

## **SECTION 8: WATER SUPPLY NETWORK**

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## **SECTION 8.01 WATER SUPPLY NETWORK: GENERAL REQUIREMENTS**

### **8.01.1 SCOPE**

**A.** The work covered in this section includes the supply of materials, installation, testing and commissioning of all pipes, fittings, valves, and appurtenances related to:

- The provision, construction and connection of water supply networks including pipes, valves, couplers and all other accessories.

**B.** The work consists of finishing all materials and the construction installation and completion in all respects as described in this Specification and as shown on the Drawings.

### **8.01.2 SPECIAL REQUIREMENTS**

**A. Manufacturer's Certificate:** Materials shall be supplied with a certificate, in respect of each delivery, stating that products comply with and have been factory tested in accordance with the specified Standards.

**B. Marking:** Unless otherwise specified in the relevant Standard, products shall have legibly cast, stamped or indelibly painted on, the following marks, as appropriate:

- The manufacturer's name, initials and identification mark.
- Nominal diameter.
- Class designation.
- Initials and number of relevant Standard.
- Length of pipe if shorter than the standard length.
- Angle of bends in degrees.
- The date of manufacture.

**C. Special Tests:** Whenever required by the Engineer, the Contractor shall supply and transport to an approved testing laboratory samples of materials selected by the Engineer. The number of samples shall not be less than 0.5% of total supplied, with at least one from each class, diameter and manufacturer. Failure of any sample shall be followed by a second and if necessary a third test from the same batch. A third test failure will result in all material from that manufacturer being rejected and replaced by material from a different manufacturer, subject to approval by the Engineer, after satisfactory testing. Laboratory test reports in an approved form shall be provided.

### **8.01.3 WORKMANSHIP: OPERATIONS**

**A.** Manufacturer's recommendations on handling, repairing, laying, jointing, anchoring, testing and other works for pipes and fittings shall be strictly followed.

## ***GENERAL REQUIREMENTS***

**B.** The Contractor shall use cranes, hoists or forklifts as directed by the Engineer. The Contractor shall use hooks, spreader beams, ropes, band or wire slings etc. as recommended by the manufacturer for each type of pipe and as approved by the Engineer.

**C.** The Contractor shall stack pipes on a level surface. Pipes shall not rest on sockets or flanges and end pipes in the bottom row shall be securely chocked. Heights of stacks shall be in accordance with the manufacturer's instructions.

**D.** The Contractor shall handle material with care to avoid damage whenever moved by hand, forklifts or hoists.

**E.** The Contractor shall provide safe storage for all material. The interior of pipes, fittings etc. shall be kept free from dirt and foreign matter. The Contractor shall provide shade for materials as required by manufacturers' instructions and recommendations and to the Engineer's approval.

**F.** Cutting: The Contractor shall use hacksaws, manually operated wheel cutter or pipe cutting machine in accordance with manufacturers' instructions. If, in the opinion of the Engineer, special precautions are required to eliminate airborne particles, the Contractor shall use methods and equipment as directed by the Engineer. The Contractor shall prepare ends according to type of joint used and follow manufacturers' recommendations. The Contractor shall take care not to damage linings. The Contractor shall repair on site minor damage if so permitted by the Engineer.

**G.** The Contractor shall repair damaged coatings, sheathings or linings in accordance with the Specification and the manufacturer's instructions. The Contractor shall use material compatible with that originally used. Repairs shall be approved by the Engineer before incorporating the materials into the works.

#### **8.01.4 SEQUENCE OF CONSTRUCTION**

The Contractor shall adhere to the sequence of construction as set out below unless a justified request for modification is approved by the Engineer at least two weeks prior to commencement of work on the affected section of the network:

- Stake out pipe alignments
- Clear and grade the right of way (wherever required)
- Carry out surveys, including trial pits if necessary, along the alignments to verify the location, depth, size and type of existing utilities.
- Prepare and submit for approval composite Shop Drawings for all utilities showing alignment, ground elevation, trench invert elevation, pipe size, class and length, station and size of fittings, valves as applicable manholes, inlets, appurtenances and structures to be demolished and reinstated (kerbstone, rails, culverts, etc.). Cross sections showing location and inverts of existing pipes and those proposed shall be prepared. Pipes, structures and other utilities to be removed or relocated shall be indicated on the Shop Drawings.

#### **GENERAL REQUIREMENTS**

- Relocate, demolish and reinstate existing services and utilities interfering with pipeline alignments.
- Remove pavement layers, excavate trenches and place bedding as required
- Lay and join pipes, fittings, appurtenances, manholes, etc.
- Place primary backfill material
- Perform hydrostatic testing
- Complete connections to existing services and curb/gutter inlets as required
- Place final backfill
- Restore or reinstate surfaces and structures as required
- Carry out final surface works road surfacing curb stone, backing walls, sidewalk paving, etc.
- Dispose of surplus materials.

#### **8.01.5 RIGHT OF WAY**

##### **A. Extent**

**A.1** All utility services shall be installed in the right-of-way of existing or proposed roads as shown in the Drawings, typical cross sections and the utility provider's requirements.

## **SECTION 8.02 PIPES AND APPURTENANCES**

### **8.02.1 SCOPE**

- A.** The work covered in this section includes furnishing and installing pipes for water as and where shown on the Drawings including jointing, connections to other pipes and backfilling.
- B.** Water supply work shall be in accordance with the requirements of Section 8.01 of the Specification.

### **8.02.2 MATERIALS**

#### **A. Ductile Iron Pipe (for Water Supply)**

**A.1** Pipes shall be manufactured to BS EN 545:2002. Unless otherwise indicated in the Bill of Quantities. Class K9 pipes shall be used for diameters up to 500 mm, Class K8 for diameters from 500 to 800 mm and Class K7 for diameters greater than 800 mm.

**A.2** Spigot and socket ended pipe joints shall be used for straight runs and adjacent to elbows or fittings. These joints shall be provided with rubber gaskets, and external thrust blocks at elbows or fittings. Anchored or self restrained joints shall be used for sections on 1000 mm pipes adjacent to elbows. Anchored joints shall be the push-in, self anchored type. Concrete thrust blocks are not required for anchored joints. The Contractor shall submit calculations verifying the number of restrained joints required noting that pipe pressure testing will be made when pipes are partially backfilled.

**A.3** Joints: flanged pipes wherever specified shall have screwed-on or cast-on flanges to sustain a minimum working pressure of NP 16 minimum.

**A.4** Flanges shall be provided in accordance with BS EN 1092-1:2002.

**A.5** Factory protection for pipes shall be as follows:

- Internally: cement lined to BS EN 545:2002 with ordinary Portland cement to BS EN 197-1:2000 to the thickness specified on the Drawings or as instructed by the Engineer.
- Externally: metallic zinc shall be applied in accordance with BS EN 545:2002 either hot applied coal tar material to BS 4164:2002 or bitumen to BS 3416:1991, minimum thickness 150 microns.

**A.6** Factory protection for fittings shall be as follows:

Coated internally and externally by dipping, or other method, using hot applied coal tar based material to BS 4164:2002 or hot applied bitumen to BS 3416:1991, Type 1, grade D, minimum thickness 250 microns.

**B. Polyethylene (PE) Pressure Pipe for Water Supply**

**B.1** Pipe and fittings shall be manufactured in accordance with DIN 8074/8075 or AWWA C906-99. Pipes shall be supplied straight with straight ends suitable for heat fusion, class 10 and 16 kg/cm<sup>2</sup>.

**B.2** Materials used shall have a minimum hydrostatic design basis of 1600 psi according to AWWA C906-99 Table 1.

**B.3** Manufacturers shall provide certification that stress regression testing has been performed on the pipe products. Materials shall also meet elevated temperature requirements as given in Table 2 AWWA C906:99.

**B.4** Fittings shall be manufactured in accordance with AWWA C906-99, extruded or injection moulded suitable for the class of pipe required.

**B.5** Joints for pipes and fittings shall be made by heat fusion and in strict accordance with the pipe manufacturer's recommendations. Joints shall have a tensile strength equal to that of the pipe. Fusion temperature, interface pressure, alignment and cooling time, shall be according to the manufacturer's recommendations.

**B.6** Where PE pipes are to be used for potable water supplies, PE compounds in pipes and fittings shall contain no toxic chemicals that can migrate into the water. PE compounds shall be tested and certified suitable for potable water by an accredited testing agency as approved by the Engineer. Tests shall be undertaken in accordance with requirements no less restrictive than those in NSF Standard No. 14 (1976), Sections 3 and 4. The seal and mark of the testing laboratory shall be included on pipes and fittings.

**C. Steel Pipe**

**C.1** Steel pipes of size 150 mm and smaller shall be black steel, seamless or welded, and shall conform to BS 1387:1985 medium class, or ISO 65:1981.

**C.2** Steel pipes of size 200 mm and larger shall be welded black steel, and shall conform to BS EN 10216:2002 or BS EN 10217. Minimum wall thickness shall be in accordance with to BS EN 10220:2002 or as given in the Bill of Quantities.

**C.3** Steel pipe shall be round and straight and free from injurious defects. Defects shall be considered injurious when the depth of defect is greater than 12.5% of the tabulated wall thickness. Pipe shall be free from rust.

**C.4** Steel pipe shall be joined by double submerged arc welding in accordance with BS EN 10311:2005. All welding shall be performed in conformance with the

rules and regulations of the American Welding Society, including surface preparation methods, welding procedures and the qualification of welders and welding operators.

**C.5** Surface preparation: Prior to coating, the surface shall be prepared by acid pickling until all scale has been removed.

**C.6** Internal lining: All steel pipes and specials shall be lined internally to the thickness specified with concrete made from ordinary Portland cement to BS EN 197-1:2000 and fine aggregate. The materials used for lining, the method of lining and curing of the finished lining and the manufacture and testing of test cubes shall comply with BS EN 10224:2002 and shall be carried out to the approval of the Engineer.

**C.7** External coating: steel pipes fittings and specials shall be protected externally with bituminous laminate tape 1.6 mm thick and with a 55% overlap or as recommended by the manufacturer.

**D. Flanged Adaptors: Ferrous**

**D.1** Ferrous flanged adaptors shall be manufactured in accordance with BS EN 545:2002 from cast iron to BS EN 1561:1997 grade 14 or mild steel plate to BS EN 10210 4SA and malleable cast iron flanges to BS EN 1562:1997 310 grade 20/10 or rolled steel to BS EN 10084 - 060A12 with bolts to BS EN 10084:1998 - EN3A and rubber rings to BS EN 681-1:1996.

**D.2** The lengths of adaptors shall be 200 mm for diameters up to 150 mm, 250 mm for diameters between 200 and 300 mm and as approved by the Engineer for diameters larger than 300 mm.

**D.3** Factory protection: Adaptors shall be coated with bitumen or coal tar to BS 3416:1991 or BS 4164:1987 respectively.

**E. Tapping Saddles: Cast Iron**

**E.1** Type: Tapping saddles shall be suitable for tapping ductile iron pipe and for a working pressure of 16kg/cm<sup>2</sup>.

**E.2** Material: Saddles shall be manufactured from malleable cast iron, ductile cast iron or gunmetal to BS EN 1562:1997 310 - B310/10, BS EN 1563: 1997 - 420/2 or BS EN 1982:1999 LG2- C respectively, with rubber 'O' ring to BS EN 681-1:1996 suitable for water supplies and manganese bronze high tensile non- corrosive bolts, nuts and washers.

**E.3** Dimensions: saddle widths shall not be less than 38 mm and diameter of discs not less than 75 mm.

**E.4** Threads for tapping shall be manufactured in accordance with BS EN 10226-1:2004



**E.5** Factory protection shall be hot bitumen dipped to BS 4164:2002 or cold bitumen coated to BS 3416:1991.

### **8.02.3 WORKMANSHIP**

Earthworks for pipelines shall be constructed in accordance with Section 2 of the Specification.

#### **A. Pipe Laying and Jointing - General**

**A.1** Pipes shall not be lowered into trenches until the pipe bed is brought to grade and approved by the Engineer.

**A.2** Pipes shall be lowered using ropes, wire slings, band slings and spreader beams as recommended by the pipe manufacturer for each type of pipe and approved by the Engineer.

**A.3** All materials shall be examined for damage. Tests shall be undertaken in accordance with the manufacturer's instructions and to the satisfaction of Engineer before installation.

**A.4** The Contractor shall ensure that all internal coatings and linings and outer coatings or sheathing are undamaged. Damaged areas shall be made good or disposed of as directed by the Engineer.

**A.5** Dirt and other materials shall be removed from pipes before lowering.

**A.6** Construction debris shall be cleared from the inside of pipes before making joints.

**A.7** Pipes shall be laid on an even formation true to grade and line, with sockets (if any) facing up the gradient.

**A.8** Holes shall be cut in the trench formation to allow for correct jointing and for barrels of pipes to bear evenly on solid ground for their full length.

**A.9** Bedding material shall be scooped out locally at sockets/couplings to enable pipes to rest uniformly on barrels and adjusted to the exact line and level. After testing, granular surround material shall be laid and compacted in 150 mm layers or as directed by the Engineer to levels shown on the Drawings.

**A.10** Rectangular blocks of concrete Class B shall be provided for pipes on concrete bed or surround. The blocks shall be made in approved moulds at least 14 days before use with hardwood folding wedges. Two concrete blocks shall be provided for each pipe, set and boned to the correct level on the formation and the pipe laid centrally and socketed. Two hardwood folding wedges shall be inserted, of widths equal to the width of the concrete blocks, between the body of the pipes and blocks and driven together until the pipes are brought to the exact level required. Blocks and wedges shall be left undisturbed while pipes are being jointed and the concrete bed and

haunch or surround are being placed. Blocks and wedges shall be of sufficient size and strength to prevent settlement of pipes. Sufficient space shall be left to enable joints to be made, tested and inspected.

**A.11** When pipe laying is not in progress, open ends of pipes shall be closed with properly fitted temporary wooden plugs or standard caps as approved by the Engineer.

**B. Jointing**

**B.1** Manufacturers' instructions shall be followed regarding placement of bedding and backfilling, cleanliness of joint surfaces, the lubricant used, the correct location of components and the provision of correct gaps between ends of spigots and backs of sockets.

**B.2** Flexible joints shall not be deflected beyond the maximum permissible angles given by the manufacturer and/or relevant Standard.

**B.3** Patent detachable and flexible joints shall strictly comply with special instructions issued by the manufacturers of proprietary joints when laying and jointing.

**B.4** Differing pipes and fitting material shall be jointed with adaptors as recommended by the pipe manufacturer.

**C. Line and Gradients**

**C.1** In open excavations sight rails and boning rods shall be provided and correctly maintained and painted to ensure the correct alignment of pipe runs. Sight rails shall be positioned either vertically above the lines of pipes or immediately adjacent thereto. At least three sight rails shall be provided for each length of pipeline under construction to any one gradient.

**C.2** In headings marks shall be provided and maintained to establish the line and level of pipelines. Marks shall be fixed in each working shaft and two further marks established in each length of heading.

**D. Floatation**

**D.1** Whenever water is excluded from the interior of pipes, sufficient backfill shall be placed above the pipes to prevent floatation.

**D.2** In the event of any pipe floating, the pipe shall be removed and relaid to the correct line and level.

**E. Pipes Built into Structures**

**E.1** Treatment of external surface: Outside surfaces of pipes to be built-into structures shall be thoroughly cleaned immediately before installation. Protective coatings to metal pipes shall be removed when specified. Clay and concrete pipes shall be roughened as directed on the drawings or instructed by the Engineer. Plastic pipes shall be painted with appropriate solvent cement and sprinkled with dry coarse sand

whilst wet. Sheathing shall be cut away from sections to be built-in and protection shall be restored up to the external faces of structures with appropriate bituminous material after installation.

**E.2** Two flexible joints or flexible patented joints shall be provided adjacent to each structure. The first joint shall be placed not more than one pipe diameter from the face of the structure and the second joint not more than the following distances away from the first:

- Pipelines not exceeding 450 mm: 2 pipe diameters
- Pipelines over 450 mm and not exceeding 1000 mm: 1.2 m
- Pipelines over 1000 mm: 1.8 m.

**F. Field Testing: General**

**F.1** All items for testing, including pressure gauges, instruments and water shall be provided on site before testing commences

**F.2** Tests shall be carried out in the presence of the Engineer.

**F.3** Fittings shall be permanently anchored before testing with all joints left exposed for checking.

**F.4** Test sections shall be limited to runs of not more than 500 metres.

**F.5** Pressure lines shall be tested between valve chambers unless agreed otherwise by the Engineer.

**F.6** No testing shall be carried out against or through the pressure reducing valves. The setting of the pressure reducing valves shall not be changed for testing purposes.

**F.7** Test plugs shall be secured at the end of the main by struts.

**F.8** Testing against a closed valve shall not be permitted unless agreed to by the Engineer.

**F.9** Pressure shall be applied by a manually operated test pump or, in the case of large diameter mains, by a power driven test pump, if approved by the Engineer.

**F.10** The Contractor shall examine exposed joints and repair all visible leaks.

**F.11** Should a test fail, the Contractor shall locate all leaks and replace or make good defective pipes or replace and make good faulty joints as necessary. The main shall then be retested.

**F.12** The Contractor shall prepare and maintain test records in a format approved by the Engineer. Original copies of the test record shall be presented to the Engineer immediately after completion of the test.

**F.13** Hydrostatic tests on pressure lines shall be carried out whilst pipelines are partially backfilled.

**F.14** Non-pressure lines not exceeding 1000 mm diameter shall be air tested before backfilling and hydrostatically tested after backfilling.

**F.15** Non-pressure lines over 1000 mm diameter shall be visually inspection tested from the inside. All joints shall be individually hydraulically tested.

**F.16** Infiltration tests shall be carried out on non-pressure lines where the crowns of pipes at the highest section under testing are more than 1.2 m below the water table.

**G. Hydrostatic Testing of Pressure Pipelines**

**G.1** For hydrostatic testing, pipes shall be slowly filled with water from the lowest point. Power-driven pumps shall not be used unless indicated on the Drawings or approved by the Engineer.

**G.2** Absorbent pipes shall be filled with water and allow to stand for at least 24 hours to allow complete absorption prior to hydrostatic testing.

**G.3** Entrapped air in the pipelines shall be bled before pressurizing.

**G.4** Pressurizing shall to continue until the specified test pressure is reached in the lowest part of the section under test. Entrapped air shall be bled while raising the pressure.

**G.5** The test pressure shall be maintained for the specified test duration with pumping stopped.

**G.6** The pipeline under test shall be repressurized to the original test pressure and the respective volumes of water pumped recorded.

**G.7** The pipeline will be deemed to have failed the test if:

- Visible leaks are detected, regardless of leakage being within specified limits,
- The volume of water lost during period when pumping was stopped exceeds allowable leakage levels.

**G.8** Test pressures shall be 1.5 times the maximum sustained pressure, minimum 13.5 kg/cm<sup>2</sup> unless otherwise specified on the Drawings or agreed by the Engineer.

**G.9** The test period shall be 2 hours.

**G.10** The allowable leakage shall be 0.1 litre/mm diameter/km length/day/30m of applied pressure.

## **H. Hydrostatic Testing of Non-Pressure Pipelines**

**H.1** The procedure for hydrostatic testing of non-pressure pipelines shall be as described for pressure pipelines.

**H.2** The test pressure shall be a 1.0 metre head of water above the pipe soffit at the highest point in the section under test and not greater than a 6 metre head of water at the lowest point. If the maximum head is exceeded then the section shall be tested in stages.

**H.3** The test period shall be 30 minutes.

**H.4** The allowable leakage shall be 0.02 litres/linear metre/metre diameter/30 minutes.

## **I. Air Testing of Pipelines**

**I.1** Testing shall be carried out in accordance with BS EN 752-4. The section under test shall be sealed at both ends with a leakproof plug.

**I.2** Pressure shall be applied by a hand pump or other method approved by the Engineer until a pressure of 3 psi (0.2 bar) head of water is indicated on a U-tube connected to the system.

**I.3** Without further pumping the pressure shall not fall to less than 1 psi (0.66 bar) after a period of 10 minutes.

**I.4** If the air test is not conclusive and no leakage can be traced by an external application of soapy water to all sealing areas, then hydrostatic testing shall be carried out.

## **J. Visual Inspection Tests**

**J.1** Visual inspection tests shall be carried out after backfilling of the section to be tested has been completed.

**J.2** The length to be visually tested at one time shall be three full-length pipes unless otherwise agreed with the Engineer.

**J.3** Rubber tyred bogies which do not damage the linings of pipes and an adequate supply of electric lamps shall be used to carry out the tests.

**L.4** Joints shall be checked by feelers to ensure rubber rings are correctly located.

**J.5** Pipes shall be checked for visible cracks.

## **K. Hydraulic Individual Joint Test for Pipes Exceeding 1000 mm**

Testing shall be carried out in accordance with BS 5886:1980 (ISO 4483:1979), Type 2 testing after backfilling. Joints shall be pressurized to 2 bars and repressurized to 2 bars after 2 minutes. After a further 5 minutes no pressure drop shall be observed or the test shall be deemed to have failed.

**L. Flushing and Disinfection of Water Mains**

**L.1** Flushing and Disinfection of Water Mains shall be carried out in accordance with AWWA C651.

**L.2** The Contractor shall provide all necessary equipment, gauges, temporary connections, chlorine and water needed for flushing and disinfection.

**L.3** Water mains shall be flushed and disinfected in sections as directed by the Engineer.

**L.4** Washout valves and fire hydrants shall be used to drain flushing and disinfecting water.

**L.5** Before commencing disinfection, mains shall be flushed until all effluent and debris has been removed and the water is clean.

**L.6** Mains shall be disinfected with chlorinated water, solutions of calcium hypochlorite or sodium hypochlorite as agreed with the Engineer.

**L.7** Initial dosing of the disinfecting agent shall be 40-50 ppm.

**L.8** The contact period shall be 24 hours.

**L.9** Residual chlorine shall be measured by orthotolidin testing. Residual chlorine shall not to be less than 5 ppm or the dosing is to be repeated as directed by the Engineer.

**L.10** After disinfection has been approved by the Engineer, the network shall be flushed with potable water until the chlorine concentration in the water leaving the main is less than 1 ppm.

**L.11** Bacteriological tests shall be carried out in accordance with AWWA C651, Section 9. The number of samples to be taken shall be one per 1 km of main feeder and one per 0.25 km of distribution line.

**L.12** Flushing and disinfection shall be carried out after cutting into existing main: in accordance with AWWA C651, Section 11.

**M. Field Protection and Coating**

**P.1** Polyethylene encasement for iron pipes shall be in accordance with ANSI/AWWA C105, Section 4.1 minimum thickness 200 microns and/or in accordance with the manufacturer's instructions.

**P.2** Metal joints to patented detachable and flexible joints and flanged connections shall be protected with mastic compound and protective tape in accordance with the manufacturer's instructions. Minimum overlap shall be 55%. All folds and irregularities shall be pressed out.

**N. Water Supply House Connections**

**N.1** Locations of tappings shall be agreed with the Engineer before starting work on construction.

**N.2** Connections shall be programmed to follow closely construction of the main network.

**N.3** Ferrule cocks shall be drilled, threaded and taped in accordance with the manufacturer's instructions.

**N.4** House connections shall be excavated, installed, laid and backfilled in the same manner as the main network.

**N.5** House connections shall be tested with the main network but testing shall exclude water meters.

**N.6** Accurate records of locations of house connections to the mains network shall be maintained by the Contractor. Record details shall include the following:

- Diameter
- Length
- Location
- Position of stop valves

**N.7** The Contractor keep records in a survey log book in a format approved by the Engineer. Survey log books shall be made available for inspection by the Engineer and handed to the Employer on completion. Survey log books shall include sketches and tables and three bound copies shall be produced for the Employer.

**8.02.4 MEASUREMENT**

**A. Earthworks**

Measurement and payment for trench excavation and backfilling shall be made in accordance with the provisions of Section 2: Earthworks.

## **B. Pipelines**

**B.1** Pressure pipes shall be paid for per linear meter measured as a straight line between the centres of consecutive coupling sections. The distance between the two centres of the couplings on both sides of any fitting or valve shall be included as pipe length. No allowance will be made for cut ends and waste. No separate payments for any in-line fitting shall be made and the costs shall be deemed to be included in the rate for pipelines.

For gravity networks, pipes shall be paid for per linear metre measured as a straight line between the inside edges of manholes plus 20 cm inside the manhole from each side. No allowance shall be made for cut ends and waste.

**B.2** Rates for pipes shall include for the following:

- 1) Staking out, field surveying and preparation of shop drawings,
- 2) Pipes, couplings and fittings,
- 3) Appropriate fittings and/or couplings for connecting to adjacent pipe or fitting including flanged fittings connecting to socket ended pipes,
- 4) Additional self restrained coupling sections adjacent to bends.
- 5) Bolts, nuts, gaskets and the like for flanged fittings,
- 6) Transportation and hauling about the Site, loading, unloading and lowering materials in the trench,
- 7) Lubricating agent used for assembling the pipe sections,
- 8) Cutting, machining, chamfering, etc. of standard length pipes,
- 9) Assembling the pipes and couplings
- 10) All work involved in connecting to new or existing fittings, valves, chambers, manholes and or structures as applicable.
- 11) Concrete thrust blocks including associated over excavation and anchors or additional self restrained coupling sections at bends. The concrete work shall include all items required for concrete work and concrete structures,
- 12) Testing in accordance with the specification,
- 13) Ancillary works and materials,
- 14) Flushing, cleaning, painting, lining and coating.
- 15) Disinfection of water supply pipes



**B.3** Rates for pipe relocation shall include for the following:

- 1) Staking out, field surveying and preparation of Shop Drawings.
- 2) Appropriate fittings and/or couplings for connecting to adjacent pipes or fittings including flanged fittings connecting to socket- ended pipes.
- 3) Additional self-restrained coupling sections adjacent to bends.
- 4) Bolts, nuts, gaskets and others for flanged fittings.
- 5) Transportation and hauling about the Site, loading, unloading and lowering materials in the trench.
- 6) Lubricating agent used for assembling the pipe sections.
- 7) Cutting, machining, chamfering, etc. of standard length pipes.
- 8) Assembling the pipes and couplings and connecting to fittings and valves, or chambers, manholes and or structures as applicable.
- 9) Concrete thrust blocks including associated over excavation and anchors or additional self restrained coupling sections at bends. The concrete work shall include all items required for Concrete Work and Concrete Structures.
- 10) Testing as per specification.
- 11) Ancillary works and materials.
- 12) Flushing, cleaning painting, lining and coating.
- 13) Disinfection of water supply pipes.
- 14) Draining, stopping and sealing ends of redundant pipes

**C. House Connections**

**C.1** Potable water house and sewer connections shall be paid per connection installed.

**C.2** Rates for house connections for water supplies shall include:

- 1) Supply and installation of all materials including pipes, accessories and fittings, extension spindle, water service unit box and cover.
- 2) Supply of stopcocks and saddles on mains (tapping collar, elbows, tees, caps, valves).
- 3) Excavation, bedding and backfilling, concrete works, thrust block, reinstatement
- 4) Installation and connection to new network and to the service box, or to the existing service connection, and testing.
- 5) Coordination with the Engineer in collaboration with water authority offices and bearing of all cost associated with their requirements and procedures for maintaining uninterrupted service.

## **SECTION 8.03 VALVES AND ACCESSORIES**

### **8.03.1 SCOPE**

The work covered in this section includes the furnishing of all materials, construction, installation and completion of valves, sluices, sprinklers, hydrants, taps and meters for water supply and drainage.

### **8.03.2 MATERIALS**

#### **8.03.2.1 Valves**

##### **A. Ductile Iron Gate Valves**

**A.1** Gate valves for pipes of size 50 mm and smaller shall be supplied in accordance with BS 5154:1991 with inside screws, solid wedges, rising stems and screwed bonnets.

**A.2** Gate valves for pipes of size 65 mm and larger shall be supplied in accordance with BS 5163:2004, with inside screws, solid wedges, resilient seated for valves 350 mm and smaller and metal seated for valves 400 mm and larger, bolted bonnets, non-rising stem types, suitable for NP 16 for water supply networks.

**A.3** Materials for component parts from basic or alternative materials shall be as listed in BS 5163:2004 and BS 5154:1991.

**A.4** End connections for pipe sizes 50 mm and smaller shall be screwed ends in accordance with BS 21:1985.

**A.5** End connections for pipe sizes 65 mm and larger shall be flanged end connection in accordance with BS EN 1092-2:1997.

**A.6** End connections shall be as shown on the Drawings and/or as described in the Bill of Quantities. Plain end connections shall be machined to suit joints specified for adjoining pipes.

**A.7** Valves larger than 400 mm diameter shall have spur gear drives operated by removable keys. Valves smaller than 400 mm shall be operated by handwheels.

**A.8** Factory protection: casting surfaces shall be given an initial coat of protective paint immediately after shot blasting and a second coat on assembly. Protective coating shall be hot applied coal tar in accordance with BS 4164:2002 or bitumen to BS 3416:1991. The minimum thickness of the applied coat shall be 250 microns.

**B. Butterfly Valves: Ductile Iron**

**B.1** Butterfly valves shall be manufactured in accordance with BS EN 593:2004 double flanged with resilient seating, for horizontal use and suitable for NP 16.

**B.2** Ductile iron butterfly valves shall be used for pipe sizes of 350 mm and larger.

**B.3** Material for component parts shall be in accordance with BS EN 593:2004 Table 3.

**B.4** End connections shall be flanged in accordance with BS EN 1092-2:1997.

**B.5** The maximum shut off pressure against which valves are operated by hand wheel shall be 15 kg/cm<sup>2</sup>.

**B.6** Factory protection: Casting surfaces are to be given an initial coat of protective paint immediately after shot blasting and a second coat on assembly. Protective coatings shall be hot applied coal tar or bitumen to BS 4164:2002 or BS 3416:1991 respectively. The minimum thickness of coatings shall be 250 microns.

**C. Check Valves**

**C.1** Check valves shall be manufactured in accordance with BS EN 12334:2001, swing, straight, for horizontal use and suitable for working pressure of 16 bars.

**C.2** Component parts shall be manufactured from ductile iron and basic materials listed in BS EN 12334:2001 Table 5, under 'copper alloy faced' column.

**C.3** Seating or facing rings shall be renewable. An arrow showing the direction of flow shall be visible from the outside and cast integral with the valve housing.

**C.4** End connections shall either be flanged to BS EN 1092-2:1997 or screw ended to BS 21:1985 to suit joints specified for adjoining pipes.

**C.5** Factory Protection: Casting surfaces shall be given an initial coat of protective paint immediately after shot blasting and a second coat on assembly. Protective coating shall be hot applied coal tar or bitumen to BS 4164:2002 or BS 3416:1991 respectively. The minimum thickness of coatings shall be 200 microns.

## **D. Air Valves**

### **D.1 Air Valves for Water**

**D.1.1** Air valves for water and irrigation mains shall have cast iron bodies and bolted covers to BS EN 1561:1997 grade 14 minimum, rubber outlet seats, plastic or ebonite balls, forged bronze screws and guides for balls acting under pressure. Valves shall be dynamic types with no possibility of balls being drawn into orifice due to high air velocities. Valves shall be factory tested to 1-1/2 times working pressure and factory coated with coal tar or bituminous coatings to BS 4164:2002 or BS 3416:1991 respectively. The minimum thickness of coatings shall be 250 microns.

**D.1.2** Single air valves, Type I (or air vacuum valve) for releasing or admitting air during filling or emptying of pipes or Type II (or air release valve) for automatically releasing, under pressure, accumulated air at summits of mains: Air valves larger than 50 mm are to be flanged to BS EN 1092-2:1997 and shall have nitrite rubber lined butterfly valves with nylon coated discs on stainless steel shafts operated by lever handles with indicator and locking thumb screws. Air valves 50 mm and smaller shall have B.S.P. threads with brass or gun metal male screwed stop valves. Valves shall be suitable for working pressures up to NP16.

**D.1.3** Double air valves (combination air valves) shall have the large orifice area equal to or greater than the valve inlet. Valves shall be fitted with nitrite rubber lined butterfly valves with nylon coated discs on stainless steel shafts operated by lever handles with indicators and locking thumb screws. Valves shall be flanged to BS EN 1092-2:1997 and suitable for working pressures up to NP16.

## **E. Ball Valves**

Ball valves 50 mm and under shall be full port, 2-piece construction, lever operated with bronze bodies and stems, chrome-plated brass balls, replaceable PTFE seats and packing, plastic coated steel handles, threaded end connections for steel piping and copper compression or solder end connections for copper piping.

## **F. Globe Valves**

**F.1** Globe valves shall be manufactured to ASTM A48 grade 30B with valve discs to ASTM A276 type 430, valve seats to ASTM A276 type 420 and stems to ASTM A276 type 403. Valves shall be suitable for a working pressure of 16 Bar.

**F.2** Globe valves shall have non-rising stems, straight pattern with flanged connections.

**F.3** Valves shall be class PN 10 and 16, cast iron with stainless steel trim.

**F.4** Manually operated valves shall have hammer type handwheels and electrically operated valves shall have motor actuators.

## **G. Underground Stop Valves**

**G.1** Underground stop valves shall be manufactured in accordance with BS 5433:1976 with crutch or square heads.

**G.2** Unless otherwise specified valve bodies, leads, glands, spindles and washer plate square heads shall be gunmetal to BS EN 1982:1999 - LG2, seating washers shall be vulcanized synthetic rubber to BS 3457:1973 Clause 6 and head sealing 'O' rings shall be in accordance with BS EN 681.

**G.3** End connections inlets and outlets of valves shall be internally threaded to BS EN ISO 228 to fit threaded specials to polyethylene pipe.

## **H. Float Valves**

**H.1** Float valves shall be globes with two operating chambers, sealed through piston discs.

**H.2** Float valves shall be the mechanically compensating, controlling the flow to tanks by modulating in direct ratio to the minimum fall in water level. Control shall be through mechanically operated, three-position, four-way valves. Moving four-way valve controls in one direction shall open valves and moving levers in other direction shall close out valves. When the lever is moved to the centre, valves shall throttle into an intermediate position.

**H.3** Valve positioning controls consists of float operated linkage mechanisms for remote mounting feeding water level changes back to main valves through low friction, flexible push-pull cables supplied by the same manufacturer.

**H.4** Valve operating controls consists of secondary linkages with the mechanism functioning off common levers connected to both the main valve position indicator rods, control valve position indicator rods and control valve operating levers. Minute changes in water level shall be transmitted through push-pull cables to three-position, four-way control valves.

**H.5** Valves shall be constructed with cast iron bodies to ASTM A 126, bronze valve trim and valve operating mechanisms to ASTM B62 and all stainless steel valve floats and pilots.

Valves shall be protected with an internal coating of epoxy to a thickness of 120 microns and external coating of epoxy and nickel plating to a thickness of 120 microns.

## **I. Flap Valves**

**I.1** Flap valves shall be flange mounted and designed for use on end closures to prevent the entrance of backwater. The seating plane shall have a 10 degree inclination.

**I.2** Flap valves shall be manufactured with cast iron bodies and covers, bronze seat faces, bronze hinge pins and spring pins, cast iron follow rings and plated steel ring draw bolts. Materials subject to de-zincification or de-aluminumization shall not be used.

**I.3** If end connections are specified or proposed as flange mounted, flanges shall be manufactured in accordance with BS EN 1092.

**I.4** Casting surfaces shall be given an initial coat of protective paint immediately after shot blasting and a second coat on assembly. Protective coatings shall be hot applied coal tar or bitumen to BS 4164:2002 or BS 3416:1999 respectively. The minimum coating thickness shall be 250 microns.

## **J. Valve Accessories and Operators**

### **J.1 Valve Accessories**

**J.1.1** Handwheels shall be manufactured in accordance with BS 5163:2004, of cast iron to BS EN 1561:1997 Grade 10. Handwheels shall be marked 'CLOSE' with an arrow to indicate a clockwise direction of closure. Diameters and other constructional details shall be to the manufacturer's standards. Handwheels shall be supplied at a rate of 1 in 5 valves.

**J.1.2** Valve caps shall be manufactured in accordance with BS 5163:2004, of cast iron or malleable iron to BS EN 1561: 1997. The valve cap set screw shall be mild steel M12.

**J.1.3** Operation keys shall be the combination prising bar and lifting key type, with a 1.5 m vertical bar and a 0.5 m horizontal bar. Keys shall be supplied at a rate of 1 for every 5 valves.

**J.1.4** Extension spindles for gate valves shall be manufactured from steel in accordance with BS 2470:1973 - M12, galvanized to BS 3382: Parts 1 & 2:1961, size 18 x 18 mm for valves up to 200 mm diameter and 24 x 24 mm for valves 250 mm to 400 mm diameter. The length for each valve size shall suit installation requirements. Spindles shall have cast iron or malleable iron caps and couplings to BS EN 1561:1997 on both sides of extension spindles (the cap for operating spindles and couplings for connecting to valves). Screws of caps and couplings shall be mild steel class M12.

**J.1.5** Protection tubes shall be either UPVC or cast iron. The shape, size and other constructional details shall be in accordance with manufacturers' standards and/or as shown on the Drawings. Tubes shall have caps circling extension spindles.

**J.1.6** Surface Boxes shall be manufactured in accordance with BS 5834-2:1983. Frames and lids shall be cast iron to BS EN 1561:1997 Grade 10. Studs, bolts, nuts and hinge pins shall be mild steel M12, chains shall be mild steel or wrought iron and lids shall have the letter 'W' cast on. Boxes shall be of the following types:

- For carriageways (wheel loads up to 11.5 tons): heavy grade type A
- For areas of light trafficking: medium grade type M
- In areas inaccessible to motorised vehicles: light grade type L

**J.1.7** Lifting key sets shall be malleable iron, supplied at the rate of 1 per 5 covers installed or fraction thereof.

**J.1.8** Guards for underground stop valves shall be manufactured from PVC. The shape, size and other constructional details shall be to the manufacturer's standards and/or as shown on the Drawings.

## **J.2 Valve Operators**

Gate, butterfly and ball valves shall be manually or electrically operated depending upon their size, torque applied on the valve stem or as shown on the Drawings:

- Valves 350 mm and smaller shall be operated manually with a maximum applied torque on handwheels of 100 Nm
- Valves 400 - 500 mm shall be operated manually with a maximum applied torque of 150 Nm
- Valves of higher torque shall have appropriate thrust bearings, slides and gearboxes to fulfil these requirements
- Gate valves 600 mm and larger and ball valves shall be electrically operated using thrust bearings, gearboxes and motor actuators
- Butterfly valves 600 mm and larger shall be either manually or electrically operated as shown on the Drawings.

## **J.3 Manual Gearboxes**

**J.3.1** Manual gearboxes shall be totally enclosed and sealed to protect moving parts from damage and corrosion. Gearboxes shall be either the spur or level type depending upon the mounting positions of valves.

**J.3.2** Components include corrosion resistant bearings, cast iron gears, cast housing covers complete with seals and gaskets and handwheel actuators. Housing covers shall have indicator windows to show the position of valves. Gearboxes shall also have stainless steel bolts.

## **J.4 Electric Valve Operators**

**J.4.1** Electric valve operators shall consist of motorized units including gear trains mounted in cast iron housings, flange mounted electric motors, control cabinets and handwheels for manual operation.

**J.4.2** Electric valve operators shall be suitable for flange mounting directly on valve bodies, for gate valves with non-rising stems and for manual operation.

**J.4.3** Electric valve operators shall have adequate horse-power and thrust ratings to open and close operated valves smoothly in all load and pressure conditions.

**J.4.4** Components shall include adjustable mechanical stop-limiting devices to prevent over-travel of the valve in either direction. Operator housings, supports and connections to valves shall have a minimum safety factor of 5 based on the ultimate strengths of the materials used.

**J.4.5** Electric valve operators shall be weatherproof, with rugged cast iron housings and handwheels having appropriate gearing for emergency manual operation with a maximum applied torque of 150 Nm. Declutch levers shall be provided to disengage drive motors during handwheel operations and prevent handwheel rotation during power operation. Handwheels shall close valves in the clockwise direction and have arrows and the word 'CLOSE' cast on.

**J.4.6** Controls shall comprise integral electric controls enclosed within weatherproof compartments, magnetic starters and reversing controllers for motors, open-stop-close push-buttons for local operation, limit switches giving remote indication when the valve is fully opened or closed, torque switches to shut down drives on excessive thrust loads, indicator lights and control voltage transformers.

**J.4.7** Electric motors shall be the totally enclosed, squirrel cage, induction types conforming to NEMA Publication No. MG1 including characteristics, tests and ratings. Motors shall carry the maximum possible loads encountered in valve operation under all normal and abnormal operating conditions without exceeding nameplate ratings and without the inclusion of service factors.

## **K.5 Valve Chambers and Markers**

**K.5.1** Unless shown otherwise on the Drawings all backflow preventers, gate valves, pressure regulators, electric solenoid valves, manual control valves, pressure gauges and water meters shall be installed in precast concrete access boxes of an adequate size for easy access. Access boxes shall be complete with precast concrete covers.

**K.5.2** Unless shown otherwise on the Drawings all access boxes shall be installed on a suitable level base of gravel to provide drainage.

**K.5.3** Valve markers showing the reference numbers of the valves shall be of materials and to the dimensions, shapes and details shown on the Drawings.



## **L. Jointing Materials**

### **L.1 General**

**L.1.1** Gaskets shall be elastomeric full face 3 mm thick joint rings to BS EN 681-1:1996 with dimensions to BS 3063:1965.

**L.1.2** Rings shall be elastomeric to BS EN 681-1:1996 with dimensions in accordance with the manufacturer's recommendations to suit the type of joint required.

**L.1.3** Bolts and nuts shall be isometric black hexagonal to BS 4190:2001 with a minimum tensile strength of 433 MN/m<sup>2</sup> and a maximum elongation of 17%. After fixing, bolt projections shall be maximum of 6 mm, minimum 3 mm.

**L.1.4** Washers shall be black steel to BS 4320:1968.

**L.1.5** Dielectric joints shall have insulating gaskets between flanges and Teflon sleeves and washers between bolts and nuts and flanges. Joints shall be suitable for the operating pressures of systems.

### **M.2 Flexible Couplings**

**M.2.1** Flexible couplings shall be the gasketed sleeve type, allowing angular deflections and axial movements of the two joined pipe ends, maintaining permanent, leak-tight joints.

**M.2.2** Flexible coupling components comprise one centre sleeve, two end followers or flanges, two rubber-compounded wedge-section gaskets and sufficient draw bolts and nuts to properly compress the gaskets. Tightening of bolts to draw the end followers together shall compress the gaskets in the recesses between the centre sleeves and followers onto the pipe ends to effect positive seals.

**M.2.3** Couplings shall have diameters specifically supplied for and properly fitting the specific types of joined pipe ends. Centre sleeves shall be of adequate thicknesses and whole couplings suitable for minimum working pressures as shown on the Drawings.

**M.2.4** Centre sleeve and followers shall be true circular sections, free from irregularities, flat spots or surface defects and formed from steel mill sections with spaces between sleeves and followers designed to provide confinement of gaskets.

**M.2.5** Bolts shall be steel having a minimum yield strength of 2800 kg/cm<sup>2</sup> and ultimate strength of 4200 kg/cm<sup>2</sup>. Bolts shall track-headed to prevent turning when nuts are tightened and threads shall be rolled with a nominal diameter larger than the shank diameter. The Manufacturer shall supply relevant information regarding recommended torques to which the bolts are to be tightened.

**M.2.6** Gaskets shall be made from a synthetic rubber-base compound with other products to produce material which will not deteriorate from age, heat or exposure to air and which is resilient and able to resist cold flow of material so that the joint will remain sealed and tight indefinitely when subjected to shock, vibration, pulsation, temperature and adjustment of connected pipes.

**M.2.7** Couplings shall be factory painted internally with a 5 mm coating of epoxy and externally with red primer to AWWA 203 Type B chlorinated rubber solution compatible with bitumen, coal tar and general paints.

**M.2.8** Couplings shall be assembled on site in accordance with the manufacturer's instructions to ensure permanently tight joints under all conditions of expansion, contraction, shifting and settlement.

### **N.3 Demountable Couplings**

**N.3.1** Demountable couplings shall be mounted next to valves to enable easy dismantling from pipework or to permit joining pipework when butterfly valves are removed for maintenance.

**N.3.2** The demountable section shall be a flanged type composed of two parts with one part sliding into the other and a free flange to compress a trapezoidal section seal to ensure watertightness. Couplings shall have locking devices as approved by the Engineer.

**N.3.3** Flanges shall be constructed of steel class PN 10, PN 16 or PN 25 depending upon the coupling location on pipework and to the Engineer's approval.

**N.3.4** Couplings shall have diameters specifically supplied for and properly fitting the types of joined ends of pipes and valves. Couplings shall permit tightening of end flanges without risk of misalignment. Seals shall be locked after end joints are tightened.

## **8.03.2.2 Pumps Generally**

### **A. Materials And Products**

**A.1** Materials for pumps shall be suitable for pump operating conditions and adequate for total heads to which pumps are subjected. Corrosion resistant materials shall be used. Assembly arrangements shall include isolation of dissimilar metals to avoid galvanic interaction.

**A.2** Pumps shall have factory plugged connections for casing vent, drain and suction and discharge pressure gauges.

**A.3** Impellers and rotating assemblies shall be statically and dynamically balanced at factory.

**A.4** Packing rings shall be installed in alternate layers staggered 90 degrees. Packing shall be tightened for seal while permitting prescribed amount of leakage for lubrication.

**A.5** Pumps shall have shaft packing or mechanical seals compatible with pump design and nature of liquid pumped in accordance with manufacturer's recommendations or as specified.

**A.6** Pump operating point of specified flow and head shall fall near the point of maximum efficiency as obtained from manufacturer's published data.

**A.7** Horsepower rating of pump drive motor shall ensure non-overloading of motor throughout capacity range of pump for impeller diameter selected.

**A.8** Electric motors shall be suitable for available electric current, voltage and frequency. Motor speeds shall not exceed 1450 rpm for 50 Hz.

## **B. Shop Drawings**

**B.1** The Contractor shall, for each pump, submit shop drawings for approval, prior to shipment from factory. The information indicated therein shall include:

- 1- Certified performance curves showing job number, customer and customer order number, pump designation number shown on the drawings, date of manufacture, model number, pump size, impeller diameter, impeller type, maximum impeller diameter pump can accommodate, rpm, noise data, flow-head characteristic curve, consumed horsepower curve and pump efficiency curve.
- 2- Pump cross-sectional drawings showing major components with parts numbers and parts list.
- 3- Pump outline dimensional drawing showing overall dimensions, location of foundation bolt holes and sizes, location and rating of suction and discharge nozzles.
- 4- Recommended list of spare parts, where not specified elsewhere.
- 5- Installation, operation and maintenance instruction manual.
- 6- Details and wiring diagrams of factory supplied pump controllers, starters, controls or other electrical device or accessory.
- 7- Special instructions for field installation and connection of factory or field supplied electrical device, control or accessory.

## **C. Shop Tests**

**C.1** The Contractor shall, for each pump, submit certified results of shop tests made by manufacturer, prior to shipment from factory. The results shall include:

- 1- Performance test throughout capacity range of pump with specified design operating point clearly indicated on pump flow-head characteristic curve.
- 2- Hydrostatic pressure test to 1-1/2 times shut-off pressure of pump.
- 3- Pump test report shall include the following information:
  - a. Pump Data: Pump designation number shown on the Drawings, model number, serial number, customer order number, flow, suction and discharge pressures, shut-off pressure, rpm and brake horsepower.
  - b. Motor Data: Make, model number, serial number, horsepower rating, rpm, voltage, phase, frequency, class of insulation, allowable temperature rise, full load amperes, locked rotor amperes and actual voltage and amperes at all test points.
  - c. Starter Data: Make, model number, size, heater sizes, ampere rating, line voltage, control voltage and frequency.

### **8.03.3 WORKMANSHIP**

#### **A. General**

**A.1** Prior to installation, the Contractor shall inspect for cleanliness of bores, seating surfaces and handling damage, cracks, missing parts and tightness of pressure-containing bolting.

**A.2** Gates and hydrants shall be set to the closed position before installation.

**A.3** Valves and hydrants shall be operated through one complete opening and closing cycle at the settings at which they are to be installed to ensure correct functioning.

#### **B. Installation**

##### **B.1 Valves**

**B.1.1** Valves shall be set and jointed to pipes in accordance with the specifications, standards and manufacturer's instructions.

**B.1.2** Valves shall be provided with class 210/25 concrete pads as shown on the Drawings so that the adjacent pipes do not support their weight.

**B.1.3** Valves without concrete pads shall be placed on firm footings to prevent settling and excessive strain on connections to pipes.

**B.1.4** Valves shall not be used to bring misaligned pipes into alignment during installation.

**B.1.5** The Contractor shall inspect all pressure-containing bolting (bonnets, seal plates and end connections) for adequate tightness after installation but prior to field testing.

##### **B.2 Field Protection**

**B.5.1** Valves shall be protected by a coat of bituminous compound, as approved by the Engineer, applied cold by brush after pressure testing on pipelines has been completed.

**B.5.2** One coat of paint shall be applied to hydrants, of a colour specified by the Engineer, after backfilling and surface restoration has been completed.

**B.5.3** Gates shall be protected with one coat of bituminous compound, as approved by the Engineer, applied cold by brush after installation.

**B.5.4** Buried bolts shall be protected against corrosion with a paint approved by the Engineer or by polyethylene wrapping.

#### **8.03.4 MEASUREMENT**

##### **A. Valves and Accessories**

**A.1** Valves and taps shall be paid for per unit installed according to the size and type indicated in the Bill of Quantities.

**A.2** Rates for gate and butterfly valves shall include for:

- 1) Supply of valves as specified,
- 2) Lowering into the trench and installing,
- 3) Over-excavation for concrete supports and boxes,
- 4) Concrete supports and thrust blocks. Concrete work shall include all items required for Concrete Work and Concrete Structures,
- 5) Appropriate fittings and/or couplings and dismantling joint for connecting to adjacent pipe or fitting,
- 6) Flanged and socket adaptors necessary for connecting to adjacent spigot ends,
- 7) Valve chambers complete with cover lock and rungs as shown on Drawings for valves placed in chambers,
- 8) Valve surface box complete with cover, lock and key and concrete surround for directly buried valves,
- 9) Bolts, nuts, gaskets, operating keys, hand wheels and others,
- 10) Ancillary works and material required,
- 11) Painting, lining and coating,
- 12) Extension spindles plus square nuts to fit spindles.

**A.3** Rates for air valves shall include for:

- 1) Supply of valves as specified,
- 2) Tees and/or saddles for connecting to the main line,
- 3) Isolating gate valves,
- 4) Drilling and fixing the flanged spool outlets for air valve connections,
- 5) Ancillary works and materials required,
- 6) Installing, painting, coating and testing,
- 7) Concrete valve chamber complete with cover and lock as shown on the Drawings.

**A.4** Rates for drain and flush valves include for:

- 1) Supply of material, items forming the complete unit, as shown on the Drawings, including pipes, flexible couplings, valves, flanged pipes, duckfoot elbows, housing and polyethylene pipes
- 2) Bolts, nuts and gaskets.
- 3) Thrust and support blocks.
- 4) Valve chambers complete with covers, locks, surface boxes and rungs.
- 5) Factory painting, lining and coating.
- 6) Ancillary works and materials.
- 7) Polyethylene pipe diameter 150 or 200 mm, 50 m long with protection and anchorage at outlet to allow free discharge to the drainage outfall.
- 8) Ductile iron pipe and flexible couplings between invert level tees and valve chambers.
- 9) Installing, painting, coating and testing.

**A.5** The quantity of mechanical items to be paid for shall be the elements to be paid for the pumps and other related works for each mechanical item installed and accepted.

**A.6** The amount of measured furnished, installed and accepted elements to be paid for at the contract unit prices of each item including all fittings, accessories as directed by the Engineer. The price shall be full compensation for furnishing all material, equipment labor, tools, fixing and incidental works necessary to complete the items.

## **SECTION 8.04      SURROUND, HAUNCHING, ENCASEMENT & THRUST BLOCKS**

### **8.04.1 SCOPE**

The work covered in this section includes in-situ concrete work and other fills necessary for the installation of water pipe installation.

Concrete work shall comply with the appropriate requirements of Section 5: Concrete, Steel and Structures.

### **8.04.2 MATERIALS**

**A.** Compressible board shall be 20 mm thick compressible fibrous board or similar material approved by the Engineer.

#### **B. Fill Material Under and Around Pipes**

**B.1** Material under and around pipe (pipe surround and backfill) shall comply with the appropriate requirements of Specification Section 2: Earthworks.

**B.2** Concrete bedding shall be in situ concrete Class 110/25.

**B.3** Concrete encasement, thrust blocks, arches and haunches shall comprise in-situ concrete Class 250/20.

### **8.04.3 WORKMANSHIP**

#### **A. Placing Concrete**

**A.1** After the laying of pipes in the trench, concrete shall be placed and compacted under the pipes to provide a solid and uniform surround.

**A.2** After pipe jointing has been completed the outstanding concrete or haunching shall be placed and compacted on both sides simultaneously.

**A.3** Vertical construction joints shall be formed in the concrete at the faces of pipe joints using compressible board and finished to the profile of the concrete and pipes. Gaps between spigots and sockets shall be filled with resilient material approved by the Engineer.



**B. Placing Material Other Than Concrete**

**B.1** Surround material shall be placed in the bottom of prepared trenches and hand tamped to the minimum thicknesses specified on the Drawings or instructed by the Engineer.

**B.2** When the pipe has been laid, additional material or haunching shall be placed in successive layers not exceeding 150 mm thick simultaneously on both sides. All spaces between pipes and the sides of trenches shall be filled and carefully hand tamped without disturbing the pipes.

**C. Thrust Blocks**

Thrust blocks shall be provided at bends and other fittings on pressure pipelines. The additional excavation required shall be undertaken after the pipeline has been jointed. No pressure shall be applied to the thrust block until the concrete has matured for at least 3 days.

**8.04.4 MEASUREMENT**

Concrete encasement for pipelines shall be measured by the cubic metre of concrete calculated on the basis of dimensions indicated on the Drawings after deducting the pipe section.

All other material and work items mentioned above, including compressible boards, surround, backfill and haunching material and thrust blocks shall not be paid for separately but shall be included in their respective pay items as indicated elsewhere in the specification.

## **SECTION 8.05      CHAMBERS**

### **8.05.1 SCOPE**

The work covered in this Section includes the furnishing of all materials, construction, installation, connection and completion of manholes, valve chambers for water supply system.

### **8.05.2 GENERAL**

- A.** Excavation and backfilling shall comply with the appropriate requirements of Section 2: Earthworks.
- B.** Concrete work shall comply with the appropriate requirements of Section 5 Concrete, Steel and Structures.
- C.** The method of reinforcing shall conform to the requirements of Section 5.03: Steel Reinforcement.

### **8.05.3 MATERIALS**

- A.** Concrete shall conform to the requirements as specified in Section 5.01: Concrete Mixes and Testing.
- B.** Reinforcement shall conform to the requirements as specified in Section 5.03 Steel Reinforcement.
- C.** Pipes shall conform to the requirements of Section 8.02: Pipes and Appurtenances
- D.** Precast concrete manhole sections shall be manufactured in accordance with BS EN 1917:2002 using reinforced concrete Class 250/20. Cement shall be ordinary Portland cement, to BS EN 197-1: 2000.
- E.** Cast in situ units shall be constructed in plain and reinforced concrete class 250/25 and 250/20 respectively. Cement shall be ordinary Portland cement to BS EN 197-1: 2000.
- F.** Bricks shall be manufactured in accordance with BS 3921:1985 and BS EN 772:1998.
- G.** Precast concrete blocks for masonry walls shall conform to BS EN 771-3: 2003 and BS EN 772-2:1998.
- H.** Grey cast iron castings shall conform to AASI-ITO M105 (ASTM A48) Class 25 or higher. Castings shall be manufactured to the sizes and dimensions shown on the Drawings.

**I.** Test bars shall be prepared and tested as specified in AASHTO M105.

**J.** Steel castings: mild to medium strength castings shall conform to AASHTO M103 (ASTM A27). Unless otherwise shown on the Drawings or instructed by the Engineer, castings shall be grade 65-35 fully annealed. Steel castings shall conform to the dimensions shown on the Drawings. Test bars shall be prepared and tested as specified in AASHTO M 103.

**K.** Wrought iron plates and shapes shall conform to the dimensions shown on the Drawings. Rolled wrought iron bars and shapes shall conform to the requirements of ASTM A207. Wrought iron plates shall conform to ASTM A42.

**L.** Covers and frames shall be manufactured from ductile iron in accordance with BS EN 124:1994, non-rock, locking and solid tops. The wording on covers shall indicate the nature of the network (water supply, sewage, stormwater, etc). Grades of covers shall be as follows:

- For roadways: Grade A, heavy duty test load 40 tons
- For sidewalks, carriage drives and cycle tracks: Grade B medium duty test load 25 tons
- For footpaths and fields: Grade C light duty, test load 7 tons

**M.** Step Irons shall be manufactured in accordance with BS EN 13101: 2002.

**N.** Steel Ladders shall be manufactured in accordance with BS 4211:2005, mild steel, galvanized to BS EN ISO 1461:1999 with 200 grams of zinc per square metre.

**O.** Safety Chains shall be 12 mm diameter wrought iron short link chains, galvanized in accordance with BS EN ISO 1461 with 200 grams of zinc per square metre.

**P.** Guardrails shall be either of the following:

- Tubular mild steel, medium grade to BS EN 10255:2004 with screwed joints, galvanized to BS EN ISO 1461:1999 with 200 grams of zinc per square metre.
- Round steel solid bars to BS 6722:1986 with welded joints galvanised in accordance with BS EN ISO 1461:1999 with 200 grams of zinc per square metre.

**Q.** Fixing bolts shall be manufactured from steel and of a type suitable for the particular purpose and to the approval of the Engineer. When used to fix galvanized material, washers shall be galvanized and fixing bolts and nuts cut to pre-plating limits and electroplated with zinc to BS EN ISO 1461:1999.

**R. Coatings**

Internal surfaces of precast concrete manholes and chambers shall be treated with a coal tar or bitumen epoxy coating if so detailed on the Drawings.

External surfaces of precast concrete manholes and chambers shall be protected with waterproofing bitumen supplied and applied in accordance with the requirements of Section 5.15 of Section 5: Concrete, Steel and Structures.

#### **8.05.4 CONSTRUCTION**

##### **A. Valve Chambers**

**A.1** Valve chambers shall be constructed using in-situ or precast concrete or blockwork as shown on the Drawings.

**A.2** External faces of valve chambers shall be protected by two layers of brush-applied bituminous paint with a minimum thickness of 400 microns and in accordance with Section 5: Concrete Steel and Structures or as detailed on the Drawings or as specified by the Engineer.

**A.3** Covers shall be embedded in mortar and seated firmly using fixing bolts. Covers shall be positioned centrally over openings and be level and square with surrounding finishes.

#### **8.05.5 MEASUREMENT**

**A.** Valve chambers shall be measured by the number of each type constructed, completed as shown on Drawings and accepted including protective painting, furnishing and installation of all materials, frames, grates, covers and steps.

**B.** No separate measurement or payment shall be made for any excavation, shoring, sheeting or backfilling or for breaking into existing pipes, channels or culverts in order to install new chamber; all such work being considered subsidiary to the relevant pay items.

**C.** No separate payment shall be made for blinding, protective and bituminous painting, equipment, forms, tools, furnishing and placing materials, labour or any other item necessary for the proper completion of the work.