

# Water Reticulation Works Specification

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## 1.0 INSPECTION OF MATERIALS

- 1.1 All pipes, specials, joints, joint rings and valves shall be in accordance to SPAN'S approval and to Syarikat Air Melaka Berhad (SAMB) approved types. Before commencement of work, the Contractor shall obtain the necessary approved and endorsement from Syarikat Air Melaka Berhad. He shall also provide every assistance to SAMB'S representative to inspect pipe laying ,pressure & leakage test strength and water tightness testing.
- 1.2 All pipes and specials supplied shall bear the following marking on the outside of the pipe or special:
  - a. Manufacturer's distinguishing mark.
  - b. Outside Diameter. (OD)
  - c. The letter designating 'SAMB' (at least 75mm high).
  - d. Length of pipes.
  - e. Class of the pipes.
  - f. Approximate weight of the pipes or specials.
  - g. Year of manufacture

## 2.0 EXCAVATION OF TRENCH

- 2.1 The excavation of trenches shall be to the lines, levels and gradients shown on the Drawings except where otherwise instructed by the Engineer. The pipe trenches shall follow accurately the center lines of the finished pipelines. Should the bottom be excavated below the specified level, it shall be brought act to level by filling with selected earth carefully rammed into place.
- 2.2 No pipe shall be laid until the trench has been inspected and approved by the S.O. on site. The trench shall be kept sufficiently dry for making joints.
- 2.3 Not more than 100meter run of trench shall be opened up ahead of the pipe laying operation.
- 2.4 The pipes shall be laid true to alignment and gradient. Except where otherwise shown on the Drawings or directed by the S.O., the crown of the pipes shall not be less than:
  - a. 900mm below the surface of the ground.
  - b. 1,200mm below the haunches of the road where the pipelines cross or are adjacent to, any roads.
- 2.5 The width of the trench shall be not less than 300mm wider than the overall diameter of the socket or collar of the pipes to be laid in the trench.
- 2.6 Should the ground be so wet that, in the Engineer's opinion, it does not form a firm base for the pipe, the trench shall be excavated 225mm below the normal depth and filled with selected earth, well rammed.

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- 2.7 The Contractor shall take reasonable precaution to keep rain and surface water out of the trenches by use of tarpaulins or temporary bonds or as directed by the Engineer. The Contractor shall provide and operate pumps for dewatering the trenches, if in the opinion of the Engineer, this proves to be necessary, but care must be taken to keep the trenches as dry as possible by preventing the access of water from above.
- 2.8 Where in the course of excavation should the Contractor expose or disturb any water mains, he shall at his own cost securely shore, strut or sling and sufficiently protect them so as to ensure that no damage shall be done to them while the work is in progress.
- 2.9 Any damage or injury to such mains shall be repaired at the expense of the Contractor.

### **3.0 EXCAVATION ACROSS EXISTING ROADS**

- 3.1 Where the pipe trench cuts the metalled surface of a road, the backfilling shall be carried out with sand well rammed. He shall replace any blocks or metalling removed while excavating the trench in the proper sequence and shall leave the backfilling level with the adjoining road surface and shall maintain its level for a period of two weeks.
- 3.2 Where pipe trench crosses a paved surface, materials forming the pavement shall be carefully removed and stacked in separate heaps. On completion of backfilling, materials shall be replaced to form a temporary surface to the satisfaction of the Engineer.
- 3.3 Excavation for thrust blocks, pipe piers, valve chamber and other ancillary works shall be taken down to the levels shown in the Drawings, or to such other levels as may be ordered by the Engineer. Excavations shall be finished to an even grade and shall be inspected and passed by the Engineer before concrete foundations are laid.

### **4.0 LAYING OF THE PIPES**

- 4.1 The pipes shall be gently lowered into the trench by means of a crane, or suitable shear legs and chain blocks, with rope slings. No pipes shall be rolled and dropped into the trench.

### **5.0 PRECAUTION AND PREVENTION WORKS**

- 5.1 To prevent the ingress of foreign matter into the pipe, the Contractor shall provide and use suitable stops for effectively closing all the open ends of the main at all times, moving and such stops forward as the laying and jointing progresses.

### 6.0 BACKFILLING OF THE PIPES

- 6.1 Backfilling of trenches shall not commence until completed pipelines are inspected and approved by the Engineer.
- 6.2 Backfilling of the pipe trenches shall follow the installation and testing of the pipes as closely as possible. Before pipe testing, only sufficient backfilling of the trenches to prevent "snaking" of the pipes and maintain the pipes in position will be permitted, but all joints shall be left exposed to provide easy inspection for leakage.
- 6.3 Care shall be taken during backfilling operations to ensure a good bed for the pipe by tamping selected materials to at least 300mm above the top of the pipe and thorough compaction of backfill.
- 6.4 The initial backfill of trench shall be sand free from stones or other hard materials and carefully spread along the trench bottom between the pipes and the walls to a depth of about 100mm and shall be hand-rammed so that the pipe is firmly bedded along the whole of its length. The second layer of the same material shall then be spread and tamped in the same manner as the first layer. Filling shall be continued thus in 100mm layers and hand-rammed until the backfilling is 300mm above the top of the pipe.
- 6.5 The materials for the remainder of the trench need not be as carefully selected as the initial filling material, but it shall be reasonably free from stone and hard materials and shall be moist. It shall be placed in 300mm layers and thoroughly compacted.
- 6.6 Approved mechanical rammers shall be used after the filling has reached a height of 750mm above the top of the pipes. Backfilling shall be finished off slightly proud of the surrounding ground to allow for subsidence and the Contractor shall make good any subsidence during the Defects Liability Period of the Contract. All timber used for the positioning and leveling of pipes shall be removed before any backfilling takes place.
- 6.7 The backfilling in foundations and around anchor blocks shall be done with approved materials deposited, compacted and watered in layers not exceeding 150mm in depth. Each layer shall be rammed solid before the next layer is added. Proper allowance shall be made for subsidence and shrinkage. The Contractor shall at his own expense make up any subsidence that may occur.
- 6.8 Before any excavation is backfilled, the Contractor or his representative and the Engineer shall make a joint inspection and compile a record of the number of pipes, specials, fittings, valves and joints that will be buried under the backfill. All such records shall be signed by both parties and shall be binding.

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- 6.9 The Contractor shall also compile and supply the required sets of record drawings (to the SAMB and the Engineer) showing variations from Contract drawings and all pertinent details of the exact positions of valves, fittings and connections and other details necessary for operation and maintenance of the piping system. These drawings shall be to the satisfaction of the Engineer and the approval of the SAMB as to the form of details.
- 6.10 Where the pipe trench is in a side-table, turf and top-soil shall be carefully stacked and both turf and top soil shall be returned to the trench after backfilling in such manner as to provide a smooth side table to the satisfaction of the Engineer.

### **7.0 GENERAL NOTES**

- 7.1 Valve pits or chambers shall be constructed in accordance with the detailed drawings. A chamber shall be installed in each valve or hydrants as directed by the Engineer.
- 7.2 When pipes are stacked, the bottom layer of pipes shall be supported clear of the ground.
- 7.3 Thrust blocks as specified shall be provided for all bends of more than 11-3/4 or as ordered by the Engineer.

### **8.0 FIRE HYDRANTS**

- 8.1 Fire hydrants shall strictly comply with B.S.750: 1977 and Fire Department approved types and approved by SAMB.
- 8.2 Pillar fire hydrants shall consist of a wedge gate valve complying with the requirements of B.S. 3161 for PN 16 valves. The wedge gate valve shall be connected to a cast iron pillar to be installed above ground by flanged cast iron specials. The cast iron pillar shall be as shown in Drawing No. PBA.H/2/91 'Standard 100 Pillar Fire Hydrant' or equivalent drawings issued by the Bomba/SAMB.
- 8.3 The wedge gate valve shall be based in a valve box of a type approved by the S.O. next to the pillar. The cover for the valve box shall be not less than 230 mmx380 mm.
- 8.4 All flanges shall be in accordance with B.S. 4504: Part I : 1969 Table 6/11.
- 8.5 The pattern of the pillar hydrant shall be submitted to the S.O. for prior approval before installation.

### **9.0 CONCRETE MARKERS**

- 9.1 The Contractor shall fix pre-cast concrete indicators posts details of which are shown on the Drawings, close to the center line of the pipes, valves, washouts, and other points as directed by the S.O.

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- 9.2 The posts shall be firmly planted into the ground to the depth shown on the Drawings and the backfilling well rammed.

### **10.0 TESTING OF PIPELINES**

- 10.1 The testing procedure for water main shall comply to be included SAMB'S requirement and to the approval of the Engineer.

### **11.0 CLEANING OF THE PIPELINES**

- 11.1 On successful completion of mains laying works and after testing, the mains shall be disinfected by the use of chloride of lime solution at 5% concentration and allowed to remain in the main for a period of twenty-four hours and scoured.
- 11.2 After the disinfection of the main has been approved by the S.O., it shall be flushed with clean water. After cleaning, the pipes and specials shall be protected from, and maintained free of all oil, grease and dirt from whatever source until it has received its external coating and concrete lining.

### **12.0 CONNECTION TO EXISTING WATER MAINS**

- 12.1 All connection works to existing pipeline shall be done by hot-tapping process unless otherwise approved by SAMB.
- 12.2 Under no circumstances shall the Contractor interfere with any pipeline or installation, which is maintained by SAMB without the written permission of the Authorities concerned.
- 12.3 Connection to the SAMB pipelines shall be carried out by the Contractor who shall provide the required pipe lengths at the connections so as to allow enough room for adjustment at the connection.
- 12.4 The Contractor shall provide assistance to SAMB representatives who may be present to inspect personnel and the Contractor shall provide the required pipe lengths at the connections so as to allow enough room for adjustment at the connection.

### **13.0 SITE MEASUREMENT**

- 13.1 All pipes shall be measured in linear meter . The total effective length shall be as measured along the crown of the pipes, excluding pipe specials, valves and fittings. Pipe specials, valves and fittings shall be measured by number.
- 13.2 Valve chambers to be provided under the Contract shall be constructed in accordance with the details shown in the Drawings.

### 14.0 CAST IRON PIPES AND SPECIALS

- 14.1 All cast iron pipes and specials shall be plain ended unless otherwise indicated or shown and shall conform with the requirements of B.S. 78 Part I: 1961 and Part 2:1965.
- 14.2 Flanges for Cast Iron Pipes and Specials where shown shall be in accordance with B.S. 4504: 1969 Table 16/11 or as directed by the S.O. All flanges shall be integrally cast to the pipes, specials and fittings.
- 14.3 Flanges jointing materials shall be as specified for steel pipes.
- 14.4 All flanges other than puddle flanges shall be machined over the full width to a tool mark finish with a pitch of between 0.8mm and 1.3mm. The serrations shall be spiral or concentric to the axis of the pipes. The faces of the flanges of bends and branches shall be at right angles to the directional axis.
- 14.5 All plain ends shall be at right angles to the axis of the ends and shall be perfectly round and of the correct external diameters.
- 14.6 Castings shall not be stopped and shall have no defects. No casting which has stopped or which contains defects will be accepted.
- 14.7 Unless stated elsewhere in the Specification cast iron pipes and specials shall be fabricated to the same outside diameters of the corresponding nominal diameter and class of other pipes.

### 15.0 DUCTILE IRON PIPES AND FITTINGS

- 15.1 All plain ended ductile iron pipes and standard ductile iron pipes with flexible joints shall be Class K9. Ductile iron pipes and fittings with cast on flanges shall be Class K12. All pipes and fittings shall conform with the requirements of B.S.4772: 1980, unless otherwise specified.
- 15.2 All pipes and fittings shall be coated externally and concrete lined internally in accordance with Appendix C.B.S.4772: 1980.
- 15.3 Flanges for ductile iron pipes and fittings shall be cast on and shall conform to the dimensions given in Table 16/11 B.S. 4504: 1969, unless otherwise specified herein or directed by the consultant.
- 15.4 Where ductile iron pipes and fittings are shown or specified as plain ended, the outside diameter of the pipe at the plain end shall be fabricated or trimmed in order that the plain ends are suitable for jointing with cast iron detachable joints to form watertight joints.
- 15.5 All plain ends shall be at right angles to the axis of the ends and shall be perfectly round and the correct outside diameters.
- 15.6 Flange jointing materials shall be as specified for steel pipes.

### **16.0 STEEL PIPES AND SPECIALS**

- 16.1 Subject to the requirements of this Specification, the manufacture and testing of steel pipes, fittings and specials shall comply with the requirements of conforming to the latest MS standards as imposed by SPAN. Pipes and specials will generally be concrete lined internally with coal tar enamel sheeting as hereunder specified. Pipes and Specials meeting any other internationally acceptable standard ensuring a quality equal to or higher than the standard mentioned above may be accepted by the consultant.
- 16.2 Flanges for flanged steel pipe work shall conform to the requirements of MS standards.

### **17.0 GRADE OF STEEL**

- 17.1 The pipes and specials shall be made from carbon steel with an ultimate tensile stress of not less than 410 N/mm<sup>2</sup> (ERW 410 or SAW 410 in B.S. 3601). Control tensile tests shall be taken on the steel, normally one test piece per 200 lengths of pipes to be manufactured.

### **18.0 PROCESS OF MANUFACTURE OF STEEL PIPES AND SPECIALS**

- 18.1 The pipes shall be made by either: -
- a. Longitudinal, butt welding internally and externally preformed carbon steel plate or strip by an automatic submerged metal-arc welding process and circumferentially butt welding these shells internally and externally by the same process into standard length pipes with a maximum of five circumferentially welds, or
  - b. Rolling a strip, sheet or plate so that a helical seam is formed around the circumference of the pipe. The helical seam shall be butt welded internally and externally by an automatic submerged arc welding process.
- 18.2 Concession will be given for pipes made with 6.5mm or less thick plates to be longitudinally welded with one deep penetration weld from the external face only but this concession will be immediately withdrawn if evidence shows that penetration was incomplete.
- 18.3 The weld metal shall have a smooth finish and shall not stand more than 1.5mm proud of the pipe shell internally or externally.

### **19.0 THICKNESS & DIAMETER OF STEEL PIPES AND SPECIALS**

- 19.1 The thickness of the steel plates and diameter of the pipes shall be as shown below, except as otherwise specified. Where the finished outside diameter of the pipes are not specified in the Appendix and/or the Bills of Quantities, then

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the steel pipes shall be fabricated to the same outside diameters of corresponding nominal diameter: -

Nominal Pipe Diameter Steel (mm)	Thickness of Plate (mm)	Thickness of Concrete Lining (mm)
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600	6.3	13.0
500	5.0	13.0
450	5.0	13.0
400	4.5	13.0
350	4.5	13.0
300	4.0	10.0
250	4.0	10.0
200	4.0	10.0
150	3.6	6.0
100	3.6	6.0

### 20.0 SPECIALS FOR STEEL PIPES, SIZED STEEL PIPES

- 20.1 Specials shall conform to the appropriate dimensions given in the Drawings.
- 20.2 Pipes shall be supplied truly circular throughout their length for cutting to provide lengths. The tolerances on the outside diameters of such pipes shall be  $\pm 1.5\text{mm}$ .

### 21.0 PIPE ENDS OF STEEL PIPES AND SPECIALS

- 21.1 For pipes of 711mm outside diameter and above the ends shall generally be suitable for forming externally and internally welded slip joints and for pipes less than 711mm outside diameter the ends shall be formed to suit an externally welded slip joint except where otherwise specified.
- 21.2 The weld metal on the external surfaces of the ends of all plain ended pipes and specials shall be machined flush with the external surfaces of the pipe shall for a sufficient distance to facilitate jointing with coupling or steel collars. At the ends of all spigot and socket ended pipes the weld metal shall be similarly machined externally on the spigot end and internally on the socket of the pipe.

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- 21.3 The concrete lining and the external coating of pipes and specials to be joined by welding shall be omitted for a sufficient distance from the ends to prevent damage to the protection during site welding. The external coating of pipes and specials to be jointed by mechanical couplings or flange adaptors shall be omitted for a sufficient distance from the ends to permit assembly of the joints but the concrete lining surfaces shall be protected with a suitable approved rust inhibitor during manufacture so that extensive cleaning of the surfaces is not required after jointing on site.

### **22.0 SLIP, JOINTS OF STEEL PIPES & SPECIALS**

- 22.1 The slip joints shall be designed to allow the pipes to be laid with an angular deflection of not less than two degree between adjacent pipes. The minimum lap shall be 75mm. The Contractor shall supply with his tender, a Drawing showing the details of the type of joint included in his tender.
- 22.2 The ends of pipes shall be machined so that fillet welds can be used for jointing. The spigot shall fit accurately into the socket so that the amount of metal required to form the weld is reduced to a minimum.
- 22.3 The socket end of the pipes shall have a suitable tapped hole provided with matching plug to permit an air pressure test of the joint to be carried out on completion of welding.

### **23.0 MECHANICAL FLEXIBLE COUPLINGS & FLANGE ADAPTORS**

- 23.1 Flexible mechanical couplings and flange adaptors shall be of mild steel and shall be Viking-Johnson couplings as manufactured by the Victualic Co. Ltd. or Dresser Couplings as manufactured by the Dresser Manufacturing Division in the U.S.A. or other similar approved type suitable for making watertight flexible connection between plain-ended pipes.
- 23.2 Flexible mechanical couplings shall be without the centre register. Unless otherwise specified, the external surfaces of couplings and adaptors shall be cleaned down to metallic finish and primed and painted with two coats of red lead oxide paint. The internal surfaces shall be similar treated and protected with two coats of non-toxic approved epoxy bituminous paint.
- 23.3 All mechanical couplings shall be capable of withstanding the maximum works test pressure specified for the pipes they are to connect.
- 23.4 All mechanical couplings and flange adaptors shall be supplied complete with all necessary coupling rings, nuts, bolts, washers and rubber rings. Wedge joint rings shall comply with B.S. 2429. Bolts and nuts shall be hexagonal and shall be in accordance with B.S. 4190.

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### **24.0 FLANGED JOINTS**

- 24.1 All flanges shall be of steel, welded to the pipe by the electric arc process or other approved method. Flanges shall be square to the longitudinal axis of the pipe and truly faced over their whole width. The bolt holes, which shall be drilled off-centre, shall be truly in line end with the longitudinal axis of the pipe.
- 24.2 Flanges shall generally be in accordance with B.S. 4504: 1969, Table 16/3.
- 24.3 Each set of flange jointing materials shall be completed with nuts, bolts, washers and joint rings. Joint rings shall be of flat section 4.5mm thick, medium rubber reinforced with two-ply flex fabric and complying with B.S. 5292, and shall extend to the inner edge of the bolt holes. Bolts and nuts shall be hexagonal and shall be in accordance with B.S. 4190.

### **25.0 COLLARS**

- 25.1 Short sleeve steel spilt collars suitable for making externally and internally welded connection between plain-ended pipes and specials shall conform to the dimensions given on the Drawings.
- 25.2 Each collar shall have two suitable tapped holes provided with matching plugs to permit air pressure tests of the joints to be carried out on completion of welding.
- 25.3 The external surfaces of collars, except where otherwise specified, shall be protected with two coats of primer compatible with the pipe coating. The internal surface shall be unlined but suitably protected with an approved rust inhibitor.

### **26.0 SPECIALS JOINTS OF STEEL PIPES AND SPECIALS**

- 26.1 Where a joint occurs between a steel pipe or special and a valve the internal diameter of the steel pipe or special shall be finished to match the bore of the valve by gradually decreasing or increasing the thickness of the concrete lining in the steel pipe or special. Any increase or decrease in thickness of the concrete lining along the length of such a pipe or special shall be gradual and smooth and the contract rates shall be deemed to include for all costs incurred in providing such a lining.

### **27.0 WORK TESTS OF STEEL PIPES AND SPECIALS**

- 27.1 The Contractor shall carry out the following tests on all pipes and specials before they are lined or coated: -
- a. Hydraulic pressure test on every pipe and special shall be 26 bars. All pipes and specials that pass this test shall be stamped with the Contractor's test stamp.

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- b. As a control on weld quality the Contractor is also required to submit radiographs of 2% of all welds for the S.O.'s approval. The minimum lengths of weld to be radiographed at any one location shall be 300mm. The clearance and acceptance of these radiographs shall be in accordance with API Standard 1104.

### **28.0 DEFECTS & METHOD OF REJECTION OF STEEL PIPES & SPECIALS**

- 28.1 Materials which show injurious defects at the place of manufacture, at site, or which proves to be defective when properly applied in service shall where permitted by the S.O. be completely repaired.
- 28.2 Injurious defects shall include cracks, leaks, laminations, lack of complete penetration, lack of complete fusion, dents exceeding one eighth of the specified wall thickness and undercutting or reduction in pipe wall thickness adjacent to a weld exceeding 0.8mm in depth.
- 28.3 Slag inclusions and gas pockets or voids shall be considered to be minor imperfections and may be accepted if the maximum size and distribution does not exceed the limits shown in Table 7.1 and 7.2 figures 7.2 and 7.3 of A.P.I. Standard 51S-1969.
- 28.4 Every pipe or special which fails to pass the Hydraulic Pressure Test shall be rejected.
- 28.5 Any pipe or special that has been rejected shall be marked in a distinctive manner which will preclude any possibility of their use for purposes of this Contract. Such pipes and specials may be submitted for re-test following the correction of any defects, where such correction is permitted.

### **29.0 INTERNAL LINING OF STEEL PIPES & SPECIALS**

- 29.1 All steel pipes and specials shall be lined internally to the thickness specified in this Specification with concrete made from ordinary Portland Cement and fine aggregate. The materials used for lining, the method of lining and curing of the finished lining shall comply with Clause 33.1 of B.S. 534: 1981 and shall be carried out to the approval of the S.O. The manufacture and testing of test cubes shall comply with Clause 33.5 to B.S. 534.

### **30.0 EXTERNAL COATING OF STEEL PIPES & SPECIALS**

- 30.1 All steel pipes and specials shall be protected against corrosion by coating and wrapping in a neat and workmanlike manner.
- 30.2 Immediately and not later than 15 minutes after each pipe or special has been cleaned to bare metal a uniform thin coat of primer compatible with the coating materials to be used shall be cold applied by final coating, spraying or brushing. The primer shall be allowed to dry properly before the coating material is applied but if more than 96 hours elapses before coating or if the primer becomes dead or powdery it shall be cleaned off and the pipe or special shall be reprimed.

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- 30.3 The coating material shall conform with the following requirements: -
- 30.4 The pipes and specials shall be coated with two layers of plasticised coal tar pitch base enamel suitable for use in tropical climate and complying with A.W.W.A. Specification C: 203 - 66. The coating to be applied shall have a total minimum thickness of 3 mm and shall be reinforced with an inner wrapping and an outer wrapping.
- 30.5 The wrapping materials shall be spirally wound onto the pipes and specials simultaneously with the coating material. Each wrap shall be from 300 - 450 mm wide and the edges shall overlap by 12 - 25 mm. Care should be taken to ensure that the inner wrap does not come in contact with the pipe metal or with the outer wrap and the minimum coating layer between wrapping and metal being 1 mm.
- 30.6 The inner wrap shall be a glass fibre resin bonded tissue reinforced in the longitudinal direction with parallel glass threads spaced 10 mm apart. The nominal thickness shall be 0.5 mm and the minimum weight shall be 46.50 gm per sq. meter.
- 30.7 The outer wrap shall be a glass fibre resin bonded tissue reinforced in the longitudinal direction with parallel glass threads spaced 10 - 25 mm apart. It shall be impregnated with material fully compatible with the coating material to give a finished thickness of 0.75 mm.
- 30.8 Coated pipes and specials shall be given one coat of water resistant white wash immediately following final inspection. The whitewash shall be mixed as specified under Section 2.5 or A.W.W.C. 203 - 57.

### **31.0 EXPOSED PIPEWORK OF STEEL PIPES & SPECIALS**

- 31.1 Steel pipes and specials required for installation above ground at stream or river over-crossings shall be concrete lined unless otherwise specified and protected externally with two coats of approved zinc chromate after cleaning as specified and one finishing coat of approved aluminium paint.
- 31.2 Flanged pipe work in chambers shall be protected. The external coating shall be taken tightly up against the back of the flange. Uncoated surfaces shall be painted with two coats of approved bituminous paint.

### **32.0 COATINGS, INSPECTION & REPAIRS OF STEEL PIPES & SPECIALS**

- 32.1 All coated pipe and specials shall be rigidly inspected for defects. Thickness shall be determined by a pit gauge, continuity with a holiday detector and coating quality by cutting out 75 mm x 75 mm samples.
- 32.2 The whole coated surface area of all pipes and specials shall be tested for pinholes or other visible defects in the coating using an approved holiday detector at a potential of 14,000 volts.

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- 32.3 Any lengths on which the coating is poorly applied shall be cleaned to bare metal and re-coated. Minor defects may be repaired by touching up. All repairs shall be checked for thickness and continuity.

### **33.0 HANDLING OF STEEL PIPES & SPECIALS**

- 33.1 Pipes and specials shall be lifted and moved only by wide non-abrasive slings or by other means acceptable to SAMB. Wire ropes, chain and hooks shall not be permitted to come in contact with external wrappings of steel pipes.

### **34.0 PROTECTION AGAINST DAMAGE IN TRANSIT**

- 34.1 The ends of all pipes and specials shall be suitably covered and protected against damage during transit with straw contained in hessian screened to the pipe ends. All flanges shall have wooden disc temporarily bolted on. Pipes and specials shall be wrapped or cushioned so that no load is taken directly on the external coating.

### **35.0 VALVES GENERALLY**

- 35.1 All valves shall be designed to avoid cavitations and vibration in all positions to minimize head loss in the open position and to seal water passage when completely shut. All operating spindles and gears shall be provided with adequate points for lubrication. Unless otherwise specified, all valves shall be closed in a clockwise direction. Lifting lugs shall be provided for valves of sizes 600 mm and above. Head loss curves through the valves for throttled flow conditions shall be provided for all valve sizes.
- 35.2 Immediately after casting and before machining, all cast iron parts of valves and hydrants shall be coated by being dipped in a bath containing a composition having a tar base and maintained at a temperature between 143°C and 166°C. The proportions of the ingredients of the composition shall be regulated so as to produce a coating having the properties hereinafter specified.
- 35.3 The castings shall be re-heated before dipping either by immersion in hot water or by heating in an oven or shall be held in the dipping bath sufficiently long to reach an equivalent temperature, the method used being at the maker's option. Care shall be taken to see that castings are perfectly dry immediately before dipping. On removal from the bath, casting shall be sufficiently drained.
- 35.4 The coating shall be such that it shall not impart taste or smell to the water and shall be smooth, glossy and tenacious, sufficiently hard so as not to flow when exposed to a temperature of 77°C and not so brittle at a temperature of 0°C as to chip off when scribed lightly with the point of a penknife.
- 35.5 All machined surfaces shall be thoroughly cleaned of the coating and before they become affected by rust shall be treated with an approved protective composition.

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- 35.6 Unless otherwise stated, all valves shall be double flanged. All valve flanges shall be in accordance with B.S. 4504: 1969 Table 16/11 unless otherwise specified by the S.O.
- 35.7 All valves shall be hydrostatically tested at the place of manufacture to the pressure specified. The Contractor shall supply a certificate stating that the valves supplied has satisfactorily pass the specified tests and complies in all respect with this Specification.
- 35.8 All valves shall be subjected to "open end" test in accordance with B.S. 5163.
- 35.9 Unless otherwise specified elsewhere in this Specification all valves shall be body tested to 20 bars or twice the working pressure stated in the Bills of Quantities. The test pressure to be applied for seat tests shall be 16 bars or the working pressure stated in the Bills of Quantities.
- 35.10 All valves and hydrants shall be marked with cast-on or stamped lettering stating the body test pressure in bars.
- 35.11 All valves and fittings shall be securely packed in crates or boxes for protection against damage during transit.

### **36.0 SLUICE VALVES**

- 36.1 Sluice calves shall conform generally to B.S. 5163 and shall be of the inside no-rising screw wedge gate type suitable for waterworks purposes.
- 36.2 All sluice valves shall be designed for a Nominal Pressure of 16 bars unless otherwise stated in the Bills of Quantities.
- 36.3 Extension spindles and valve keys of mild steel shall be provided for all valves supplied without hand wheels. The bottom end of the extension spindle shall be in the form of a socket to fit the cast iron cap and the top end squared to suit the valve key. Valve keys shall be of mild steel suitable to operate the extension spindles of the valves.

### **37.0 AIR VALVES**

- 37.1 All air valves shall be suitable for operation at a maximum working pressure of 12.5 bar and their bodies and covers when assembled shall be capable of withstanding a hydrostatic test pressure of 25 bar without any sign of leakage. All air valves shall be made insect proof by providing screens at the vents leading to the atmosphere.

#### **37.1.1 SINGLE ORIFICE AIR VALVE**

- a. Single orifice air valves shall be of the small orifice type valve suitable for automatically releasing air that may accumulate in pipelines under pressure and shall be supplied with air release nipples of bronze screwed into brass

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plugs. The float shall possess the inherent means of completely sealing the orifice where water rises in the valve.

- b. The ball which forms the valve element shall be either rubber or vulcanite, or covered with rubber or vulcanite and shall be of a diameter suitable for operating at maximum working pressure of 12.5 bar.
- c. Each air valve shall be fitted with a gunmetal isolating cock of the screw down pattern at the inlet. The inlet and outlet of each isolating cock shall be threaded with British Standard Male Pipe Threads.

### 37.1.2 DOUBLE ORIFICE AIR VALVE

- a. Double orifice air valves shall be of the combined small and large orifice valve pattern. The small orifice shall be of the type as specified above for single orifice air valve. The large orifice shall be suitable for air venting during charging or emptying of the water main. The design of the large orifice valve shall be such that there is no possibility of the ball of the large orifice being suddenly caught in the escaping turbulent air or mixture of air and water spray during the filling of the water main, thereby closing the valve prematurely. The valve shall close only when water enters the casing and raises the float onto the seat.
- b. The ball of the large orifice valve shall be vulcanite or covered with vulcanite.
- c. Each air valve shall be supplied with a horizontally positioned isolating sluice valve of the same size and a set of flange jointing materials including nuts, bolts, washers and joint gaskets for inserting between the air valve and sluice valve. It shall be provided with a 1.2 mm tapping for draining purposes and the tapping shall be closed with a brass screw plug. The inlet end shall be flanged and the flange shall be machined and drilled to B.S. 4505: 1969 Table 16/11 corresponding to the nominal diameter of the inlet bore.

### 38.0 FLOAT VALVES

- 38.1 Ball float valves shall be of the downward discharge double-beat type with direct long float travel to close the main valve. They shall be made of cast-iron with gunmetal fittings and seats. Valve faces shall be of rubber and hat cups in the stuffing boxes shall be leather. Levers shall be of mild steel with oil-lite bushes, bronze pins and gunmetal links. Ball floats shall conform to B.S. 1968 and shall be of tinned copper. The valves shall satisfactorily pass the specified test pressure. Flanges shall be machined and drilled to B.S. 4504: 1969 Table 16/11 corresponding to the nominal diameter of the inlet pipe.

### 39.0 PACKING

- 39.1 All valves and fire hydrants shall be protected from damage during transit. All valves up to and including 100 mm diameter shall be packed in strong cases battened and bound with steel strip 2.5 mm wide by 18 S.W.G. The flanges

of valves above 100 mm in diameter shall be protected by wooden discs secured in position by black service bolts or by approved steel strapping. Spindle caps by sluice valves shall be removed and where the size of the valve permits, they shall be secured to the inner side of one of the wooden discs by means of a steel strip, otherwise they shall be packed in a case. The projecting end of the spindle shall be well wrapped with straw rope covered by hessian cloth and secured in place by binding wire which shall be carried under the flange of the gland.

- 39.2 All plain ends shall be adequately protected by straw rope secured in place by binding wire or strap.
- Due to internal pressure the pipe expands during all 6 hrs test and it can loose up to a 0.8 bar/hr pressure
  - During the preliminary test it is necessary cyclically inspect all welded jointing and check the tightness of flanged joints.

### 40.0 FIELD TESTING OF PIPELINE

- 40.1 The Contractor shall provide all water required for the filling, testing and retesting of the pipelines and any pumps, pipework and pressure gauges required for the purpose. The Contractor Shall make provision for another gauge to be installed by lap alongside the Contractor's gauge.
- 40.2 Whenever a section, which shall not exceed 300 metre long in built up urban areas and in or adjacent to roads, or not exceeding 600 metres long in open ground, of any pipeline has been laid, jointed and partt or fully backfilled as specified, it shall be prepared for testing by closing the open end temporarily with stop ends. The stop ends shall be of cast iron or steel, The stop end at the lower end of the section of the main shall be fitted with a valved inlet pipe for use to fill the section of the main with water and the stop end at the higher end of the section of the main shall be fitted with a valved air release vent pipe. The pressure gauge shall have a dial of not less than 150mm diameter and shall such the maximum field test pressure of pipeline shall be at 60% to 70% of the gauge range. The gauge shall be graduated in bar. The Contractors shall arrange for the Contractor's pressure gauges to be tested by an approved independent body for use.
- 40.3 The stop end shall be braced to the approval of the consultant to withstand the end, trust which develops from the water pressure. All thrust and anchor blocks shall have been properly completed and have attained an adequate strength before the tests are carried out. Where gentle curves are effected deflection of pipes, the pipe shall be securely packed with backfield to prevent movement.
- 40.4. The section of the main to be tested shall approved be filled with water of fair quality free from sediments and from a source approved by the SAMB. The water shall beintroduced into the section of the main through the valved inlet in the stop end at the lower end of the section. During filling provision shall be

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made for air to escape from all high-spots in the section by properly installing all air valves and from the air release vent pipe in the stop end at the higher end of the section.

- 40.5. The field pressure test shall be carried out first. Each section of the pipeline shall be tested to the respective pressure as shown in the Table 4.1. Ductile Iron pipes shall be tested to the pressure given in Table 4.2. When more than one material of pipe is used on the same pipeline or pipe network, the lowest of the field pressure test values stipulated shall be used

**Table 4.1 – Test Pressures For Field Pressure And Leakage Test.**

Type Of Pipe	Class/ Series Of Pipe	Maximum Permissible Working Pressure (Bar)	Pressure For Pressure Test (Bar)	Pressure For Leakage Test (Bar)
* uPVC	PN 12	10.0	12.0	10.0
**Steel		15.0	22.5	15.0

\* Maximum permissible working pressure at 30 degrees Centigrade

\*\* Steel pipe are capable of withstanding a working pressure of more than 15 bars. If these pipes are used to their maximum working pressure i.e. half the factory hydrostatic test pressure given in table 4.1., all valves used shall than be of the appropriate rating

**Table 4.2 – Test Pressures For Field Pressure And Leakage Test.**

Type Of Pipe	Class/ Series Of Pipe	Maximum Permissible Working Pressure (Bar)	Pressure For Pressure Test (Bar)	Pressure For Leakage Test (Bar)
Ductile Iron				
* Spigot * Socket	-700	12.5	18.8	12.5
Flanged	80-300	12.5	18.8	12.5
Flanged	350-600	10.0	15.0	10.0

\* Spigot and socket cast iron pipes are capable of withstanding a working pressure of 15 bars. If these pipes are used to the maximum working pressure of 15 bars, all fittings used shall be of ductile iron.

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- 40.6. After the section of the main has been filled with water more water shall be pumped into the section to raise the pressure slowly in increments of 1 bar with a pause of one minute between each increment. Should any appreciable drop in pressure be noted during any of these pauses the test shall be stopped until the cause of the pressure drop has been investigated and rectified. An engine driven pump may be used until 90% of the test pressure has been attained, and thereafter only a hand operated pump shall be used.
- 40.7. The pressure test shall be considered to have been passed when the pressure gauge shows no reduction in pressure during the specified one minute pause and also during the period of 10 minutes after full test pressure has been attained. If these conditions are not satisfied a thorough inspection of the section of the main shall be made. All defects shall be repaired and the test shall be repeated.
- 40.8. The leakage test shall then follow. The pressure shall be reduced to the relevant leakage test pressure as shown in table 4.1 and 4.2. The pressure shall be maintained a constant as possible for a period of 24 hours. Make-up water shall be pumped into the section of the main from time to time to maintain this pressure. The leakage test shall be considered to have been passed if the make-up water pumped into the section of the main does not exceed the allowable leakage calculated as : 0.34 litre per cm of pipe diameter per km of pipe per 24 hours per 1.0 bar of water pressure. If this specified rate of leakage is exceeded a thorough inspection of the section of the main shall be made. All leaks discovered should be repaired and the section shall be tested again.
- 40.9. Every section of all pipeline shall be tested as described above in the presence of the SAMB and consultant. Testing may be carried out between sluice valve but not against the gates of the sluice valves.

### **41.0. AIR TESTING OF WELDED JOINTS**

- 41.1. Welded joints shall be air tested in the following manner in the presence of the consultant
- 4.1.2. The annular space between the two welds shall be air tested to a pressure of 2 Mpa. While the pressure is maintained for a minimum period of ten minutes, the welds shall be examined carefully for leakage. Any defective welding shall be treated as directed by consultant. The screwed plug shall be replaced and welded after each joint has been satisfactorily tested. The Contractor shall provide all necessary gauges, equipment, labour and materials for air testing of welded joints.

### **42.0. DISINFECTING AND FLUSHING PIPELINE**

- 4.2.1. The operation of valves including scour and air valves shall be checked by the Contractor and any necessary adjustments made to ensure correct operation.

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- 4.2.2. The section of pipeline to be disinfected shall first be emptied and then filled with a solution of chloride of lime containing at least 20 part per million of chloride. After the main has been filled with the chlorinated water, it shall be closed and left overnight. The main shall be deemed to have been disinfected if the samples of the water taken from the various points on the main show a chloride residual of at least 0.2 mg/l.
- 4.2.4. After the disinfection of the main has been approved by the SAMB and the consultant it shall be flushed with clean water.