

05 CHAPTER

SPECIFICATIONS – PIPELINES, PIPEWORK AND FITTINGS

Applicable codes

The following codes and standards unless specified herein shall be referred to.

Materials

IS	:	210	Specification for grey iron casting
IS	:	290	Specification for coal tar black paint
IS	:	456	Code of practice for plain and reinforced concrete
IS	:	458	Specification for pre cast concrete pipes (with and without reinforcement)
IS	:	516	Method of test for strength of concrete
IS	:	638	Specification for sheet rubber jointing and rubber insertion jointing
IS	:	783	Code of practice for laying of concrete pipes
IS	:	816	Code of practice for use of metal arc welding for general construction in mild steel
IS	:	1367	Technical supply conditions for threaded steel fasteners
IS	:	1387	General requirements for the supply of metallurgical materials
IS	:	1500	Method for Brinell hardness test for metallic materials
IS	:	1536	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS	:	1537	Specification for vertically cast iron pressure pipes for water, gas and sewage
IS	:	1538	Specification for cast iron fittings for pressure pipes for water, gas and sewage
IS	:	1916	Specification for steel cylinder pipes with concrete lining and coating
IS	:	2078	Method for tensile testing of grey cast iron
IS	:	3589	Specification for MS Spirally Welded Pipes
IS	:	3597	Method of tests for concrete pipes
IS	:	3658	Code of practice for liquid penetrant flow detection
IS	:	5382	Specification for rubber sealing rings for gas mains, water mains and sewers
IS	:	5504	Specification for spiral welded pipes
IS	:	6587	Specification for spun hemp yarn
IS	:	7322	Specification for specials for steel cylinder reinforced concrete pipes
IS	:	8329	Specification for DI pipes
IS	:	9523	Specifications for DI fittings
IS	:	4984	Specifications for HDPE pipeline
IS	:	14846	Specifications for valves

Code of Practice

IS	:	783	Code of practice for laying of concrete pipes
IS	:	3114	Code of practice for laying of cast iron pipes
IS	:	3764	Excavation work - Code of Safety
IS	:	4127	Code of practice for laying of glazed stoneware pipes
IS	:	5822	Code of practice for laying of electrically welded steel pipes for water supply
IS	:	6530	Code of practice for laying of asbestos cement pressure pipes.

Pipe Work

The pipe works for the plant involves manufacturing, supplying, laying and jointing of suitable size cast iron, ductile iron pipes along with matching special etc as required. All piping inside the plant shall be cast iron/ductile iron except for chemical house and chlorine piping. The specifications for manufacturing, supplying, laying and jointing of pipes shall generally conform to the standard specification.

All pipe work and fitting shall be of class rating in excess of the maximum pressure attained in service including any surge pressure.

The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipments. CI dismantling joints which can take radial and axial misalignment of minimum 1 percent of valve nominal size with tie bolts shall be provided. All pipe work shall be adequately supported with purpose-made fittings. When passing through walls, pipe work shall incorporate a puddle flange. Flange adapters and unions shall be fitted in pipe work runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment.

The Contractor shall be responsible for ensuring that the internal surface of all pipe work is thoroughly clean before and during erection and before commissioning. Cleaning shall include removal of all dirt, rust, scale and welding slag due to site welding. Before dispatch from the manufacturers' works, the ends of the pipe, branch pipe etc., shall be suitably be removed until immediately prior to connecting adjacent pipes, valves or pumps. All small bore pipes shall be blown through with compressed air before connection is made to instrumental and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Engineer-in-charge.

Materials for Pipelines

Each pipeline shall be constructed in a material compatible with the fluid conveyed through that pipeline i.e. the materials used in the pipes which are or can be in contact with the untreated sewage, suitable additive for mortar protection shall be provided.

Pipework and valve materials for the following duties shall be as follows or equivalent to the approval of the Employer's Representative:

CAST IRON PIPING

Supplying lowering, laying to line, level and slope, centrifugally cast iron (spun) pressure pipes (LA Class strictly conforming to IS: 1536 (1989) with latest amendment) and jointing with specials such as Tees, Bends, Reducers including and other safety provision, cutting the pipes and making joints and hydraulic testing after laying etc. complete.

The CI pipes shall be LA Class conforming to IS: 1536 (1989) with latest amendments bearing ISI Mark.

The pipes shall be free from the defects resulting from raw materials, loading, handling, carting and unloading. The pipes shall be free from load, dents or bulges greater than 3mm in depth and extending over a length in any directions greater than twice the thickness of barrel.

Each lot of pipes supplied by the contractor must be accompanied by the test certificates as specified in IS: 1536 (1989) with latest amendments. The contractors shall have to make arrangement for inspection/testing of the pipes at manufacturers' factory at contractor's own risk and cost.

Each pipe shall have cast, stamped or indelibly painted on it the following marks.

- a) Manufacturer's name or identification mark.
- b) The nominal diameter.

- c) Class reference.
- d) The last two digits of the year of the manufacture.
- e) IS Certification mark / Manufacturing Standard. For CI socket & Spigot pipes IS Certification mark is must.

The materials shall be carted to the site by the contractor very carefully. The handling, while carting the pipes, specials, valves etc. shall be done carefully.

In case of heavy pipes, specials etc. lowering shall be done with the help of the chain pulley block.

Caulking

After a section of convenient length has been leaded, caulking shall be commenced. The lead shall be free from the leading pipe, outside of the socket of the other pipe with flat chisel, and then caulked round 3 separate times with the proper caulking tools of increasing thickness and hammer 4 to 5 lbs. in weight in such manner as to make the joints sound and water tight.

Joints under water shall be made with lead wool inserted in strings not less than 6 mm thick and very thoroughly caulked.

New Flanged Joints

Flanged joints should be made by painting the facing of the flanges with red lead freely and belting up evenly on all sides.

A thin fiber, of lead wool may be very useful in making the joints water tight, where facing of the pipes is not true.

Where packing must be used, it should be of rubber insert cloth three ply and of approved thickness. The packing should be of the full diameter of the flange with proper pipe hole and bolt holes cut and even at both inner and outer edges.

Where the flange is not fully faced, the packing may be of the dimension of the facing strip only. Its proper placing should be tested before another pipe is jointed on.

Testing

After each section of the pipe line has been completed, it shall be tested for water tightness before being covered in. This can be done by closing each end by means of a reliable gauge. When the pipe is laid on any appreciable gradient, the test should be carried out at the lower end of the section. Any leaking joints should be made good, and the above test reapplied until no further leaks are apparent.

Tyton Joints

After the pipes are examined for line and levels, the CI pipes shall be jointed with rubber gaskets (tyton joints) as follows.

The socket and spigot end shall be cleaned with kerosene oil, then grease has to be applied to the spigot and socket ends, duly after inspection of rubber gasket. Then the rubber gasket shall be jacked and fixed in perfect condition such that the gasket will fall in groove correctly and the joint become water tight.

Tyton/Lead jointing shall be carried out after the CI pipes and specials are properly laid and approved by the Engineer-in-charge.

The lead shall be more than 99%. It shall be soft bluish grey pig lead free from admixtures of tin or other impurities. The lead shall confirm to the IS: 3114 (1965).

The spun yarn shall be clean hemp and soaked in hot tar or bitumen, cooled and dried before use.

The outside of the spigot and the inside of the socket shall be thoroughly cleaned with a brush. The spigot shall be carefully centered in the socket by spun yarn twisted into ropes of uniform thickness. The rope shall be well caulked in to the back of the socket to leave a sufficient depth for lead as directed by Engineer-in-charge. The lead shall be used as specified in Table-1 of IS: 3114 (1965).

The proper depth of each joints shall be as specified and tested before running the lead by passing completely around it a wooden gauge notched out to the correct depth of lead.

The leading of joints shall be done by means of ropes covered with clay or a by using special leading rings. The lead shall be melted rendering it thoroughly fluid and each joints shall be filled in one pouring.

After a section of convenient length has been leading pipe outside of the socket of the other pipe, with a flat chisel and then caulked round three separate time with the proper caulking tools of increasing thickness and hammer 2 to 3 kg weight in such a manner as to make the joints sound shall be left flush neat and even with the socket.

The item includes all materials tools, tackles etc. required to carry out the work including fire wood etc.

After each section of the pipe line has been completed it shall be tested for water tightness. The ends shall be suitably closed with a valve, cap or plug or a blank flange. The pipe line shall then be filled with water, pressure shall then be supplied with a hand force pump up to 7 kg./sq.cm. (Above 100 lbs./sq. inch.) Or 15% above. If the pipe is laid on an appreciable gradient, the test shall be carried out at the upper end of the section.

Any leaking joints shall be made good and the test repeated until a perfectly leak proof pipe line obtained.

Consumption of lead for jointing of pipe lines:

The purity of lead must be more than 99% and the contractor shall have to furnish the test certificate and get approval from Engineer-in-charge. The consumption of lead and the depth of jointing shall be as per table listed below:

Sr. No.	Dia. of pipe line for joint in mm	Consumption of lead in kg.	Depth of lead joint in cm
1	80	1.86	5.00
2	150	3.62	6.00
3	200	5.00	6.00
4	250	6.12	7.75
5	300	7.70	8.00
6	350	10.45	8.12
7	400	11.20	8.25
8	450	14.30	8.40
9	500	16.25	8.50
10	600	19.00	9.15
11	700	21.00	10.00
12	800	31.50	10.50
13	900	41.00	10.50

Hydraulic Test

It shall be incumbent upon the contractor to give a successful hydraulic test of each and every pipe line before filling of the trench. The test shall be carried out in the approved manner by an approved testing machine and pressure gauge to be supplied by the contractor. All the arrangements for such a test should be made by the contractor at his cost including filling the pipe with water etc. and giving a successful hydraulic test.

Testing of the pipe line in the field shall be carried out after the completion of whole length or in parts as directed by Engineer-in-charge. The trenches shall be partially refilled except at the joint before starting the test. In each case, the contractor has to plug the both ends of the section of pipeline to be tested either by providing caps or by sluice valves as per direction of Engineer. No extra payment will be made for providing, fixing and removing caps used for testing purpose. If necessary, both the ends shall be properly anchored by providing 1:3:6 c.c. blocks of required dimensions. Contractors shall provide required number of plug points with ferrules of required diameters to serve as injection points, air relief points etc. No payment shall be made for this work. On the completion of the test these points shall be closed by plugs by the contractors without any extra cost.

Testing will be carried out by the contractors under the guidance of Engineer-in-charge. Contractors shall arrange for required machinery, equipments and technical staff for testing the pipe line. Contractors shall also arrange for labourers, other materials and tools required to attend the leakage etc. during the test.

The pipe line shall be subjected for following tests.

Leakage Test

The test shall be conducted after satisfactory completion of the pressure test.

There shall not be any leakage in the pipe or at the joint. A seepage allowance of a 2.5 litres per kilometer per hour per centimeter diameter of the pipe shall be permissible and that quantity will not be considered as leakage.

If the retest is delayed for more than 48 hours after any test has proved unsuccessful the Engineer-in-charge, after giving 24 hours notice, shall have every right to get all defects rectified and carry out other necessary works and take hydraulic test/leakage test to the contractor. Any damage done to the pipes, materials, the other labour cost, etc. incurred there under shall be recoverable from the contractor either from his bill or deposit.

The responsibility of the contractor as specified above in case of unsuccessful hydraulic test shall not cease to exist by his pleading that any materials used by him in the pipe line was having cracked or was otherwise defective, as if he has a reason to believe so, he must refuse to accept such materials right at the stores.

If the first test is not found satisfactory, repeated tests will be taken and procedure mentioned above should be followed for testing till a satisfactory test is given. All testing shall be done at the risk of the contractors and they have to attend be done at the risk of the contractors and they have to attend all defects including repairing bursts, leaks at joints, sluice valve ends, caps etc. removing and replacing cracked pipes etc. These unserviceable articles shall be the property of the contractors and they shall arrange to remove the same from the site as directed by the Engineer.

Any portion of the pipe line that does not stand the specified pressure, shall be rectified by the contractor, who should make his own arrangement for the water required for the testing.

When the section of the pipe line is tested successfully the contractor shall remove the blank flanges, pump out water from the pipes and back fill the portion as per directions of the Engineer.

CI Double Flanged Pipes/Piping within pump house shall be tested for 150% of maximum system pressure.

The items include all materials and labour required to carry out the work as detailed above.

CAST IRON FITTING AND SPECIAL:

Supplying at site of work CI fittings/specials confirming to IS: 1538 (1993) with latest amendments.

The contractor shall have to procure required cast iron specials such as Tees, Bends of required degrees, reducers, collars, caps, plugs and tail pieces etc. necessary for completion of this item as per site conditions.

The CI fittings and specials shall conform to IS: 1538 (1993) with latest amendments.

The fitting shall be stripped with all the precautions necessary to avoid warping or shrinking defects. The fitting shall be free from defects other than any unavoidable surface imperfection which results from the method of manufacture and which do not affect the use of the fittings.

The fittings shall be such that they could be cut, drill or machine.

The mass of CI fittings/specials shall strictly conform to IS: 1538 (1993) with latest amendments.

The contractor shall have to procure the required CI fittings or specials as per the site conditions and as per direction of Engineer-in-charge.

DUCTILE IRON PIPES and FITTINGS:

Pipes and Fittings

(a) General

Ductile iron pressure pipes (up to Class K9) shall comply with IS: 8329. For flanged pipe flanged end shall be welded on flanged pipe and pipe shall be min. K9 class.

Ductile iron pressure fittings (up to Class K12) shall comply with IS: 9523. For flanged fittings flanged end shall be welded on flanged fitting.

All fittings shall be socketed unless specified except for incoming and outgoing below unit shall be flanged.

(b) Materials

The materials used in the manufacture pipes shall comply as per IS:8329 and for fittings shall comply as per IS: 9523.

(c) Tests

Tests on pipes shall be carried out in accordance with IS:8329 and on fittings shall be carried out in accordance with IS: 9523.

Testing of Pipe

The main test among others to be conducted shall be as per IS: 8329 (2000) or with its latest revision/amendments.

(A) Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes as specified in the Standards. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS: 11606 (1986). The test results so obtained for all the pipes and fittings of different sizes shall be submitted to Engineer. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS: 8329/EN 545 for pipes and IS: 9523/EN 545 for fittings.

(B) Brinell Hardness Test

For checking the Brinell hardness the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS:1500. The test shall comply with the requirements specified in IS: 1500/ISO 6506.

(C) Re-tests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in the standard for a period of minimum 15 seconds during which the pipes shall be struck moderately with a 700gms hammer for conformation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

Quality Assurance

The manufacturer shall have a laid down Quality Assurance Plan for the manufacture of the products offered which shall be submitted along with the tenders.

The Employer's representative shall be permitted free access to the place of manufacture for the purpose of examining and witnessing the testing of pipes and fittings.

Joints

(a) Spigot and Socket Joints

These shall have sockets which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS:12820 suitable for carrying raw sewage with high septicity.

EPDM Rubber Gasket

Rubber Gasket shall be suitable for Push-on-Joint on lines carrying septic sewage.

The spigot ends shall be suitably chamfered or rounded off to facilitate smooth entry of pipe in the socket fitted with the rubber gasket. Rubber Gasket shall conform to IS: 5382 and ISO 4633-1996 or its latest revision or amendments if any. Rubber ring bundles from every lot shall carry with them manufacturers test certificate for the following mechanical properties

- ☐ Hardness
- ☐ Tensile strength
- ☐ Compression set
- ☐ Accelerated aging test
- ☐ Water absorption test

- ☐ Stress relaxation test

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint, the size of the pipe with which they are to be used, the manufacturer's name and trade mark, etc. such other required details.

(b) Flanged Joints

The flanges shall comply with dimensions and drilling details in IS: 8329 for applicable class. All flanged joints between steel and ductile iron pipe work shall be electrically isolated joints.

These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts.

Linings

Ductile iron pipes and fittings shall have a cement mortar lining, in accordance with IS: 11906 or ISO 4179.

Pipe linings shall be inspected on site and any damage or defective areas made good to the satisfaction of the Employer's representative. The Contractor may use specialist mortars, mortar additives or curing agents only with the approval of the Employer's representative.

Certain sections are amplified as follow:

For sewage & industrial effluent application Sulphate Resistant Cement shall be used as specified below for internal lining requirement and no other additive shall be used without the written approval of the Employer's representative, and shall be used strictly in accordance with the manufacturer's recommendations.

The minimum thickness of the lining at one point shall not be less than 4mm.

Internal Lining

Internally pipe shall be Cement mortar lined as per IS: 8329 / IS: 11906. Ductile iron pipes and fittings shall normally have a portland cement mortar lining. However, for Sewage and Industrial effluent lining shall be Sulphate Resisting Cement Mortar Lining.

Cement mortar lining shall be applied at the pipe manufacturing shop in conformity with the aforesaid standards.

Pipe lining shall be inspected on site and any damage or defective areas shall be made good to the satisfaction of the Engineer. Lining shall be uniform in thickness all along the pipe. The minimum thickness of factory applied cement mortar lining shall be as per IS: 8329 Annexure-B or ISO 4179. This is given below.

Nominal Pipe Size (mm)	Nominal lining thickness (mm)
Up to 300	3
350-600	5
700-1200	6
1400-2000	9

Coating

Pipe shall be delivered internally and externally coated.

External Coating

Pipe shall be metallic zinc coated and after that it shall be given a finishing layer of bituminous paint as per IS: 8329 (2000). Zinc coating shall comply with IS: 8329/EN 545/ ISO 8179. Only molten zinc spray coating shall be acceptable. The average mass of sprayed metal shall not be less than 130 g/sq. m with a local minimum of 110 g/sq. m.

Bitumen overcoat shall be of normal thickness of 70 microns unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II suitable for tropical climates factory applied preferably through an automatic process.

Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

(a) General

Ductile iron pipes and fittings shall be zinc coated with a bitumen over coating, all in accordance with the following Specifications. Buried pipes and fittings shall also have a site or factory applied polythene sleeving. Pipe coatings shall be inspected on site and any damage or defective areas made good to the satisfaction of the Employer's representative.

(b) Zinc Coating

Zinc coating shall comply with ISO 8179 and shall be applied as a spray coating. The mass of sprayed metal shall not be less than 130 g/m² as described in Clause 5.2 of ISO 8179.

(c) Bitumen Coating

Bitumen coating shall be of normal thickness 0.07mm unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions.

Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

(d) Polythene Sleeving

Where polythene sleeving is specified to be applied in addition to bitumen coating it shall comply with ISO 8180. Site applied sleeving shall be stored under cover, out of direct sunlight, and its exposure to sunlight shall be kept to a minimum. Pipes having a factory applied sleeving must be stored in the same conditions.

CEMENT CONCRETE PIPES

Design

Design of Cement Concrete pipes including reinforcement details and the ends of pipes shall be in accordance with the relevant clauses of IS: 458 (2003).

Manufacturing

(a) General

The method of manufacture shall be such that the form and the dimensions of the finished pipes are accurate within the limits specified in relevant clause of IS: 458.

The surfaces and edges of the pipes shall be well defined and true, and their ends shall be square with the longitudinal axis. The ends of the pipes shall be further reinforced by an extra ring of reinforcement to avoid breakage during transportation.

The RCC pipes and rubber rings shall be systematically checked for any manufacturing defects by experienced supervisors so as to maintain a high standard of quality.

The Employer's representative shall at all reasonable times have free access to the place where the pipes and collars/rubber rings are manufactured for the purpose of examining and testing the pipes and collars/rubber rings and of witnessing the test and manufacturing.

All tests specified either in this Employer's requirements or in the relevant Indian Standards shall be performed by the supplier/contractor at his own cost and in presence of the Employer's representative if desired. For this, sufficient notice before testing of the pipes and fittings shall be given to the Employer's representative.

If the test is found unsatisfactory, the Employer's representative may reject any or all pipes of that lot. The decision of the Employer's representative in this matter shall be final and binding on Contractor and not subject to any arbitration or appeal.

(b) Materials

(i) Cement

Cement used for the manufacture of RCC pipes and collars shall conform to relevant IS codes. The use of pozzolana as an admixture to Portland cement shall not be permitted.

(ii) Aggregates

Aggregates used for the manufacture of RCC pipes and collars shall conform to IS: 383. The maximum size of aggregate should not exceed one third the thickness of the pipe or 20mm, whichever is smaller.

(iii) Mixing and Curing Water

Water shall be clean, color less and free from objectionable quantities of organic matter, alkali, acid, salts, or other impurities that might reduce the strength, durability or other desirable qualities of concrete and mortar.

(iv) Reinforcement

Reinforcement used for the manufacture of the RCC pipes and collars shall be mild steel Grade I or medium tensile steel bars conforming to IS: 432 (Part-1) or hard-drawn steel wire conforming to IS: 432 (Part-2). Reinforcement cages for pipes and collars shall be as per relevant requirement of IS: 458.

(v) Concrete

Concrete used for the manufacture of RCC pipes and collars shall conform to IS: 456. The minimum cement content and minimum compressive strength of concrete shall be as per relevant requirements of IS: 458. Compressive strength tests shall be conducted on 15cm cubes in accordance with the relevant requirements of IS: 456 and IS: 516.

(c) Dimensions

The internal diameter, wall thickness and length of barrel and collar of pipes, reinforcement (longitudinal and spiral), type of ends and minimum clear cover to reinforcement and strength test requirements shall be as per the relevant clauses/tables of IS: 458 for different classes of pipes. The

tolerances regarding overall length, internal diameter of pipes or sockets and barrel wall thickness shall be as per relevant clause of IS: 458.

(d) Workmanship and Finish

Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench no opening between ends in contact shall exceed 3mm in pipes up to 600mm diameter (inclusive), and 6 mm in pipes larger than 600mm diameter.

The outside and inside surfaces of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation unless otherwise agreed to between the Employer's Representative and the manufacturer or supplier.

The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding.

The pipes shall be free from local dents or bulges greater than 3mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

The deviation from straight in any pipe throughout its effective length, tested by means of rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters 3mm for every meter run.

(e) Testing

All pipes for testing purposes shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under the criteria of tolerances as mentioned in IS: 458.

During manufacture, tests on concrete shall be carried out as per IS: 456. The manufacturer shall supply, when required to do so by the Employer's representative the results of compressive tests of concrete cubes and split tensile tests of concrete cylinders made from the concrete used for the pipes. The manufacturer shall supply cylinders or cubes for test purposes required by the Employer's representative and such cylinders or cubes shall withstand the tests prescribed as per IS: 458. Every pressure pipe shall be tested by the manufacturer for the hydrostatic test pressure. For non-pressure pipes, 2 percent of the pipes shall be tested for hydrostatic test pressure.

The specimen of pipes for the following tests shall be selected in accordance with relevant clause of IS: 458 and tests in accordance with the methods described in IS: 3597.

- i) Hydrostatic test
- ii) Three edge bearing test
- iii) Absorption test

(f) Sampling and Inspection

In any consignment, all the pipes of same class and size and manufactured under similar conditions of production shall be grouped together to constitute a lot. The conformity of a lot to the requirements of this Employer's requirements shall be ascertained on the basis of tests on pipes selected from it.

The number of pipes to be selected from the lot for testing shall be in accordance with Table 15 of IS: 458.

Pipes shall be selected at random. In order to ensure randomness, all the pipes in the lot may be arranged in a serial order and starting from any pipe, every r the pipe be selected till the requisite number is obtained, r being the integral part of N/n where N is the lot size and n is the sample size.

All pipes selected shall be inspected for dimensional requirements, finish and deviation from straight. A pipe failing to satisfy one or more of these requirements shall be considered as defective.

The number of pipes to be tested shall be in accordance with column 4 of Table 15 of IS: 458. These pipes shall be selected from pipes that have satisfied the requirements mentioned in the above clause.

A lot shall be considered as conforming to the requirements of IS: 458 if the following conditions are satisfied.

The number of defective pipes shall not be more than the permissible number given in column 3 of Table 15 of IS: 458.

All the pipes tested for various tests shall satisfy corresponding requirements of the tests.

In case the number of pipes not satisfying requirements of any one or more tests, one or two further samples of same size shall be selected and tested for the test or tests in which the failure has occurred. All these pipes shall satisfy the corresponding requirements of the test.

(g) Marking

The following information shall be clearly marked on each pipe.

- a) Internal diameter of pipe
- b) Class of pipe
- c) Date of manufacture and
- d) Name of manufacturer or his registered trade-mark or both.

Jointing

(h) General

Jointing of RCC pipes shall be done as per the following Employer's requirements and as per the relevant IS. After jointing, extraneous material, if any, shall be removed from the inside of the pipe and the newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS: 5382.

(i) Spigot and Socket joint (Rigid)

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar which shall be rammed with caulking tool. This joint is used for low pressure pipe line.

(j) Collar Joint (Rigid)

After laying the RCC pipes at proper alignment and gradient their abutting faces shall be coated with hot bitumen in liquid condition by means of a brush. The wedge-shaped groove in the end of the pipe shall then be filled with a tarred gasket in one length for each joint. The collar shall then be slipped over the end of the pipe and the next pipe butted well against the tarred gasket by suitable appliances approved by the Employer's representative so as to thoroughly compress the tarred gasket into the grooves, care being taken that the concentricity of the pipes and levels are not disturbed during this operation. The collar shall then be placed symmetrically over the end of the two pipes and the space between the inside of the collar and the outside of the pipe filled with a mixture of cement and sand, tempered with just sufficient water to have a consistency of the semi-dry conditions, well packed and thoroughly rammed with caulking tools. The joints shall be finished off with a fillet sloping at 45° to the side of the pipe. The finished joints shall be protected and cured thoroughly as directed by the

Employer's representative. Any plastic solution or cement mortar that may have been squeezed into the inside of the pipe shall be removed so as to leave the inside of the pipe perfectly clean.

(k) Flush Joint (Internal)

This joint shall be generally used for culvert pipes of 900mm diameter and over.

The ends of the pipes are specially shaped to form a self centering joint with an internal jointing space 13mm wide. The finished joint is flush with both inside and outside with the pipe wall. The jointing space is filled with cement mortar mixed sufficiently dry to remain in position when forced with a trowel or rammer.

(l) Flush Joint (External)

This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with cement mortar sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

(m) Spigot and Socket (Semi-flexible)

This joint is composed of specially shaped spigot and socket ends on the RCC pipes.

A rubber ring shall be lubricated and then placed on the spigot which is forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls in to the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar shall then be filled into the remaining annular space with a caulking tool.

(n) Collar Joint (Semi-Flexible)

This joint is made up of a loose collar which covers two specially shaped pipe ends.

Each end shall be fitted with a rubber ring which when compressed between the spigot and collar, seals the joint. Stiff mixture of cement mortar shall then be filled into the remaining annular space and rammed with a caulking tool.

(o) Spigot and Socket Joint (Flexible)

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The RCC pipes shall be of spigot and socket type and rubber rings shall be used, and the manufacturer's instructions shall be deemed to form a part of these Employer's Requirements. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

Cleaning of Pipes

As soon as a stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by the Employer's representative, Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by the Employer's representative to prevent entry of mud or silt etc.

If as a result of the removal of any obstructions the Employer's representative considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately.

Should such test prove unsatisfactory, contractor shall amend the work and carry out such further tests as are required by the Employer's representative.

It shall also be ascertained by contractor that each stretch from manhole to manhole or the stretch as directed by Employer's representative is absolutely clear and without any obstruction by means of visual examination of the interior of the pipe line suitably enlightened by projected sunlight or otherwise.

Testing at Work Site

After laying and jointing of RCC pipes is completed the pipe line shall be tested at work site as per the following Employer's requirements and as directed by the Employer's representative. All equipment for testing at work site shall be supplied and erected by contractor. Water for testing of pipes shall be arranged by him. Damage during testing shall be contractor's responsibility and shall be rectified by him to full satisfaction of the Employer's representative. Water used for the test shall be removed from pipes and not released to the excavated trenches.

After the joints have thoroughly set and have been checked by the Employer's representative and before back filling the trenches, the entire section of the sewer or storm water drain shall be proved by the contractor to be water tight by filling in pipes with water to the level of 1.50m above the top of the highest pipe in the stretch and heading the water up for a period of one hour. The apparatus used for the purpose of testing shall be approved by the Employer's representative. Contractor if required by the Employer's representative shall dewater the excavated pit and keep it dry during the period of testing. The loss of water over a period of 30 minutes should be measured by adding water from a measuring vessel at regular 10 minutes intervals and noting the quantity required to maintain the original water level. For the approval of this test the average quantity added should not exceed 1 liter/hour/100 linear meters/10mm of nominal internal diameter. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good.

In case of pressure pipeline, the completed stretch of pipeline shall be tested for site test pressure. The site test pressure should not be less than the maximum operating pressure plus the calculated surge pressure, but in no case should it exceed the hydrostatic test pressure as specified in IS: 458.

Support of Pipe work and Accessories

All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to support the pipe work and its associated equipment in an approved manner. Valve, meters, strainers, and other devices mounted in the pipe work shall be supported independently of the pipes to which they connect.

All brackets or other forms of supports, which can conveniently be so designed, shall be rigidly built up of steel by riveting or welding in preference to the use of castings.

No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Employer's representative.

After the collars and boxes or other fitting have been fixed in position, the floors, walls and roof structure will be made good by the Contractor.

Storage and Shipment

Protection of Pipes and Fittings for Shipment

Except where otherwise specified all items shall have received their complete protective coatings before dispatch from the manufacturers' works and shall be additionally protected by approved means for the period of transit, storage and erection, against corrosion and accidental damage.

For the protection of pipe linings and in particular for protecting cement mortar linings from drying out, protective metal or timber discs shall be fitted over the ends of pipes and fittings. Similar timber protective discs shall be attached to all flanges of pipes and fittings, by means of bolts specifically provided for the purpose and which shall be discarded when the item is incorporated in the Works. The sleeves and flanges of flexible joints shall be wired together in suitable bundles.

Storage of Pipeline Materials

Pipes and fittings shall be stored raised off the ground, and shall be carefully supported, cushioned and wedged. Pipes shall not rest directly on one another and shall not be stacked more than four pipes high or two pipes high in the case of pipes of 500mm diameter or over. Special care shall be taken to ensure that flexible pipes are cradled and supported in a manner that prevents any distortion of the pipes.

Couplings and joints (and all components thereof) and other similar items shall be stored in dry conditions, raised from the ground in sheds or covered areas.

Storage areas shall be carefully set out to facilitate unloading, and checking of materials with different consignments stacked or stored separately with identification marks clearly visible.

Where items to be stored have a limited shelf life or require special storage arrangements, the method of storage shall be to the approval of the Employer's representative and in accordance with the manufacturers' instructions.

All pipes and fittings supplied as spares shall have end covers which are proof against the entry of sand and vermin. Mortar lined pipes and fittings shall have end covers which form a complete seal, provision being made to accommodate the effects of temperature changes. Pipes and fittings supplied as spares shall have a temporary white external finish and shall be stored sheltered from the direct rays of the sun.

End covers and protection shall not be removed until incorporation of the pipes and fittings into the Works.

Transportation of Pipes and Fittings

Any vehicle on which pipes are transported shall have a body of such length that the pipes do not overhang. Large pipes shall be placed on cradles and the loads properly secured during transit. The pipes shall be handled in accordance with the manufacturers' recommendations.

Approved slings shall be used and all hooks and dogs and other metal devices shall be well padded. Hooks engaged on the inner wall surface at pipe ends shall not be used. Steadying ropes shall be employed. The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes are kept at a minimum.

Pipe handling equipment shall be maintained in good repair and any equipment which in the opinion of the Employer's representative may cause damage to the pipes shall be discarded.

Under no circumstances shall pipes be dropped, be allowed to strike one other, be rolled freely or dragged along the ground.

Inspection of Pipes and Fittings

Before incorporating into the Works each pipe shall be brushed out and carefully examined for soundness. Damaged pipes which in the opinion of the Employer's representative cannot be satisfactorily repaired, shall be rejected and removed from Site. Damage to pipe coatings or linings shall be repaired to the satisfaction of the Employer's representative.

Built-in Pipe Work and other Plant

The pipes and other Plant in water retaining structures shall, wherever possible, be built in as the work on the structure proceeds. The Contractor shall ensure that delivery of the requisite pipe work and other Plant is in accordance with the requirements of the programme.

Where a pipe subject to thrust passes through a concrete structure or where an external seal is required, a puddle flange shall be used. The puddle flange dimensions shall be to BS 4504 but shall be undrilled. The exterior of the pipe shall be cement washed symmetrically about the puddle flange by the manufacturer for a length at least equivalent to the thickness of the wall through which it passes.

The Contractor shall be responsible through every stage of the works for checking the correctness of the setting of built-in Plant and shall satisfy himself they are positioned in accordance with his approved drawings.

Unplasticised PVC Pipes and Fittings

Unplasticised polyvinyl chloride (UPVC) pipes, fittings and specials shall be to BS 3505 / IS:4985:2000 Class-5 and minimum Schedule 40 for potable water and BS 4346: Part-1 for fittings. The pipes shall be of the spigot and socket type PVC pipes, fittings and specials are to be connected to cast iron, DI, stainless steel or steel pipes by suitable type flange adaptors or stepped couplings shall be used.

Rubber Hosing

Rubber hosing shall conform to BS 5119, Type 2. It shall be capable of handling a working pressure of 12 bars.

HDPE Pipes

The item shall be covering manufacturing, supplying, and delivery of HDPE pipes having pressure rating PN 10 and material grade PE-80/PE-100 bearing IS: 4984 (1995) and its latest version or amendments. The HDPE pipes shall be supply in standard length or as per owner's requirements.

Standard

The HDPE pipes is to be procured, supplied under the scope of this item and which shall be meet the requirement of pressure rating of PN 6 /PN 10 and material grade PE-80/PE-100 in accordance and confirming to IS: 4984 (1995) or its latest version or amendments with IS certification mark.

Temperature Variation

All the pipes to be supplied and delivered shall be subject to weather condition like sun, dust, rain and wind as available in the state of Gujarat. They shall also be subject to carry and convey drinking water under available temperature condition ranging from 4 °C to 40 °C.

Marking

The method of marking to all the pipes to be used under the scope of contract shall ensure that all the information as mentioned in clause 10 of IS: 4984 (1995) and/or its latest amendments. The marking will remain legible even after transportation, storage in open space etc. In general the legible and indelible marking upon the pipes shall indicate the following:

- a) Manufacturer's name or trade mark.
- b) Type / Grade of material.
- c) Class of pipes / pressure rating.
- d) Nominal diameter.

e) Manufacturing Standard .

Any other important matter that the manufacturer or purchaser deems fit to be inscribed.

Push fit joints shall be used for joining of pipes. These fittings shall carry the necessary international approvals for leak proof jointing.

100 % virgin material only shall be used and no rework/recycled material is to be used for the production of pipes.

Inspection of Joints

The visual inspection of each joint should be done to ensure correct bead formation. Weld joint should be checked for axial alignment of welded pipes.

UPVC PIPES

uPVC pipes made of unplasticized polyvinyl chloride shall be confirming to IS:15328 with socket(s) suitable for elastomeric sealing ring type joints for conveyance of water under pressure. The pipes are intended to be used for buried water mains with ambient atmospheric temperature reaching up to 45 °C and soil surface temperature rising more than 65 °C. The stipulations given in this document for uPVC pipe which are not covered by any other code/standard, shall be governed by the provisions of IS: 4985. The pipes will be supplied with plain ends or one end plain with chamfer and other end socket suitable for elastomeric sealing ring type joints in accordance with IS: 4985 as per requirement.

Material

The material from which the pipes are made shall consist substantially of unplasticized polyvinyl chloride conforming to IS: 10151, to which may be added only those additives that are absolutely needed to facilitate the manufacture of the polymer, and the production of sound, durable pipes of good surface, finish, mechanical strength and opacity. The pressure rating of pipes shall be of class-3 and class-4 in accordance with IS: 4985 with a maximum continuous working pressure at 27 °C of 6 and 10 kg/cm².

Dimensions of Pipes and Sockets

The dimensions and tolerances of pipes shall comply with IS: 4985. The tolerance on outside diameter and wall thickness of pipe shall be as per Table given in IS: 4985. The dimensions of the socket for elastomeric sealing ring type joint shall be in accordance with IS: 4985. The pipe shall be supplied in straight lengths of 6m with tolerance of + 20mm and - 0mm. The effective length of socket pipe shall be considered as shown in IS: 4985.

Physical and Chemical Properties

The pipe shall confirm to the clause 10 of IS: 4985 (2000) for its physical and chemical properties except for the density and ash content provisions which shall be as per the stipulations made above. The colour of the pipes shall be dark grey. Influence on water intended for human consumption shall be governed by IS: 12235. All plastic and non-plastic material for components of the uPVC piping system e. g. Elastomeric sealing ring, lubricants, when in permanent or in temporary contact with water which is intended for human consumption, shall not adversely affect the quality of the drinking water.

Mechanical Properties

The pipes and integral sealing ring will confirm to internal hydrostatic pressure in accordance with Clause 11.1 and sampling as per annexure D of IS: 4985.

Inspection

The pipes shall be offered for factory inspection and performance testing as per relevant standard if required by Purchaser/Client/Client's Consultant.

MS PIPES, SPECIALS/FITTINGS and FLANGES

MS Pipes

Fabricate, test, paint and supply of MS pipes of specified ID/OD and wall thickness conforming to IS: 3589 (2001) /IS: 1239 (1990). The pipes up to 150mm shall confirm to IS: 1239 with latest amendments of required class. The pipes of 200mm and above shall confirm to IS: 3589 Fe410 with latest amendments.

Tolerances on Outside Diameter of Pipes shall confirm as per IS:3589:2001.

Ovality shall not exceed 1 percent of the specified outside diameter for pipes having diameter to thickness ratio not exceeding 100 as per IS:3589:2001

Quality of Steel

Pipes shall be fabricated from steel plates conforming to IS: 2062 E250 BR and IS: 10748 Gr 3.

Thickness of Pipes

The pipe shall have minimum specified wall thickness as mentioned in IS:3589:2001 or as per Table-5 below, whichever higher.

TABLE - 5

MINIMUM SPECIFIED THICKNESS OF PIPES

Nominal Size (mm)	Minimum Specified Thickness of pipe in mm Up to 150NB Heavy IS: 1239 Part 1 and From 168.8mm OD IS: 3589 of FE 410 Grade
Up to 300	: 4
above 300 to 500	: 5
above 500 to 600	: 6
above 600 to 850	: 7
above 850 to 950	: 10
above 1000 to 1500	: 12

Hydraulic Pressure Test

Each pipe shall be hydrostatically tested at the manufacturers' works before the pipe is coated, wrapped or lined at the manufacturer's work as per applicable standard.

The Hydraulic test pressure shall be the pressure calculated from the following formula, except that the maximum test pressure shall not exceed 5 Mpa.

$$P = \frac{2 \times S \times t}{D}$$

P = Test pressure

S = A stress in MPa which shall be taken as 40% of the specified minimum Tensile strength.

t = Specified thickness in mm and

D = Specified outside diameter in mm.

Test pressure shall be applied and maintained for sufficiently long time for proof and inspection.

Carbon Steel/MS pipe after installation at site with respective joints, piping shall be tested for joint tightness at 150 % of Maximum working/system pressure it is likely to subject to.

MS SPECIALS

Scope shall include providing, fabricating, testing and supplying/installing MS Specials suitable to MS pipes, valves and other fittings from steel plates. MS specials shall be conforming to IS: 7322/IS: 1538 dimensionally. MS specials and fittings shall be fabricated at site of work tested to specified test pressure and including providing flanges required, painting inside zinc epoxy coating and outside anti corrosive red oxide primer, coated with three coats of anti-corrosive water proof paint including freight, loading, unloading, carting, stacking as directed, and including all taxes, insurance etc. The sizes and types of specials shall be as per requirements taking into consideration in tender items like pumps, sluice valves, non-return valves, scour valves, expansion joints, dismantling joints etc.

Flanges

All MS flanges conforming to IS: 6392, PN 1.0 and their dimensions of drilling be in accordance with IS: 1538/IS: 6392 suitable for pressure 10 kg/cm² (specification for MS fittings for pressure pipes for water, gas and sewage) or its latest revision. The flanges shall be flat faced with off center bolt holes. Prior to manufacturing process, the contractor shall have to obtain approval of Engineer in charge for all sizes and types of flange drawings.

Galvanising

Hot dip zinc coated Mild Steel Tubes/Pipes and fittings shall be as per IS: 4736 (1986).

Inspection

The material shall be offered for factory inspection and performance testing as per relevant standards if required by Purchaser/Client/Client's Consultant.

MS SPIRALLY WELDED PIPES

Manufacturing, supplying, lowering and laying in position sleeve/swaged ended, outer coated, spirally weld MS pipes conforming to IS: 3589 (2001) including all type of necessary coping, welding, outer coating treatment with corrosion chloride resistant treatment of "corrocretive te" or 4mm thick pipe coat, inner lining, safeguarding, lightening, barricading, fencing, field welding and hydraulic test as per the detailed item specifications and as per the directives of the Engineer-in-charge.

Material

I. Spirally submerged arc welded pipes shall be manufactured from steel produced by the open hearth or electric or one of the basic oxygen process.

II. Steel to be used in manufacture of spiral welded pipe shall be conforming to IS: 2062 (1992) and its latest amendments. Steel should be of Grade B, designated as Fe 410 in IS: 2062 (1992).

III. Sampling of pipes shall be as per IS: 4711 (1994).

Manufacture

The pipes shall be manufactured from steel strips by spirally submerged arc welding as per IS: 4353. The weld must be automatic and continuous. All the edges of the plates/ strips should be prepared suitable prior to the welding of pipes. Welding joints and its manufacturing process shall conform to IS: 3589 (2001). Weld consumable for SAW shall be as per IS: 814, IS: 3613, IS: 6419 and IS: 7280.

Length

The Client intends speedy as well as easy laying work of pipes procured through this tender. Accordingly, spiral welding pipes of all sizes shall be supplied in single random length from 5.50 meter to 6.50 meter. Pipes in such lengths shall be 90% of the total quantity. Remaining 10% (Maximum) pipes of the ordered quantity may have a length 10% shorter/longer in running meters to the length specified above.

Wall Thickness

Wall thickness shall be as per IS: 3589 (2001) without negative tolerance.

Finished pipes shall not deviate from straightness by more than 0.1% of the total length. Straightness shall be checked out by using a taut string or wire from end to end, along the side of the pipe to measure, the greatest deviation.

Hydraulic Pressure Test

Each and every pipe shall be hydraulically tested at manufacturers' works' at test pressure. Testing shall be carried out as specified in IS: 3589 (2001).

Mechanical Tests

I. Tensile Test

Tensile test shall be carried out as mentioned in IS: 1894 (1972) as well as IS: 3589 (2001). The tensile strength and percentage elongation of the pipes shall strictly conform to the provisions of IS: 3589 (2001). The Manufacturer shall submit the required test certificates at free of cost both for pipes as well as steel strips.

II. Guided Bend Test

Guided Bend Test shall be carried out as per the provisions of IS: 3589 (2001) and necessary test at free of cost for ERW pipes. Flattening test shall be as per IS: 1239/IS: 3589.

Other Tests

Radiographic testing or Ultrasonic testing in factory (15% of welded length of each pipe) as per IS: 3589 (2001). Radiography as per IS: 2595 ASME Section V Article 2 and 22. Ultrasonic test as per IS: 7343 ASME Section V Article IV.

Chemical Composition

As mentioned earlier the steel used for manufacturing shall strictly conform to IS: 2062 (1992) having grade designation Fe 410 WA. Chemical composition should be conforming to IS: 2062 (1992) and various constituents viz. Carbon, Manganese, Sulphur, Phosphorus, Silicon, Copper etc. shall be within prescribed permissible limits. The manufacturer shall submit the required test certificates at free of cost, both for pipes as well as steel strips.

Pipe Ends

I. All pipes shall have one end swelled and one end plain suitable for field welding. Both the edges of each pipe must be truly vertical. The swelled end shall be formed strictly as per the dimensions mentioned in IS: 3589 (2001).

II. The sleeve/swelled end of the pipes shall be formed in such a way that the plain end of the pipe shall be inserted inside freely/easily.

Mass

The mass of steel shall be 7.85 g/cm³.

Workmanship

I. All pipes shall be clearly finished and when visually inspected shall be free from defects such as cracks, surface flaws, lamination etc. The ends of pipes shall be cleanly cut as mentioned in 7.0 and truly vertical with the axis of the pipe.

II. The copy of the ISI License for manufacture of pipes for the particular unit from where the pipes will be manufactured shall also be submitted.

III. Client intends to utilize pipes with two coats of Red Oxide as anti-corrosive primer. The pipes shall be supplied Oxide to avoid corrosion during monsoon period. The anti-corrosive primer shall be applied to the inside and outer side of the pipes.

Marking

Each pipe shall be legibly marked at free of cost with the following details.

- (a) Manufacturer's name or trade mark.
- (b) Outside diameter in mm.
- (c) Wall thickness in mm.
- (d) ISI mark.
- (e) Purchaser's Name
- (f) Last two digits of the year of Manufacture.

Field Welding

The welding and joint of the pipes in the field shall comply with IS: 816 (1965) and its latest amendments/IS: 9595.

The weld shall be run in three runs of welding. The welding and testing of the weld shall also be done as per the procedure laid down in IS: 823 (1964) and its latest amendments. Experienced welders whose performance shall be tested from time to time, shall only be permitted to carry out the welding work. No apprentices or helpers shall be allowed to do any welding work, No apprentices or helpers shall be allowed to do any welding whatsoever. If any un authorised person is found to do welding work, he shall be removed from the work and the work carried out by him will have to be redone after gauging out the same. The following points shall be borne in mind by the contractors.

Electrodes

The contractors shall use standard AWS E7018 electrodes its number (i.e. type) depending on the thickness of plate and the type of joint. They shall also use standard current and voltage required for the machine in use. Electrodes be of ESAB India, ADVANI and D & H make only.

Electrodes to be used in welding work shall conform to IS: 814 and 815 and welding shall conform to IS: 816, 822 and 823. The electrodes must be of make "ESAB-INDIA", "Advani", "D&H" only.

Testing of Welded Joints

(i) General

The weld joints shall be tested in accordance with IS specifications IS: 823 (1964) and IS: 3600 (1973) or to its latest amendments.

The test pieces shall be taken out from the pipes pointed out by the Engineer without any delay. They shall be immediately delivered at the Engineer's Office for being numbered, machined and tested.

The shape of the test pieces removed from the pipes shall be such that It will give a specimen of the required dimension and at the same time leave a hole in the pipe with round corners. This hole shall be closed up by patch plating from the outside so as to have over lap of 3" on all sides of the opening. Great care shall be taken in preparing required MS plates for this, which is included in the item. After the jointing is completed all protruding portions shall be chipped off and the portion of the pipeline near the field joint shall be thoroughly scrapped and cleaned to receive the guinite.

(ii) Details Of Tests

The following test shall be carried out.

Tensile Test

The test specimen taken perpendicularly across the weld shall be shaped in accordance with the IS: 1663 (1962). The specimen shall be taken from the end of the pipe or at any joint in the pipe as directed by the Engineer and shall be cut with the weld approximately in the middle of the specimen. The tension test specimen shall be machined. The protruding welding portions from both inside and outside shall be removed by machining or grinding before the specimen is tested.

At least one field joint out of every 100 shall be subjected to test by taking out a specimen. If a test specimen shows defective machining or taking out a specimen. If a test specimen shows defective machining or develops flaws not associated with welding, it may be discarded and another specimen substituted.

The weld joint shall show a strength not less than the minimum tensile strength specified for the plate.

Bend Test

The bend test specimen shall be prepared in the same way as for tensile test and tested in the presence of the Engineer. The specimen shall be taken from the pipe selected for tensile test. The specimen shall stand being bent cold through 180 degrees around a pin, the diameter of which is equal $4\frac{1}{2}$ times the thickness of the plate without developing cracks. In making the bend test be placed next to the pin.

Outer Coating

Corrosion and chloride resistant treatment shall be carried out as specified below.

I. Prior to application of treatment, the pipe shall be made free from all mill scale, rust, foreign matters or any such materials must be removed from the pipe surface by use of wire brush followed by sand blasting to "SA 2 $\frac{1}{2}$ standard immediately prior to the application of priming coating.

II. In addition, metal surface should be free from oil, grease and other impurities which can impair the adhesion.

In case of COROCRETIN_TE (i.e. thixotropic two component resin system with modified amine harder) layer, outer coating shall be carried out as below.

Prior to application of treatment, the pipe shall be made free from all mill scale, rust, foreign matters or any such materials must be removed from the pipe surface by use of wire brush followed by sand blasting to “SA 2 ½ standard immediately prior to the application of priming coating.

In addition, metal surface should be free from oil, grease, and other impurities which can impair the adhesion.

Application

I. Mix the individual components (Component A and Component B) separately with homogeneity. Mix one part of component A and one part of component B by weight thoroughly and apply using conventional brush, roller and spray.

II. Immediately after preparing surface by sand blasting apply one coat of Corocrete TE(S). Apply two more coats within the interval of 12 to 48 hours until the surface is completely free from pores.

Following care should be taken while application of this treatment.

- i. Due care should be taken to prevent impurities and dampness on the surface in the time between the every application of treatment coat.
- ii. If longer time is anticipated between topcoat, then the existing coat should be roughened before fresh coating is applied.
- iii. After application of corocrete TE(S) should be protected from moisture (rain, dew, fog) for a period of 6-8 hours.

Consumption

For one prior coating and two topcoat each of 80 micron (total 240 micron) the consumption of Corocrete TE(S) shall be 750 gm/sm.

a) Painting near expansion joints internally and external paintings of patch plates.

b) For curing, depth of 20 to 30cm of water be maintained in the flat portion of the pipeline to maintain adequate humidity in the pipe required for curing.

c) Carrying out performance test for ‘C’ value.

Outer coating work, in case of “pypekot” Material shall be carried out as below.

1) All the mill scale, rust, foreign debris or any such material must be removed from the pipe surface by use of wire brush/power brush immediately prior to the application of primer on the surface of the pipe.

2) One coat of fibre coal tar and solvent based compatible primer of density 0.92 gm/cu mt. and viscosity of 1000 to 2000 CPS at 150 gm/sq. mt. shall be applied. The primer shall be allowed to dry until the surface becomes tacky. The primer shall be applied to dry until the surface become tacky. The primer shall be allowed to dry until the surface becomes tacky. The primer shall be applied to dry until the surface becomes tacky. The primer shall be applied in such a manner that it produces an effective bond between metal and subsequent coating of 4mm thick polymeric tape.

3) Tape may be wound either circumferentially or spirally with using thermo fusion process to completely adhere with primer coated surface maintaining minimum 15mm overlaps to the two adjacent layers. Cost of overlap is included in the item and no extra payment shall be done for it.

4) Either end of the pipe shall be left uncoated to enable proper installation/laying as well as field welding work. This area shall be coated in situ after the installation/laying and welding of the pipes in the trench. In case of any damage is occurred to the outer coating of the pipe during handling, laying and installation at any place of the surface, the rectification shall be done by patching up the damaged area by thermo-fusion at no extra cost.

5) Holiday test as described in IS: 10221 shall be conducted at the cost of the Contractor in the presence of an authorised representative of and if any fault/defect is found, it shall be rectified at no extra cost.

6) Cross adhesive test.

Inner Lining

This clause covers scope of material and application of cement mortar lining on the inside surface of the pipe line. The application of mortar lining covers lining of straight pipe sections, long, short radius bends, vertical shafts and all specials etc. the lining shall be carried out through an access by a machine that progress uniformly through an access by a machine that progress uniformly through the pipe and applies mortar against the pipe surface and Mechanically trowels it to obtain smooth lining of bends, specials and areas adjacent to valves shall be appropriately dealt with according to the best practice of the trade for the diameter concerned. The Contractor should specify what is the best practice and produce acceptable evidence therefore.

All access openings and feed openings or manhole for feeder hoses shall be re-welded in position after lining them. The line will be restored to the satisfaction of the owner.

The scope further includes mobilization of equipment, making access openings wherever required and curing of the mortar lined pipe including testing. Patching access holes etc. as described in following pages.

The main items of work will be generally as follows.

- a) Mobilisation of equipment, plant and machinery.
- b) Deciding access openings in the main and providing temporary access up to openings wherever necessary.
- c) Making trenches of suitable depth, width and length for making access openings in case of underground (U/G) pipe including dewatering and refilling.
- d) Breaking gunited/concreted surface (if any) of U/G pipe and cutting the top portion of pipe (Underground as well as above ground) to provide for access opening.
- e) Provide necessary platform for installation of mixing machinery.
- f) Remove and refit appurtenances, provide additional ventilation openings and plugs, if required. Take suitable measures for adequate ventilation in case of U/G pipes.
- g) Maintaining the pipe temperature between 50 °F and 90 °F.
- h) Cleaning the pipe surface internally.
- i) Mortar lining the internal surface of the pipe lines.
- j) Curing the mortar lining.
- k) Inspection and testing of mortar lining.

- l) Hand lining with cement mortar for top and bottom portion of pipe removed for access opening. While at enter side it should be coated with 4mm thick thermo-fusible polymeric corrosion protection tape called “PYPE COAT” conforming to IS: 10221.

General Cement Mortar Lining Design

a) Composition

Mortar for the lining shall be composed of cement, sand and water that have been well mixed and are of such consistency as to produce a dense, homogenous lining. Unless otherwise specified by the Client, the mortar may also include admixtures as per IS: 3589 and IS: 11906 (1986).

b) Proportions

The approximate proportions of cement and sand in the mortar for the mortar for the lining shall be 1 part of Portland cement to 1 part of sand by volume.

The exact proportions shall be determined by the characteristics of the sand used. Admixtures, if added, shall be used in strict compliance with the Manufacturers recommendation.

The Contractor should specifically state as to the cement proportion to use having regard to his experience (to be stated) and the practice or specifications his principle follow generally and recommend in this particular case.

c) Water Content

The water content shall be IS: 456 the minimum quantity that produces a workable mixture, with full allowances made for moisture collecting on the interior of the pipe surfaces. Slump tests should be made periodically on freshly mixed mortar immediately prior to the mortar lining conveyed to the lining machine. The test results of slump test should indicate slump of Mortar required consistency or as per directives of the Engineer-in-charge. Each lot cube will be Taken and Tested as per IS: 3589.

Mortar shall be mixed long enough by machine to obtain Maximum plasticity. The mortar shall be used before initial set.

d) Field Test

The Slump test for compressive strength of mortar shall be carried out by the Contractor for determining the Quality of mortar.

e) Thickness of Lining

The lining shall be uniform in thickness within the allowable tolerance, except at joint or deformations in the pipeline. Cement mortar lining thickness shall be 9.5mm. The tolerance for lining shall be + 2.5mm for pipe and + 5.0mm for specials with no minus tolerance, the mortar lining work shall be by single application.

Laying Of Pipes

Carting and Handling

Pipes and fittings/specials shall be transported from the factory to the work sites at places along the alignment of pipeline as directed by the Employer’s representative. Contractor shall be responsible for the safety of pipes and fittings/specials in transit, loading/unloading. Every care shall be exercised in handling pipes and fittings/specials to avoid damage. While unloading, the pipes and fittings/specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber skids

with steadying ropes or by any other approved means. Padding shall be provided between coated pipes, fittings/specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to other. In case of spigot socket pipes, care should be taken regarding orientation of pipes while unloading. As far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or swelling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded. Dragging of pipes and fittings/specials along concrete and similar pavement with hard surfaces shall be prohibited.

Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stock shall not exceed 1.5m.

Fittings/Specials shall be stacked under cover and separated from pipes.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they are not left out on the ground in the sun or overnight under heavy frost or snow conditions.

Laying

f) Laying of Pipes and Fittings/Specials

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipeline of water, gas, sewage etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Employer/Employer's representative. Pipes and fittings/specials shall be carefully lowered in the trenches. Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings/specials shall be made by Contractor. In no case pipes and fittings/specials shall be dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes and fittings/specials shall be used to lift and lower the coated pipes and fittings/specials. The pipes and fittings/specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. If doubt persists, further confirmation shall be done by pouring a little kerosene/dye on the inside of the pipe at the suspected spot. No sign of kerosene/dye should appear on the outside surface. Pipes and fittings/specials damaged during lowering or aligning shall be rejected by the Employer's representative.

All the pipes are to be laid perfectly true both in alignment and to gradient specified. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipeline runs uphill in which case the socket ends should face the upgrade. The laying of pipes shall always proceed upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes and fittings/specials which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings/specials of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Employer's representative. During the period that the plug is on, the Contractor shall take proper precautions against floating of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted the deflection

allowed at joints shall not exceed 2 ½". In case of pipes, with joint to be made with loose collars, the collars shall be slipped on before the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes in case of flexible joints only

The cutting of pipe for inserting valves, fittings, or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.

g) Thrust Blocks

Thrust blocks shall be provided, to counteract hydraulic thrust, at places wherever directed by the Employer's representative especially at horizontal and vertical bend.

h) Jointing

Jointing for pipes and fittings/specials shall be done in accordance with the relevant Employer's requirements depending upon the type of pipes being used.

i) Testing and Commissioning

Testing and commissioning of pipes shall be done in accordance with the relevant Employer's requirements.

Carbon Steel/MS pipe after installation at site with respective joints, piping shall be tested for joint tightness at 150 % of maximum working/system pressure it is likely to subject to.

Further the contractor shall offer ultrasonic testing for 15% of welded length of each field joint of pipe at site.

j) Backfilling

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipeline. The tamping around the pipe shall be done by hand or other hand-operated mechanical means. The water content of the soil shall be as near the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur. Backfilling shall be done in layers not exceeding 30cm. Each layer shall be consolidated by watering, ramming, care being taken to avoid damage to the pipeline. In case of the mild steel pipes/specials, the spiders provided during assembly and welding shall be retained until the trench is refilled and consolidated. Where timbers are placed under the pipeline to aid alignment, these timbers shall be removed before backfilling.

k) Reinstatement of Road/Footpath

Reinstatement of road/footpath shall be done as per the requirements of local authorities and the Employer's requirements after completion of work.

l) Clearing of Site

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by the Employer's representative and the construction site left clean to the satisfaction of the Employer's representative.