shall be left uncovered.

The Contractor shall provide for transmitting the unsupported end thrusts to solid ground at the ends or into the sides of the trenches.

Before testing, the Contractor shall ensure that the anchorage of bends is complete and that all branch outlets taking end thrusts are properly stayed. All anchor blocks must be fully cured before testing the pipeline.

The test pressure unless otherwise directed in the Contract will be 1.5 times the working pressure with a minimum of 50 metres head.

The specified test pressure must be achieved at all points along the section of pipeline under test.

The ends of the section to be tested must be blanked off by means of end pieces, blank flanges or discs provided and temporarily fitted by the Contractor at his own expense together with any anchorage that may be required. Valves shall not be used to isolate test sections forming the pipeline.

The pipeline or pipework shall be filled with water in such a manner as to prevent any shock or water hammer and allow for the complete evacuation of air, and kept under observation for leakage at static head for twenty four hours. If there are no leakages the pressure shall be raised slowly to the required test pressure for that pipeline and maintained at that pressure for a period long enough for the Engineer to examine the whole section under test, or not less than 4 hours which ever is the longer period. Thereafter, for a period of 2 hours the leakage of water, as measured by the amount drawn into the pump to maintain the pressure must not exceed a rate of 0.1 litre per mm nominal internal diameter per kilometre length of main per 30 metres head for each 24 hours.

All pipes or joints which are proved to be in any way defective shall be cut out, remade and retested as often as may be necessary until a satisfactory test is obtained and any work which fails or is proved by test to be unsatisfactory in any way shall be cut out and re-done by the Contractor at his own expense.

In addition to the tests in separate sections, on completion the main shall be tested in whole or in parts to the same pressure and by the same procedure as that outline for individual sections.

During pipe laying the gauge shall remain in the pipeline and shall be pulled by a stout rope or chain which shall be threaded through each successive pipe or tube so that the gauge is never more than one pipe length behind laying. Any debris collected in front of the gauge shall be regularly cleaned out before the next pipe is placed in position.

### **3.15. Sterilization of Water Mains**

The pipelines after testing shall be thoroughly flushed out and cleaned.

After the Engineer has approved the cleaning the Contractor shall completely fill the pipelines with water to which he shall have added chloride of lime or other approved chemical to give concentration of free chlorine of 50 mg. per litre.

Chlorine gas must not be injected direct into the main from a cylinder otherwise than through an approved chlorinator and care must be taken to ensure that there is no flow back into the preceding sections of main.

The method used for sterilization shall be approved by the Engineer and solution allowed to remain in the pipelines for not less than 6 hours, nor more than 24 hours. Chlorine residual tests shall then be taken at the end of the main furthest from the dosing point. The sterilization process shall be repeated until the free chlorine residual test shall be carried out on site in order to obtain an accurate reading of the free chloride present.

### **3.16. Septic Tanks**

Septic tanks shall be constructed to the dimensions and general arrangement detailed on the drawings and in the Contract. Tanks with blockwork shall be constructed as for manholes.

### **3.17. Testing of Septic Tanks**

Septic tanks and other chambers shall be tested by filling with water after completion of backfilling.

The first one metre of depth may be filled as quickly as the supply permits. Between this and top water level the rate of filling must not exceed one metre in 24 hours. After filling to top water level no further water shall be introduced for 2 days. At the end of this period the tanks shall be topped up to water level and allowed to stand. The tank shall be considered satisfactory if the fall in water level in 24 hours does not exceed 15 mm.

In the event of a fall exceeding the above the tank will be emptied and any defects made good prior to re-test as before, all at the Contractor's expense.

## **4. DRAINAGE**

### **4.1. STANDARD AND CODES OF PRACTICE**

The requirements of the following British Standards and Codes of Practice shall be observed.

#### British Standards

- a) B.S. 556 Part 1+2 Concrete cylindrical pipes and fittings (including manholes, inspection chambers and street gullies)
- b) B.S. 401 Concrete un-reinforced tubes and fittings (with ogee joints for surface water drainage)
- c) B.S. 437 Part 1 Cast iron spigot and socket drain pipes and fittings.
- d) B.S. 1247 Manhole step irons (in malleable cast iron)
- e) B.S. 2760 Pitch-impregnated fibre drainage pipes and fittings.
- f) B.S. 1211 Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
- g) B.S. 1130 Cast iron drain fittings.

#### Codes of Practice

- |    |      |      |                   |
|----|------|------|-------------------|
| a) | C.P. | 301  | Building drainage |
| b) | C.P. | 2005 | Sewerage          |
| c) | C.P. | 2010 | Pipelines         |

### **4.2. PLASTIC PIPES**

The pipe work and fittings for use underground shall be u PVC to B.S. 4660

### **4.3. CONCRETE PIPEWORK**

Where concrete pipes and fittings are used in connection with the conveyance of surface water or sewage under atmospheric pressure, they shall be manufactured in accordance with the requirements of B.S. 556, Class 1, except where otherwise stated.

The joints of concrete pipe and fittings may be one of the following depending upon application and conditions:-

- 1) Flexible spigot and socket type
- 2) Flexible rebated type (storm water drainage only)
- 3) Ordinary spigot and socket type.
- 4) Ordinary rebated type (Storm water drainage only)

Joints (1) and (2) shall be sealed with suitable rubber gaskets manufactured in accordance with B.S. 2494 except where they are likely to be contaminated by oil products, in which case the gaskets shall be manufactured in accordance with B.S. 3514.

Joints (3) and (4) shall be made with approved cement mortar mix.

#### **4.4 VALVES**

##### **4.4.1 DRAW-OFFS AND STOP VALVES (UP TO 50MM NOMINAL BORE)**

Draw off taps and stop valves up to 50mm. Nominal bore, unless otherwise stated or specified, for attachment or connection to sanitary fittings shall be manufactured in accordance with the requirements of B.S. 1010.

##### **4.4.2 GATE VALVES**

All gate valves 80mm. Nominal bore and above, other than those required for fitting to buried water mains shall be of cast iron construction in accordance with the requirements of B.S. 3464.

All gate valves required for fitting to buried water mains shall be of cast iron construction in accordance with the requirement of B.S. 1952.

All gate valves up to and including 65mm. Nominal bore shall be of bronze construction in accordance with the requirements of B.S. 1952.

The pressure classification of all gate valves shall depend upon the pressure conditions pertaining to the Site Works.

##### **4.4.3 GLOBE VALVES**

All globe valves up to and including 65mm. Nominal bore shall be of bronze construction in accordance with B.S. 2060.

All globe valves 80mm. Nominal bore and above shall be of cast iron construction in accordance with the requirements of B.S. 3961.

The pressure classification of all globe valves shall depend upon the pressure conditions pertaining to the Site of Works.

##### **4.4.4 CHECK OR NON-RETURN VALVES**

All check or non-return valves up to and including 65mm. Nominal bore shall be of the swing check of bronze construction in accordance with B.S. 1953.

All check or non-return valves 80mm. Nominal bore and above shall be of the swing check type of cast iron construction in accordance with the requirements of B.S. 4090.

The pressure classification of all check-non-return valves shall depend on the pressure conditions pertaining to Site of the Works.

#### 4.4.5 **BALL VALVES**

All ball valves for use in connection with hot and cold water services shall be of the Portsmouth type in accordance with the requirements of B.S. 1212, constructed from bronze or other corrosion resistant materials. These valves fall into three pressure classification as follows:-

( a ) Low Pressure	-	3,538 b maximum
( b ) Medium Pressure	-	7,725 b maximum
( c ) High Pressure	-	12,620 b maximum

The pressure classification required for each ball valve will be designated in the description of its associated equipment contained in Part C of the Specification.

#### 4.4.6 **MANUALLY OPERATED MIXING VALVES**

Mixing valves for shower fittings and other applications being provided under the Sub-Contract Works shall be manufactured in accordance with the requirements of B.S. 1415 from bronze or other corrosion resistant materials.

#### 4.5 **WASTE FITMENT TRAPS**

##### 4.5.1 **STANDARD AND DEEP SEAL P AND S TRAPS**

Where standard or deep seal traps are specified they shall be manufactured in suitable non-ferrous materials in accordance with the full requirements of B.S. 1184.

In certain circumstances, cast iron traps may be required for cast iron baths and in these instances bath traps shall be provided which are manufactured in accordance with the full requirements of B.S. 1291.

##### 4.5.2 **ANTI-SYPHON TRAPS**

Where anti-syphon traps are specified, these shall be similar or equal to the range of traps manufactured by Greenwood and Hughes Ltd., Deacon Works, Littlehampton, Sussex, England.

#### 4.6 **GENERAL**

Drain pipes have been measured over all bends, junctions and other fittings and the Contractor shall include in his prices for all joints, short lengths, cutting and waste. Rates for bends, junctions, etc., shall include for the extra joints, cutting and waste and any labour required.

Lines of drains shall be accurately set out and trenches excavated and bottom trimmed to accurate gradients to approval before pipe laying commences.

Generally the drainage is to be executed in suitable sections to cause the minimum interference to the continual use of any existing drains. The location and depths of any existing drains shall be ascertained before other work is commenced and the rates are to include for all costs of complying with this requirement.

Excavation for drain trenches shall be not less than 300mm wider than the external diameter of the pipes and rates shall include for grading ground under beds, carefully filling earth to avoid damaging pipes, ramming and carting away surplus excavated material, keeping excavations free from water, if necessary executing such works and installing such pumps as may be required to keep the excavations dry at all times, and any necessary planking and strutting.

No subsoil water shall be discharged into the sewers without the written permission of the Architect.

Excavations shall be made to such depths and dimensions as may be required by the Architect to obtain proper falls and firm foundations. No permanent construction shall be commenced on any bottom until the excavation has been examined and approved by the Architect. Should the Contractor in error or without the instruction of the Architect, make any excavation below the required level of the drain or bed, as the case be, he will be required to refill such excavation to the correct levels with concrete (1:4:8 – 38mm gauge).

Rates shall include for excavating in all materials met with and for trimming bottoms to the necessary falls and working space.

The first back filling of pipes trenches is to be of material free from stone and shall be watered and carefully tamped over and around the pipes in 300mm layers until they are covered to a depth of 600mm. Subsequent filling is to be in 150mm layers watered and rammed, only, materials approved by the Architect are to be used for backfilling.

Where hardcore is used for backfilling it is not to exceed 150mm gauge and all interstices shall be properly filled with small pieces and fine binder. Surplus excavated materials are to be removed from site.

If in the opinion of the Architect care has not been exercised in refilling trenches, he may order a fresh test to be on the drain. In the event of the drain failing to pass the test the contractor will be required to remedy the fault at his expense.

Concrete beds and surrounds shall be of concrete 1:3:6 – 20mm gauge to the thickness falls, and widths specified. Hollows shall be left to receive the collar of the pipe, so that the pipes sufficiently wide to form hard-holds to permit the joining of pipe, and after resting drains shall be haunched to both sides to half the diameter of the pipe in similar concrete.

Where pipes are specified to the surrounds, the concrete shall be carried up from the bed in a square section with a minimum of 150mm in thickness over the barrel of the pipe.

Rates for beds and surrounds shall include for forming recesses and filling with concrete, for mortar layer etc. and for any necessary formwork.

Each pipe shall be carefully examined on arrival, any defective pipes shall be removed immediately from the site and not used in the works. Minor damage to the protective coating of cast iron pipes shall be made good by painting with hot tar; if major defects in the coating exists such pipes shall be rejected and removed from the site.

Drains are to be laid in a straight line from point to point and each pipe is to be properly bowed in so that the invert is a true and even gradient in order to achieve a fall giving a self cleansing velocity. The Contractor shall provide suitable equipment and set up and maintain all sight rails, bowing rods, and bench marks etc. necessary for the purpose.

All drains shall be kept free from earth debris, superfluous cement and other obstructions or water during laying and until completion of the contract when they shall be handed over in a clean condition.

Pipes shall be laid with sockets leading uphill and shall rest on solid and even foundations for the full lengths for the barrel, sockets recesses shall be formed in the foundations, as short as practicable but sufficiently deep to allow the pipe jointer room to work right round the pipe. Such recesses shall be filled with cement mortar (1:4) on completion of laying.

All joints are to be accurately made by butting the pipes together, caulking with tarred rope neat cement finished externally with bold fillet neatly pointed. As each pipe is laid it is to be drawn with a badger and left free of all obstructions.

Rates of bends junctions and other fittings in drains shall include all cutting and waste and extra joints.

The testing of drains shall be done at completion and before the trenches are filled in. They shall be tested in the presence of the Architect and a representative of the Local Authority by filling with water having a head not less than 1.5m at the highest point of the section under test. A second and similar test may be applied, after the drain trenches are filled in and the work complete.

Manholes shall be construction in the position indicated on the Drawings or as required by the Architect. Such chambers shall be to the depths required to obtain even gradients in the drain and of sufficient size to contain the requisite main channel and any branches thereto and all the entire satisfaction of the Architect and Local Authority.

Rendering to manholes shall be trowelled smooth coved at all internal angles and rounded at arises.

Manholes are to be tested for water-tightness in the same way as to drain by filling with water but not exceeding 1.5m head. The Contractor shall supply all testing apparatus and materials necessary for these tests and provide all labour and assistance required. Any failure whatsoever in the drainage system to withstand the specific tests and any defects appearing are to be made good and the drains re-tested to the satisfaction of the Architect and Local Authority.

For connection to public drainage the Contractor shall make all arrangements with the Local Authority and pay all fees that may be required for connections to main sewers.

#### **4.7 TESTING AND INSPECTION**

Site Tests – Pipework System

##### **4.7.1 UNDERGROUND DRAINAGE SYSTEM**

A Site test shall be carried out on all drainage pipes before concrete haunchings or surrounds are applied. These tests shall be carried out preferably from manhole to manhole.

Short drains connected to a main drain between manholes shall be tested as one system with the main drain. In long branches a testing junction shall be inserted next to the junction with the main drain and the branch tested separately. After the test has been passed, the testing junction shall be effectively sealed.

All tests on underground drains shall be water tests. Smoke tests shall not be permitted.

In certain circumstances air tests may be permitted on cast iron drains at the discretion and to the approval of the Architect.

Water tests shall be carried out in accordance with the methods described under B.S. Code of Practice 301. Clauses 601 (b) and (c) and the test pressure shall be not less than 1.520m head at the highest point in the pipe section and not more than 10.360m head at any point in the section.

The test pressure shall be maintained for a period of one hour during which time the pipes and joints shall be inspected for sweating and leakage. Any leaks discovered during the tests shall be made good by the Sub-Contractor and the section re-tested.

In addition to pressure tests, drain pipe runs shall also be tested for straightness where applicable. This test shall be carried out in accordance with one of the two methods described in B.S. Code of Practice 301, Clause 601 (C).

Testing of manholes shall be carried out in accordance with the methods described under B.S. Code of Practice 301, Clause 601 (f).

#### **4.7.2 ABOVE GROUND SOIL WASTE AND VENTILATION PIPE SYSTEMS**

All soil, waste and ventilation pipe system forming part of the above ground installation, shall be given a smoke test to a pressure of 38mm of water gauge and this pressure shall remain constant for a period of not less than three minutes.

All soil, waste and ventilation pipe system forming part of the above ground installation, shall be given a smoke test to a pressure of 38mm of water gauge and this pressure shall remain constant for a period of not less than three minutes.

Water tests on above ground soil, waste and ventilating pipe systems shall not be permitted.

Pressure tests shall be carried out before any work which is to be concealed is finally enclosed.

Any defects revealed by the tests shall be made good by the Sub-Contractor and the test repeated to the approval of the Architect.

In all other respects, tests shall comply with the requirements of B.S. Codes of Practice 304.

#### **4.7.3 SITE TEST – PERFORMANCE**

Following satisfactory pressure tests on the pipework systems, operational tests shall be carried out in accordance with the relevant B.S. Codes of Practice on the system as a whole to establish that special valves, gauges, controls, fittings equipment and plant are functioning correctly to the satisfaction of the Architect.