NEW TIRUPUR AREA DEVELOPMENT CORPORATION LIMITED
(NTADCL)

BID DOCUMENT

Name of Scheme: - **Procurement, Construction and Commissioning of Combined Water Supply Scheme for providing 3.5 MLD to SIPCOT Defense Industrial Park, Varapatti, 2.0 MLD to TIDCO Aerospace Industrial Park, Sulur and 3.0 MLD to TIDCO Semi-Conductor Industrial Park, Kethanur from NTADCL Water Distribution Station (WDS 24) Murugampalayam, Tirupur.**

(TECHNICAL SPECIFICATION)

(E - Tendering System)

TECHNICAL SPECIFICATIONS

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I. MATERIALS

All materials required for the works shall be procured and supplied by the contractor himself. The materials shall be of good quality and conforming to relevant BIS. The materials which are classified for ISI marking should be supplied with ISI marking only.

1. Cement and Steel

1.1. The entire quantity of cement and steel required for the work will be procured by the contractor. The contractor is responsible for all transport and storage of the materials and shall bear all related cost. The Employer shall be entitled at any reasonable time to examine the cement and steel supplied by the contractor.

1.2. The cement procured by the contractor shall comply with requirements of IS 269/1976 with the latest revision thereof for ordinary Portland cement. It shall be of the best normal setting quality unless especially rapid hardening or quick setting quality if expressly instructed by the Engineer to be supplied. Each bag shall bear ISI Certification mark and as per specification no. 10 of TNBP Volume I.

1.3 The steel bars shall comply with the requirements set forth in the IS 432 Part I, IS 1139,IS 1786 as the case may be with the latest revision thereof and the test as described for ultimate tensile strength, bond test and elongation tests.

All reinforcing steel shall be clean and free from oil, grease, loose scales or rust or other coatings of any character which would reduce or destroy the bend. Each band containing the bars shall bear the ISI Certification mark.

1.4 All the samples of construction materials should be tested in the Material Testing Laboratories located within the region (Coimbatore) to ensure the quality of the material. If the sample could not be tested in the Coimbatore Laboratory due to some unavoidable reasons, the sample may be tested in any one of the other 3 Materials Testing Laboratories located at Madurai, Trichy and Tindivanam. Two samples should be taken by the Engineer in charge in the presence of the contractor or his authorised representatives or the technical personnel employed by the Contractor as in the agreement. The contractor shall without extra cost provide samples and cooperate in the testing of the cement/steel. One sample shall be got tested and the other sample shall be retained by making clear identification in the sample by the Engineer in charge so as to identify at a later date. The cost of such test shall be borne by the contractor.

1.5 All cement shall be procured in bags and shall be stored in a dry place for which the contractor shall be responsible. Consignment of bagged cement shall be properly stacked in a manner which will permit easy access for inspection and definite identification. Cement shall be used in approximately in the chronological order in which it is received, but cement that has been stored for a period longer than 4 months from the date of initial sampling shall not be used unless it has been retested at the expenses of the contractor and passed by the Engineer in charge as good quality on the retest. Cement aged more than 180 days from the date of initial sampling shall be rejected.

1.6 Cement which has become caked or perished shall on no account be used on the works and shall be rejected. Although the Engineer may have passed any consignment, he shall however have the power at the subsequent time to reject such consignment if he finds that any deterioration in the quality thereon has taken place.

1.7 A record of the quantity cement /steel procured with the name of dealer, bill number and date shall be maintained by the contractor. This should be produced for examination by the Engineer in charge at any time. The age of the cement shall be reckoned from the date of manufacture and it shall be verified by the Engineer in charge.

1.8 The rejected consignment of cement and steel should be removed from the site within two days.

2. Aggregates

2.1 Sand for use in masonry and plaster works shall confirm to relevant specification in TNBP (specification No.7) and I.S. 2116/1985, 1.S.1542/1977.

2.2. The coarse and fine aggregates for concrete shall conform to I.S. 383 /1970 and as specified in the relevant clauses of I.S. 456/ 1978. Other aggregates free from deleterious materials shall be used at the concurrence and approval of the Engineer after sufficient tests have been carried out at the contractor's cost.

2.3. The maximum quantities of deleterious materials in the aggregates, as determined in accordance with I.S 2386(Part II) /1963 shall not be exceeding the limits given in table I of I.S. 383. Unless otherwise specified all coarse aggregate in RCC shall be graded aggregate of 20 mm. nominal size. All aggregates shall be stored in hard impervious surface to ensure exclusion of all foreign materials and as per IS 4082/ 1977 and specification No.5 of TNBP volume I.

3. Water required for Construction

3.1 The water used in the construction shall be of potable quality and shall be tested the contractor' cost. The contractor has made his own arrangements at his cost for water required for construction, testing, filling etc. either from local bodies or from elsewhere, by paying the charges directly and arranging tanker etc., as per necessity. No claim for extra payment on account of non-availability of water nearby or extra lead for bringing water shall be entertained.All required piping arrangements and pumping if required for water shall be made by the contractor at his cost. Water for mortar, mixing and curing of concrete shall be free from harmful matter or other substances that may be deleterious to concrete or steel and taken from a source approved by the Engineer. Ground water for mixing and curing shall conform to the provisions in the class 4.3 of IS 456/1978.

4. Admixtures.

Only where a beneficial effect is produced shall any admixture be used and that too after test has been carried out to convince the Engineer that no harmful effect will be produced by the use of such admixture and after approved by the Engineer. The admixture shall conform to IS 9103/1972.

5. Form Work and Centering

5.1 Steel/wooden form centering shall be used. If wooden form work is used, it shall consist of planks not less than 40 mm thick and strong props. This shall be providing complying with clause 10 of IS 456 /1978 and specification no. 30.8 of TNBP. The timber of form works shall be best hard wood and got approved by the Engineer in charge. This shall be deemed to be included in the items of contract even otherwise specified.

6. Separator (Cover Block)

6.1 For bottom cover of beams, slabs etc., separators of pre-cast cement motor blocks of suitable size with wire embodiment as directed shall be used and tied to the reinforcement. Between layers of reinforcements, separators consisting of pieces of bars of suitable diameter shall be used. The required cover shall be provided as per clause 24-4 of IS 456/1978

STRENGTH:

A satisfactory butt welded joint of HDPE will have the strength factor of one. Temperature is of primary importance and weld efficiency may decrease if the temperature is more or less than 210 deg C.

7.4 Ductile Iron pipe

Ductile Iron pipe shall be procured from the reputed manufacturers and the pipes shall confirm to IS 8329/2000. The pipes diameter given in schedule is the clear inner diameter. The pipe and specials should be supplied with inside lining with a cement mortar of standard thickness and specifications and outside coating of Metallic Zinc as per I.S. specifications. The pipes should be with ISI marking. The test certificate furnished by the manufacturers should be produced.

7.5 PVC pipes.

The unplasticized PVC rigid pipes shall strictly conform to IS 4985/1988 and amended from time to time and shall carry ISI marking in every pipe.

The contractor should procure the PVC rigid pipes from a reputed manufacturer.

The contractor should furnish the test certificate issued by the manufacturer.

The manufacturer's test certificate and third-party inspection certificate should be produced by the contractor for the pipe used in the works.

In addition to third party inspection, wherever felt necessary, the Engineer shall have the power to test the PVC pipes for its quality such as specification gravity, impact strength at 0^0C internal hydraulic pressure test, diameter, thickness etc. in TWAD Board laboratory.

The PVC pipe joints shall be with solvent cement of good quality, conforming to IS 14182/1994.

The Engineer in charge, shall verify, in addition to the test certificate, whether the pipes are as per BIS, by visual examination, diameter, weight, wall thickness, flexibility, colour etc.

All the PVC specials required for use in conjunction with PVC pipes, should be got approved by the Engineer-in-charge.

7.6 GI pipes

GI pipes should be procured by the contractor from reputed manufacturer or from their authorized dealer of reputed manufacturer and should conform to IS 1239 /part I, namely the inner and outer diameter, length and weight. The pipes which are found to be not conforming to relevant specification shall be rejected by the Engineer-in-charge.

7.7 CI D/F Pipes

The CI D/F Pipes procured for use in the wok should conform to the relevant BIS Specification and suitable for use in the work.

Valves

7.7.1 The contractor should procure reputed make of sluice valves, scour valves, reflux valves and air valves from the manufacturer or his authorized dealer and they should conform to the relevant BIS Specification and suitable for use in the work. The valves shall bear ISI marks.

7.8 CI/PVC/GI Specials and Fittings

7.8.1 The specials and fittings should be in conformity to the relevant BIS specification.

7.9 Testing of pipes

7.9.1 The manufacturer test certificate/third party inspection certificate should be produced by the contractor for the pipes used in the work. The engineer shall have the right to test the pipes, wherever felt necessary for its quality. All testing charges should be borne by the contractor.

7.9.2 Testing of materials to be used in works, for the quality of finished items shall generally be done by the contractor at his own cost in the laboratory approved by the Employer by providing requisite materials, transport of test specimen and other assistance required thereof.

8. Water meter

a) Water meter should be supplied conforming to ISO 4064 Class B
b) Life cycle test certificate approved by M/S. Fluid Control Research Institute, Palghat (or) through National Physical Laboratories (NPL), New Delhi (or) any other National Accreditation Board of Laboratories (NABL), approved Government Organisation should be furnished.

II. CIVIL WORKS

1. General

1.1 Tamil Nadu Building practice (TNBP) shall be strictly followed for carrying out different items of the work for which no standard specifications are available and no alternate specification have been given under the description of works.

1.2 Where any provision of the TNBP is repugnant to or at various with any provision under IS or description of work, technical specifications and conditions of contract, the provisions of the latter shall be deemed to supersede the provision of the TNBP.

2. Earth work

2.1 Specification.

Tamilnadu Detailed Building Practice (Specification No. 23 to the extent applicable) shall be followed for earthwork excavation.

2.2 Conveyance

The excavated earth, blasted rubble etc., shall be conveyed and deposited in the departmental lands within 150m. of plant site and as directed by the Engineer in charge.

2.3 Stacking.

Where the location of the work is such and does not permit the deposition of excavated earth while digging trenches for laying pipes, the excavated earth should be conveyed to a convenient place and deposited there temporarily, as directed by the Engineer-in-charge. Such deposited soil shall be reconveyed to the site of the work for the purpose of refilling of trenches, if it is suitable for refilling. The unit rate for trench work of excavated and refilling shall include the cost of such operation

2.4 Disposal of surplus Earth

The excavated soil which is surplus to that required for refilling and after allowing for settlement will have to be removed, spread and sectioned at places shown on the site during execution for purpose of widening or leveling the road. Sectioning is to be done as detailed in TNBP. It is to be understood that no extra payment, will be made for this and the unit rate for trench work of excavation and refilling shall include the cost of removal of surplus earth to disposal site approved by the Engineer-in-charge, its spreading and sectioning at the bidder's expense.

2.5 Shoring, Strutting and Baling out Water

The rate for excavation of trench work shall include charges of shoring strutting, bailing out water wherever necessary and no extra payment will be made for any of these contingent works. While bailing out water, care should be taken to see that the bailed-out water is properly channelized to flow away without stagnation or inundating the adjoining road surfaces and properties.

3. **Concrete**

3.1 Specification

Concrete for use in the works shall generally comply with TNBP (specification No.30) and the relevant BIS. The concrete mix shall be specified proportions satisfying the maximum aggregate size, water cement ratio and required cube strength and workability as per IS 456-1978. Such concrete must be adequately vibrated to form solid mass without voids. The entire concreting works should be done only with the prior approval and in the presence of Engineer in charge.

3.2 Mixing of Concrete

The concrete shall be proportioned as far as cement and aggregates are considered by volume. The amount of water required being measured either by weight or volume the adjustments must be made to frequent intervals at the discretion of the Engineer or his assistant to account for the moisture content of the aggregates. The mixing operation shall be performed only a mechanical concrete mixer and shall continue until the whole batch of uniform consistency and colour. The mixing of concrete shall be done in accordance with clause 8 and 9 of IS 456-1978.

3.3 Transporting, Placing and Compacting Concrete

3.3.1 Transportation, placing and compaction of concrete mix by mechanical vibrators shall be done in accordance with clause 12 of IS 456-1978. It is imperative that all concreting operations be done rapidly and efficiently with minimum re handling and adequate manpower shall therefore be employed to ensure this.

3.3.2 The forms shall be first cleaned and moistened before placing concrete.

3.3.3 The mix should be dropped from such a height as it may cause segregation and air entrainment. When the mix is placed in position, no further water shall be added to provided easier workability.

3.3.4 No concrete mix shall be used for the work if it has been left for a period exceeding its initial setting time before being deposited and vibrated into its final position in the member.

3.3.5 While one concrete is being placed in position it shall be immediately spreaded and ramped sufficiently and suitable to attain dense and complete filling of all spaces between and around the reinforcement and in to the corners of form work for ensuring a solid mass entirely free from voids.

3.3.6 Construction joints required in any of the structural members shall be provided generally complying with clause 12.4 of IS 456-1978 and as directed by the Engineer in charge. The efficiency of tempering and consolidation will be judge by complete absence of air pockets, voids and honey combing after removal of form works.

3.4 Curing

3.4.1 Curing shall be done to avoid excess shrinkage or harmful effort to the members generally complying with clause 12.5 of IS 456-1978.

3.4.2 The method adopted shall be effective and any special method used must be approved by the Engineer and be subject to complete supervision.

3.4.3 Any deficiency in concreting such as cracking, excessive honeycombing, exposure of reinforcement or other fault which entail replacement of the defective part by fresh concrete and whatsoever remedy reasonable required without hampering the structural safety and architectural concept, all at the cost of contractor.

3.5 Removal of Form Work

3.5.1 Removal of form work shall be done as per TNBP and BIS and as directly by the engineer in such a manner that no damage is caused to the structures. The striping time shall not be less than that indicated in clause 10.3 of IS 456-1978.

3.6 Testing of Concrete

3.6.1 During the course of construction works, preparation of test specimens, curing and casting of concrete shall be done in accordance with IS 1199 and IS 516 to ascertain the strength requirements and acceptance criteria indicated in IS 456-1978. The contractor shall provide all apparatus, labour and arrange to test the cubes at his own cost at the test laboratory decided by the Employer.

3.6.2 In addition to the above tests, any other test which may if desired by the Engineer in charge be carried out from time to time as per relevant specifications at the cost of contractor. In case the concrete does not meet the strength required. All corrective measures shall be taken at once at the contractors' cost.

3.6.3 The inspection and testing of structures shall be done in accordance with clause 16 of IS 456-1978

4. Masonry

4.1 All masonry works such as Random Rubble /Coursed Rubble/Brick work must be done as per TNBP Specification and Bid schedule specification.

5. Plastering

5.1 Plastering would be 12mm. 20mm and 25 mm thick cement plaster either plan or water proof as may be specified.

5.2 The plastering items shall be executed in thickness and cement mortar of proportion as detailed in respective item in the BOQ. Similarly, the plastering shall be either ordinary or water proof as specified in respective item in the BOQ.

5.3 In case of water proof plaster standard and approved water proofing compound shall be mixed in cement mortar in required percentage as directed and then the plaster is applied.

5.4 The finishing shall be either smooth or rough as may be directed by the Engineer unless otherwise specifically mentioned in the BOQ.

5.5 Neat finish wherever directed by the Engineer shall be done at no extra cost.

5.6 Curing and watering shall be done as directed and plaster shall be in alignment and level. Any substandard work is liable to be rejected and shall have to be re-done at contractors' cost. Sand to be used shall be of approved quality only. Cost of all scaffolding shall be included in the rates quoted in the BOQ.

6. Flooring

6.1 40mm. thick cement concrete 1:2:4 shall be provided for flooring. The size of metal shall not be more than 12mm. and it shall be properly graded. A thin coat of very fine plaster shall be provided on top to give a smooth finish. The marking of false grooves to surfaces as directed includes the cost of labour.

7. Doors and Windows

7.1 Sizes shown on drawings are clear openings in masonry and not the shutter's size. These sizes shown on drawings are, therefore inclusive of required frame sizes and doors, windows,

etc. and shall be manufactured, accordingly. If sizes bigger than shown in drawings are manufactured, as instructed specifically in writing they shall be measured and paid for accordingly.

7.2 The work shall be executed as per the size of frame thickness of shutter type viz. Plain planked panelled, glazed, etc., and fixture, etc., as described in tender item. Iron bars for windows and ventilators are to be provided if specifically mentioned in the tender item. Iron bars for windows and ventilators are to be provided if specifically mentioned in the tender item at Contractor's cost. Specifications in TNBP shall be applicable.

7.3 The design of shutters and quality of wood shall be got approved form the Engineer-in-charge before manufacture. The CW/TW to be used for wood work shall be inform in substance straight, free from large deed knots, flows flanks. The work shall be done as per specification of TNBP latest edition. The joints shall be perfect.

7.4 Part of wood embedded in masonry shall be painted with the tar. The frames of doors, windows, ventilators, etc. shall have proper hold-fasts embedded in masonry.

7.5 Whenever iron bar is to be provided as per tender item the rate thereof is included in tender item. The painting shall be done as prescribed in tender item. No painting, however, shall be permitted till the woodwork is approved by the Engineer-in-charge.

7.6 Any substandard work not conforming to the specifications are liable to be outright rejected and Executive Engineer's decision in such cases shall be final and binding on the Contractor.

7.7 The mode of measurement shall be on area unit as mentioned in BOQ.

8. Painting

8.1 The work shall be carried out as per the description of the tender item and as directed by Engineer-in-charge. It shall be white washing, distempering and or snowcem painting. Shade and make shall be as directed by the Engineer and for decorative purpose, Engineer may ask for different components or different parts of the same component which the Contractor shall have to do within his tendered rate only at no extra cost to the Employer. Cost of priming coat as directed, scaffolding, etc. shall be included in the tender rate. The work shall be executed as per the specifications of TNBP for painting.

In general, all items of works must be done as per TNBP specifications and bid schedule specifications.

III. SOURCE CREATION

The proposal involves drawing potable water 8.50 MLD by gravity by providing 300mm Inlet Tapping from the Distribution Main of NTADCL Water Distribution Station (WDS 24) Murugampalayam, Tirupur to the adjacent proposed collection sump cum pump house with a storage capacity of 7.50 ML.

From the collection sump potable water is being pumped to the respective destinations through DI 450mm/ OPVC 400mm to 160mm pipe for a total length of 50.68 Kms. The water will be pumped for 20 hours daily using vertical turbine pumps (2 Working and 1 Standby) each pump with a discharge rate of 213 m^3 per hour and a total head of 171 meters.

IV. PIPE LAYING WORKS

1. General.

1.1 The earthwork or the pipe laying work shall generally conform to the details given below:

Sl. No.	Dia of pipe in millimeter	Depth of Bottom of pipe below trench Bottom in centimeter	Width of at ground level centimeter
1.	PVC Pipe up to 140	105	60
2.	For other Pipes up to 150	105	75
3.	200	110	80
4.	250	120	80
5.	300	135	80
6.	350	145	90
7.	400	155	90
8.	450	170	100
9.	500	185	100
10.	600	205	110
11.	700	230	120
12.	750	245	125

1.2 Wherever necessary, sand cushioning for the bed shall be given as per IS Standards and as directed by the Engineer in charge. The pipe should be laid true to the alignment line and grade wherever necessary, appropriate bends should be used. The pipes laid must be jointed properly and carefully by using approved type of jointing materials.

1.3 After the pipes are laid and jointed, the pipelines are to be subjected to hydraulic pressure test as detailed in the relevant BIS Specification for various types as indicated below.

Cast iron Pipes	IS 7118/1983 & IS 15371996
MS Pipes	IS 3589/2001
DI Pipes	IS 8329/2000
PVC Pipes	IS 4985/2000
HDPE Pipes PE 100	IS 4984/2016

In portion of pipe line, where the pipes have developed cracks or sweating, such pipes with jointing materials shall be removed and re-laid with new pipes at the contractor's cost and the pipe line shall be re-tested to the entire satisfaction of the Engineer in charge. No extra payment will be made on this account. The bidder has to make his own arrangements for the procurement of the required equipments for testing of pipes which shall be subjected to such test as the Engineer-in-charge deems fit to ensure the accuracy of the gauge.

Refilling shall be done with proper compaction with excavated earth. In no case the contractor shall be allowed to refill the trenches in hard excavated portion to be refilled by the boulders or excavated stuffs. This portion of trench shall be refilled by the soft strata from excavated stuff from distance place at no extra cost. The refilling shall be done in 15cm thick layers duly waiting and compacting each layer. The refilling may be done up to a height of 20 to 30 cm than the natural ground level to allow that sinking afterwards. If the refilling gets sunk below the natural ground level at any time till the completion of the work, the contractor at his cost should make good there filling to the required level as may be directed by the Engineer in charge.

1.4 In case of pipe trenches, the Engineer may reduce the width of trench wherever a hard strata is met with, if he feels adequate and just sufficient to lay the pipe line in order to reduce the hard rock quantity. In such case the contractor will be paid as per the actual measurement.

1.5 If the work is in a residential area, the contractor should carry out the excavation carefully to avoid collapse of any structure.

1.6 Valves shall be provided with valves pits with proper cover to bear the loads coming on it as per bid documents and departmental drawings and specification Public fountains, Fire hydrants shall be provided as per type design and specification.

1.7 Adequate protective measures shall be taken against surge pressure. Zero velocity valves and air cushion valves should be provided at the appropriate places; Trust blocks and anchor blocks should be provided at all bends and appropriate places.

1.8 Water required for testing the pipeline shall be arranged by the contractor at his cost.

2. Laying of Cost Iron/DI Pipes

2.1 The laying and jointing of cast iron pipes shall be carried out as follows.
Before laying the pipes, the contractor shall carefully brush then to remove any soil, stones or other materials which may be therein. An even and regular bed having been prepared and joint pit excavated to form a recess under the socket of each pipe of no greater depth and width than to enable the pipe jointing to be properly done. Each pipe shall then be carefully lowered and placed singly in the trench and shall rest in the solid ground for a distance of not less than two thirds of its entire length. In places where the soil is not hard, cement concrete bed blocks or timber piles have to be provided under the pipes if directed by the Engineer in charge.

2.2 Pipes not Truly Laid

Any pipe or pipes laid, which on inspection are found to diverge from the true lines and levels shall be removed and re-laid to the true lines and levels and the old jointing properly cleared off the pipes and fresh joints made by the contractor at his expense. Any pipes damaged in removal shall be replaced by the contractor at his cost.

2.3 Cutting of C.I./DI Pipes.

Where necessary and as ordered by the Engineer in charge, the Contractor shall cut the pipes and fix and joint common collars for jointing spigot ends. The cut ends of the pipe shall be made truly at right angles with the axis of the pipe.

2.4 Covering up Open Ends.

The Contractor shall take particulars care to ensure that the apertures and open ends of pipes are carefully covered whenever the workmen are not actually employed therein.

2.5 Jointing of C.I./DI Pipes.

The trench must be kept quite dry during jointing unless in any particular case the Engineer permits laying of the pipe in wet conditions. Plain spigot and socket pipes shall be joined as follows.

a) Lead joints

Generally, lead joints shall be used for all sizes. In the case of 100 mm pipes, cement joints may be used if specified in which case for every ten cement joints, one lead joint shall be used. Provision of lead joints shall also be made at street crossings, at closing joints and for all specials and as determined by the Engineer depending upon the site condition.

The spigot of the pipe must be forced well home into its socket and must be centered, so that the joint may be of even thickness all round. As may laps of white hemp spun yarn as may be needed to leave the space required for the lead shall be driven to the bottom of the socket without being forced through the joint into the pipe but carefully driven home with a caulking tool. The proper depth of each joint shall be tested before running the lead by passing completely round it a wooden gauge, notched out to the correct depth of lead, the notch being lead close against the face of the socket. The joints shall then be run with molten lead in sufficient quantity so that after being caulked solid, the lead may project 3mm beyond the face of the socket against the outside of the spigot but must be flush with the outside edge of the socket.

For pouring lead in the joints, a ring of hemp rope covered with clay shall be wrapped around the pipe at the end of the socket leaving an opening at the top of the socket into which the lead can be poured. The hemp rope shall be supported by clay packing so as to withstand the operation of lead pouring.

The lead used shall be carefully skimmed of all scale, when melted in a cast iron pot or patent melting machine. Sufficient lead shall then be taken by a ladle and run hot into the joint, and the joint filled at one running. The joint shall then be caulked when cool by a suitable caulking tool ad a 2 kg. hammer and the joint left neat and smooth.

The weight of lead and hemp which shall be used in each joint shall be used in each joint shall be in conformity with the table given below or as specified by the Engineer.

Quantity of lead and spun yarn for different sizes of pipes.

Nominal size of pipe in mm.	Lead / Joint In kg.	Depth of Lead joints in mm.	Spun Yarn per joint in kg.
80	1.8	45	0.10
100	2.2	45	0.18
125	2.6	45	0.20
150	3.4	50	0.20
200	5.0	50	0.30
250	6.1	50	0.35

Nominal size of pipe in mm.	Lead / Joint In kg.	Depth of Lead joints in mm.	Spun Yarn per joint in kg.
300	7.2	55	0.48
350	8.4	55	0.60
400	9.5	55	0.75
450	14.0	55	0.95
500	15.0	60	1.00
600	19.0	60	1.20
700	22.0	60	1.35
750	25.0	60	1.45
800	31.5	65	1.53
900	35.0	65	1.88
1000	41.0	65	2.05
1100	46.0	65	2.40
1200	50.0	70	2.60
1500	66.5	75	2.80
8 Inches	4.54	2.00 Inches	0.29
9''	5.10	2.00	0.31
10''	5.67	2.00	0.34
12''	6.58	2.00	0.48
14''	9.30	2.50	0.63
15''	9.98	2.50	0.68
16''	10.66	2.50	0.74
18''	14.06	2.50	0.95
20''	16.33	2.50	1.04
21''	17.92	2.50	1.08
24''	20.41	2.50	1.21
27''	23.13	2.50	1.33
30''	25.86	2.50	1.46
33''	28.35	2.50	1.65
36''	31.58	2.50	2.40

Note:
The quantities of lead and spun yarn given in the table are provisional and variation of 20 percent is permissible.

b) **Flanged joints.**
Flanged joint should be made by painting the facing of the flange with white lead freely and bolting 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.

When packing must be used, it should be of rubber insertion of approved thickness. The packing should be of the full diameter of the flange with proper pipe hole and bolt holes cut out evenly on both the inner and outer edges. Where the flange is not fully faced, the packing may be of the diameter of the packing strip only. Proper placing of the pacing should be checked before another pipes is joined on.

c) **Cement Joints**
The cement for the joints shall conform to IS269\1996 specification for ordinary, rapid hardening and low heat Portland cement.
Cement and water taken in proportion 8: 1 by weight shall be thoroughly mixed. The mixture shall be such that when it is tightly compressed by hand into a ball and the ball is broken into two pieces the break shall be clean. If the hand becomes water stained, it has to be considered that the water is excessive. If there is evidence of crumbling in the break, water added is less than required. The cement mixture shall ring with metallic sound while caulked.
Cement which has been wet for more than one hour or which has undergone initial set shall not be used for jointing.

Making the joints
When new pipes are laid close ahead of a newly made cement joint, the disturbance caused during the forcing home of the pipe ends into the sockets during the adjustment of the pipe to proper alignment may damage the new joint. To avoid this damage, jointing shall be done only when there are at least six pipes laid to the final grade and alignment ahead of the joint to be made of the joint to be made. Starting at the bottom of the joint the joint space shall be filled with wetted cement and caulked. The remaining joint space shall than be refilled with cement and caulked until the joint is practically flush with the face of the socket. The mixture shall be thoroughly compacted to make a water tight joint. No water shall be allowed to touch the joint until the initial set had taken place. Immediately after initial set has taken place, the joint shall be covered with wet burlap, or other approvedwet materials to ensure complete hydration of the cement. No water shall be allowed into the pipe until the elapse of 12 hours after the last joint in the line is made. Filling the pipe with water without pressure after this interval will be beneficial to curing of the joint.

d) **Rubber Ring Joints**
In the case of rubber ring joints or push on joints, the groove and the socket shall be thoroughly cleaned before inserting the rubber gasket. While inserting the gasket it shall be made sure that it faces the proper direction and that it is correctly seated in the groove. After cleaning dirt or foreign materials from the plain end, lubricant shall be applied in accordance with the pipe manufacturer's recommendations.
The Contractor shall make sure that the plain end is beveled as square as sharp edges may damage or dislodge the gasket and cause a leak. When the pipe is cut at site, the plain end shall be beveled with a heavy file or grinder to remove all sharp edges.
The plain end of the pipe shall be pushed into the socket of the pipe and while pushing, the pipe shall be kept straight. If any deflections are to be made in the alignment, it may be made after the joints are assembled. A timer header shall be used between the pipe and crow bar

or jack to avoid damages to the pipe while the plain end of the pipe is pushed onto the socket either with a crow bar or jack, or lever puller.

2.6 Fixing Sluice Valve

The sluice valves to be fixed on the pipelines shall be examined, cleaned and placed in the positions as shown in the drawings. The valves shall be placed on the pipe line and valve chambers constructed according to drawings. The depth at which the valve is to be laid and the dimensions of concrete and masonry shall be varied when necessary under the orders of the Engineer.

As the pipes in some instances may be required to be fixed at a less depth than will permit the top of the valve spindle being below the level of the road (but this may only be in cases where the position of the valve is to one side the metalloid road) the walls of the valve chamber shall be in such cases be carried upto such height at may be ordered, and the chamber shall have such covering as the Engineer may direct.

The valve shall be supported in the valve chamber so that no stress or strain occurs in the flange or other joints of the valve.

The valve shall be carefully protected from slime or dust by a suitable mat or gunny covering and the pit itself shall be cleared of all unwanted material.

2.7 Fixing Scour Valve

Scour valves shall be fixed at places shown in the drawings or as directed by the Engineer, and the scour connections from the main shall be carried out completely as per drawings.

2.8 Fixing Air Valve.

Air valves shall be fixed at the summits of pipe lines or at places may be directed by the Engineer. The air valve connections etc., shall be carried out as per drawing.

2.9 Interconnection work

The Inter connection work between the existing main to the existing main to the laid under this contract shall proceed from the new main to the existing main. Before actually proceeding with the interconnection work, the Contractor shall make ready necessary tools and plants required for the work at site, such as pump sets, shoring materials etc. He shall also keep ready at site necessary pipes, specials, valves if any required for the work. The Contractor shall keep necessary skilled workmen of sufficient strength at site and once the work is commenced, the entire interconnection work shall proceed without interruption by engaging labour for carrying out the work on a continuous basis both day and night till the work is completed. The work shall be executed as per programme drawn up by the Engineer and shall be completed within the time ordered by the Engineer, for each individual interconnection. The work shall be carried out under the direction of the Engineer from the beginning to end.

Laying of Specials, valves(except straight pipes from the branch of the new main to the connecting point in the existing main) including conveying specials etc., from the stores or site of stacking, excavation, timbering, pumping, out water from the trenches, lowering, aligning, jointing specials and valves cutting the existing mains, baling out water, inserting the necessary branches, jointing, testing refilling etc., shall comprise as one unit of work and will be paid at the lump sum rate quoted in the schedule for inter connection.

2.10 Works to be left Water tight

The Contractor shall construct the pipes chambers and all other works so that they shall be water tight. Should any leakage appear, it shall be made good by him at his expense by removing and reconstructing the portions of the Work so affected or by other method which will render the Work thoroughly water tight to the satisfaction of the Engineer.

2.11 Cleaning of Mains

During the execution of the work the Contractor shall keep the interior surface of the mains free from cement, brick, soil or other superfluous matter and shall hand over the mains perfectly clean and free from deposit on completion.

2.12 Masonry Chambers

Chambers for sluice valves, inspection, scour valves, air valves shall be constructed on the pipes in the positions as shown in the drawings or in such positions as the Engineer may direct. The work shall be done strictly in accordance with the detailed drawings or as ordered by the Engineer. The excavation shall not be made lower than necessary to admit of the earth being properly timbered. The bottom of the excavation shall be properly leveled, rammed and a bed of concrete laid thereon. When the concrete has sufficiently set the building of the brick walls shall then be proceeded with and all iron work fixed in as the building proceeds. The inside of all chambers shall be plastered with cement mortar 20mm thick and the outside with cement mortar 12 mm thick. The chamber shall be topped with pre-cast R.C.C. Slabs 1:2:4 or cast-iron surface box of valve cover as ordered by the Engineer. The surface box or valve cover shall be fixed on the top of the R.C.C. slab by a layer of cement mortar and sides of the surface box or valve cover covered over with cement concrete.

Where pipes pass through walls of chambers relieving arches shall be turned neatly over the upper half of the pipes or R.C.C. lintels shall be provided to avoid load of the walls transmitted to the pipes.

Cast Iron steps shall be built in each chamber as the work proceeds one being inserted to every 4 courses of brick work, horizontal distance center to center of each row being 30 cms.

The Contractor shall include in risk rate for brick work cost for fixing steps, frame, cover etc., for completing all chambers in accordance with the drawings and with the above specifications.

2.13 Testing of Main-Hydrostatic Test

After laying and jointing the pipes and specials, the pipe lines shall be tested for hydrostatic pressure in such length as may be specified by the Engineer.

The test pressure shall be equal to 50% or such other higher percent as may be specified in excess of the pressure the pipe will have to withstand subsequently subject to a minimum test pressure of 7 kg. / sq.cm.in the case of lead joints. However, in the case of cement joints, the joints may be tested to a minimum test pressure 3.5 kg./sq.cm.

If cement joint show seepage or slight leakage, such joints shall be cut out and replaced as directed the Engineer and the test repeated.

The Contractor shall make his own arrangements to procure, necessary equipments, apparatus etc., required for testing and shall provide necessary labour for filling with water

the length of pipes to be tested, fixing all apparatus and for carrying on the testing operations until the length of pipes, specials and connections are finally passed by the Engineer.

The length to be tested shall be provided with two blank flanges fastened on in the usual manner by collar bands and bolts to the end pipes or if the length to be tested shall have a sluice value at each end, such blank flanges may be dispensed with.

The length of pipes to be tested shall first be filled in with water from a higher section of pipes already laid or with clean water shall be arranged at the contractor's expense with the approval of the Engineer.

Before the actual testing pressure is applied any air which has lodged in the length of pipes to be tested shall be got rid of, by screwing on at the highest part of the length of pipes or temporary air value, or, by opening a temporary stop-cock or by other mean as the Engineer may direct.

The test pressure shall then be applied to the length of pipes under test by a hand or powered hydraulic test pump. The connection of the test pump to the length of pipes shall either be at the union connection provided at a blank flange or shall be at a temporary stop cock or fountain connection as the Engineer may in the circumstances direct.

The actual test shall be made by pumping water into the length of pipes under test, until the test pressure as specified as specified above has been reached on the pressure gauge.

The test pressure shall be maintained for one hour or for such other period of time as may set by the Engineer and each joint will be inspected. While the pressure is on, the pipes should be struck smartly with a 2kg hammer.

When a flange joint is found to be leaking, care shall be taken that while tightening up the flanges, the neighbouring joints are not affected.

If the length of pipe line under test in is found to be satisfactory and on leaks or sweatiness are found at the pipe joints or at the joints of specials and connections then this length of pipe line will be passed by the Engineer.

But should any pipe, joint, special or connection be found to sweat or leak, the contractor shall make good at his cost defective joint and the length of pipe line shall be retested by the Engineer until all pipes, joints, specials and connection are found to be satisfactory.

If any pipe or special leaks or bursts, the damaged portion shall be removed and new pipes or specials shall be laid and jointed at the contractor's cost.

2.14 Restoring Road Surface

The surface of the road or ground shall be finished off to the proper level with the same kind of material as the surface consisted of before the excavation commenced, except in the case of superior roads and tarred roads in which case the surfaces should be finished off with water bound macadam surface. Should any settlement occur after refilling is completed, and up to the end of the period of maintenance, it shall be made good at once and the surface restored to the satisfaction of the authority under whose jurisdiction such road or ground may be, all at cost of the contractor.

2.15 Collection or Rubbish

The Contractor shall, at his cost, on the completion of the work remove all water and all materials or rubbish of every description which may have been collected in the works and find a deposit thereof and anything which may have collected within the works, during the period of maintenance shall also be removed before the works are finally accepted by the Employer.

3.2 Ductile Iron pressure pipes and special with tyton joints

3.1 Applicable codes

The laying of DI pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and codes. In particular the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards/codes shall be referred to. Other IS: Codes not specifically mentioned here but pertaining to the use of DI pipes shall be part of this Specification.

Table No. 3.1

I.S. Number	Title
IS: 8329: 2000 Amend No.-1 2000	Centrifugally cost (spun) ductile iron Pressure pipes for water, gas and sewage (third revision)
IS: 9523: 2000	Ductile iron fittings for pressure pipes for water, gas and sewage.
IS: 12288: 1987	Code of practice for use and laying of ductile iron pipes
IS: 5382: 1985	Rubber sealing rings for gas mains, water mains and sewer (first revision)

3.2 Ductile iron pipes

3.2.1 The pipes shall be centrifugally cast (spun) Ductile iron pipes for water and sewage confirming to the IS 8329: 2000. The pipes used shall be either with push on joints (Rubber Gasket Joints) or Flanged joints. The class of pipe to be used shall be of the class K-7 & K-9.

3.2.2 The pipes shall be coated with bitumen and have factory provided cement mortar lining in the inside as per the provisions of the IS 8329:2000. The pipes are supplied in standard length of 4.00, 5.00, 5.50 and 6.00 meters length with suitably rounded or chamfered ends. Each pipe of the push on joint variety shall also be supplied with a rubber EPDM/(SBR) gasket.

3.2.3 The flanged joints shall confirm to the Clause 6.2 of IS: 8329.The pipe supply shall include one rubber gaskets for each flange.

3.2.4 Specifications of sockets and spigot pipes, classes K7 and K9 are mentioned below.

Table No.3.2
(Refer Table 2 IS 8329-2000)
(in mm)

Nominal Diameter	External Diameter	Barrel wall thickness 'e'	
DN	**DE**	**K7**	**K9**
80	98	5	6
100	118	5	6
125	144	5	6
150	170	5	6
200	222	5	6.3
250	274	5.3	6.8
300	326	5.6	7.2
350	378	6	7.7
400	429	6.3	8.1
450	480	6.6	8.6
500	532	7	9
600	635	7.7	9.9
700	738	9	10.8
750	790	9.7	11.3
800	842	10.4	11.7
900	945	11.2	12.6
1000	1048	12	13.5

3.2.5 Specification of (PN 10) Standard flange Drilling for screwed Flanges and Welded Flange are mentioned below:

(PN 10) Table No.3.3
(Refer Table 3 IS 8329-2000)
(in mm)

Nominal Diameter	Outer diameter of flange D	Holes		Bolt size
DN	**D**	**Number**	**Dia d**	Metric
80	200	4	19	M16
100	220	8	19	M16
125	250	8	19	M16
150	285	8	23	M20
200	340	8	23	M20
250	395	12	23	M20
300	445	12	23	M20
350	505	16	23	M20
400	565	16	28	M24
450	615	20	28	M24
500	670	20	28	M24
600	780	20	31	M27
700	895	24	31	M27

Nominal Diameter	Outer diameter of flange D	Holes		Bolt size
DN	D	Number	Dia d	Metric
750	960	24	31	M27
800	1015	24	34	M30
900	1115	28	34	M30
1000	1230	28	37	M33

3.2.6 Specifications of (PN 16) standard Flange Drilling for screwed Flanges and Welded flange are mentioned below:

(PN 16) Table No.3.4
(Refer Table 4 IS 8329-2000)
(in mm)

Nominal Diameter	Outer diameter of flange	Holes		Bolt size
DN	D	Number	Dia (d)	Metric
80	200	8	19	M16
100	220	8	19	M16
125	250	8	19	M16
150	285	8	23	M20
200	340	12	23	M20
250	400	12	28	M24
300	445	12	28	M24
350	520	16	28	M24
400	580	16	31	M27
450	640	20	31	M27
500	715	20	34	M30
600	840	20	37	M33
700	910	24	37	M33
750	970	24	37	M33
800	102	24	40	M36
900	112	28	40	M36
1000	125	28	43	M39

3.1 Coating:

Pipe shall be supplied internally (cement mortar lining) and externally (bituminous coating) coated as under:

3.3.1 Cement Mortar Lining –

3.3.1.1. Cement -the cement used for the lining shall conform to the existing standards on cement, the type of cement to be used is to be mutually decided between the purchaser and manufacturer, Normal recommendations are:

3.3.1.1.1 Portland cement (as per IS 8112 or IS 455) mortar lining perform rather well and have an expected life of approximately 50 years in soft water with moderate amount of aggressive Co2 and when Ph is within 6 to 9. Longer service life can be obtained by increasing the mortar lining thickness.

3.3.1.1.2 Where cement mortar lining may be exposed to sulphate attack, ordinary Portland cement should be replaced by sulphate resisting Portland cement (as per IS 12330 or IS 6909).

3.3.1.1.3 The sulphate concentration limit for sulphate resisting Portland in approximately 3000 mg/litre, the same as blast furnace slag cement which naturally possess a good resistant to sulphate attack.

3.3.1.1.3 High alumina cement (as per IS 6452) mortar lining is suitable for continuous use of pH between 4 and 12 and no sever damage occur after occasional exposure to pH 3 to 4 and 12 to 13.

3.3.1.1.4 The recommended type of cement used for lining are as given in table 3.5

Recommended type of cement used for lining
Table no 3.5
(Refer Table 14 IS 8329-2000)

Sl. No	Water characteristics	Portland	Sulphate Resisting Cements (including Blast-Furnace Stag Cement)	High alumina Cement
1	2	3	4	5
1	Minimum value of pH	6	5.5	4
2	Maximum Content (mg/l) of:-			
	Aggressive co_2	7	15	No limit
	Sulphates (so_4)	400	3000	No limit
	Magnesium (Mg^{++})	100	500	No limit
	Ammonium (NH_4)	30	30	No limit

3.3.1.2 Sand

3.3.1.2.1 The sand use shall have a controlled granulometric distribution from fine to coarser elements; it shall be clean and shall be composed of inert, hard, strong and stable granular particles.

3.3.1.2.2 The fine fraction comprising particles passing through a sieve of aperture size 0.125 mm shall not be more than 10 percent by mass.

3.3.1.2.3 The coarsest fraction (comprising particles which do not pass through a sieve of the aperture size closest to half the normal thickness of the mortar lining) shall not exceed 5% by mass.

3.3.1.3. Water- The water used for the preparation of the mortar shall not contain substances deleterious to the mortar nor to the water is it eventually intended to transport in the pipe. The presence of solid mineral particles is, however, admissible provided that these requirements are still fulfilled.

3.3.1.4. Mortar - The mortar of the lining shall be composed of cement, sand and water.

Additives may be used, provided that they do not prejudice the quality of the coating and that of the transported water.

3.3.1.4.1 The mortar shall be thoroughly mixed and shall have a consistency which results in a dense and homogenous lining.

3.3.1.4.2 The mortar shall contain by mass at least one part of cement to 3.5 parts of sand.

3.3.2 Bituminous Coating-

3.3.2.1. Coating shall not be applied to any pipe unless its surfaces are clean, dry and free from rust.

3.3.2.2 The coating material shall set rapidly with good adherence and shall not scale off.

3.3.2.3 The mean thickness of the coating shall be not less than 70 μm and the local Minimum thickness shall be not less than 50 μm.

3.3.2.4 Where the coating material has a bitumen base, it shall be smooth and tenacious and hard enough penknife.

3.3.2.5 When the pipes to be used for conveying potable water the inside coating shall not contain any constituent soluble in such water or any ingredient which could impart any taste or whatsoever to the potable water after sterilization and suitable washing of the mains.

3.3.2.6 Pipes with or without sockets and flanges which are imperfectly coated or where the coating does not set or conform to the required quality, the coating shall be removed and the pipes/flanges recoated.

3.4 Hydrostatic site test pressures and hydraulic working pressure.

3.4.1 Hydrostatic site test pressures and hydraulic working pressure of the newly laid pipe line is specified as under in

Table No.3.6
Refer Amendment No.1, (Annex E -Table 1): IS 8329-2000

DN	Allowable operating pressure (excluding surge) AOP		Allowable Maximum Operating pressure (including surge) MOP		Allowable site test Pressure (STP)	
	K7	K9	K7	K9	K7	K9
	Mpa		Mpa		Mpa	
80	0.8	6.4	1.25	7.7	1.75	9.6
100	0.8	6.4	1.25	7.7	1.75	9.6
125	0.8	6.4	1.25	7.7	1.75	9.6
150	0.8	6.4	1.25	7.7	1.75	9.6
200	0.8	6.2	1.25	7.4	1.75	7.9
250	0.8	5.4	1.25	6.5	1.75	7

300	0.8	4.9	1.25	5.9	1.75	6.4
350	0.8	4.5	1.25	5.4	1.75	5.9
400	0.8	4.2	1.25	5.1	1.75	5.6
450	0.8	4	1.25	4.8	1.75	5.3
500	0.8	3.8	1.25	4.6	1.75	5.1
600	0.8	3.6	1.25	4.3	1.75	4.8
700	0.8	**3.4**	1.25	**4.1**	1.75	**4.6**
750	0.8	**3.3**	1.25	**3.9**	1.75	**4.4**
800	1	**3.2**	1.5	**3.8**	**2**	**4.3**
900	1	**3.1**	1.5	**3.7**	**2**	**4.2**
1000	1	**3**	1.5	**3.6**	**2**	**4.1**

3.4.2 Other Test of Pipes:

3.4.2.1 Mechanical test are carried out during the manufacture. One test shall be conducted for every batch of production.

3.4.2.2 Tensile Test shall be conducted by cutting a sample from the spigot end of the pipe. This sample may be cut perpendicular to or parallel with the pipes axis, but in case of dispute the parallel to axis sample shall be used.

3.4.2.3 Two methods of measuring the tensile strength may be used at the manufacturer's option.

3.4.2.4 Method 1 - Machine the test bar to its nominal diameter + 10 percent, measure the actual diameter before the test with an accuracy of 0.01 mm and use this measured diameter to calculate the cross-sectional area and the tensile strength; or:

3.4.2.5 Method 2 - Machine the test bar to its nominal area S0 within a specified tolerance on diameter and use the nominal area to calculate the tensile strength.

3.4.3 Brinell Hardness Test:

3.4.3.1 When tested in accordance with IS 1500, the Brinell hardness shall not exceed 230 HB on the external un-machined surface.

3.5 Marking

3.5.1 Each pipe shall have as cast or stamped or legibly and indelibly painted on it with the following appropriate marks:

(a) Indication of the source of manufacture:
(b) The nominal diameter:
(c) Class reference;
(d) The last two digits of the year of manufacturer:
(e) The non-standard length of the pipe if specially ordered:
(f) Where applicable, an indication of length over which the pipe is suitable for cutting on site: and
(g) A short white line at the spigot end of each pipe with push-on joint in sizes DN 700 and above, to indicate the major axis of the spigot.

3.6 Fittings

3.6.1 Dimensional and other requirement for fittings for specified Diameter shall conform to the details given in tables 15 to 31 section 3 of the IS specification code IS: 9523: 2000.

3.6.2 Hydrostatic test

For hydrostatic test, the fittings shall be kept under pressure for 10 seconds. They shall withstand the pressure test without showing any sign of leakage, sweating or other defect of any kind. The test shall be conducted before the application of surface coating.

3.6.3 The fittings shall withstand the hydrostatic pressure given in table.4.7 Hydrostatic test pressure for castings

Table No. 3.7
(Refer Table No. 2 IS 9523-2000)

Nominal Diameter DN (mm)	Hydrostatic Test Pressure at works, MPa
Up to and including 300	2.5
Over 300 and up to and including 600	1.6
Over 600 and up to and including 2000	1.0

3.7 Tolerances:

3.7.1 The tolerance on dimensions of barrel and socket for push-on-joint fittings shall be as given in Table 4.8

Table No.3.8
(Refer Table No. 3 IS 9523-2000)

Nominal Diameter	External Diameter DE		Wall Thickness mm		
DN	Nominal	Tolerance	K12	K14	Torerance
1	2	3	4	5	6
80	98	+1/-2.7	7	8.1	-2.38
100	118	+1/-2.8	7.2	8.4	-2.40
125	144	+1/-2.8	7.5	8.7	-2.42
150	170	+1/-2.9	7.8	9.1	-2.45
200	222	+1/-30	8.4	9.5	-2.50
250	274	+1/-3.1	9.0	10.5	-2.55
300	326	+1/-3.3	9.6	11.2	-2.60
350	378	+1/-3.4	10.2	11.9	-2.65
400	429	+1/-3.5	10.8	12.6	-2.70
450	480	+1/-3.6	11.4	13.3	-2.75
500	532	+1/-3.8	12.0	14.0	-2.80
600	635	+1/-4	13.2	15.4	-2.90
700	738	+1/-4.3	14.4	16.8	-3.00
750	790	+1/-4.4	15.0	17.5	-3.05
800	842	+1/-4.5	15.6	18.2	-3.10
900	945	+1/-4.8	16.8	19.6	-3.20
1000	1048	+1/-50	18.0	21.0	-3.30

3.7.2 Tolerances for the various dimensions of flanges shall be as given in tables 4.9 and 4.10

3.7.2.1 Dimensions of standard Flange Drilling for Flange Fittings PN 10

Table No.3.9
(Refer Table No. 4 IS 9523-2000)

(in mm)

Nominal Diameter	Dimensions of flange		Holes	Dia of Holes	Bolt Size, Metric
DN	D (outer dia)	b (Thickness)	No	Dia (d)	
1	2	5	7	8	9
80	200	16	4	19	M16
100	220	16	8	19	M16
125	250	16	8	19	M16
150	285	16	8	23	M20
200	340	17	8	23	M20
250	395	19	12	23	M20
300	445	20.5	12	23	M20
350	505	20.5	16	23	M20
400	565	20.5	16	28	M24
450	615	21	20	28	M24
500	670	22.5	20	28	M24
600	780	25	20	31	M27
700	895	27.5	24	31	M27
750	960	29	24	31	M27
800	1015	30	24	34	M30
900	1115	32.5	28	34	M30
1000	1230	35	28	37	M33

3.7.2.2 Dimensions of standard Flange Drilling for flange fittings PN 16

Table No. 3.10
(Refer Table No. 5 IS 9523-2000)
(in mm)

Nominal Diamer	Outer Diameter	Holes		Bolt Size, Metric
DN	D	No	Dia (d)	
1	2	3	4	9
80	200	8	19	M16
100	220	8	19	M16
125	250	8	19	M16
150	285	8	23	M20
200	340	12	23	M20
250	400	12	28	M24
300	455	12	28	M24
350	520	16	28	M24
400	580	16	31	M27
450	640	20	31	M27
500	715	20	34	M30
600	840	20	37	M33

Nominal Diamer	Outer Diameter	Holes		Bolt Size, Metric
DN	D	No	Dia (d)	
700	910	24	37	M33
750	970	24	37	M33
800	1025	24	40	M36
900	1125	28	40	M36
1000	1255	28	43	M39

3.7.2.3 Lengths of Fittings

The permissible deviations on the lengths of fittings shall be as under.

Deviation on Lengths of Fittings
Table No.3.11
(Refer Table No. 14 IS 9523-2000)

Types of fittings	nominal Diameter DN mm	Deviation in L & H mm
Flange socket, Flanged Spigot, Collars, tapers	80 to 1200	±25
Tees	80 to 1200	± 50/-25
Bends 90º (1/4)	80 to 2000	± (15 + 0.03 DN)
Bends 45º (1/8)	80 to 2000	± (10 + 0.025 DN)
Bends 20º (30) and11º (15)	80 to 1200	± (10 + 0.02 DN)

3.8 Marking

3.8.1 Each fitting shall have as cast, stamped or indelibly painted on it, the following appropriate marks.
(a) Indication of the source of manufacture.
(b) The nominal diameter
(c) The last two digits of the year of manufacture.
(d) PN rating of flanges when applicable, and
(e) Any other mark required by the purchaser.

3.8.2 Marking may be done on the barrel of castings or on the outside of the sockets.

3.8.3 BIS Certification Marking
The fittings may also be marked with the Standard Mark.

3.8.4 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

3.9 Specification for Laying and jointing of Pipe Line System for water Supply.
Code of practice for use and laying of DI Pipes should be as per IS 12288:1987.

3.9.1 **Preparatory work:**

The contractor will inspect the route along which the pipe line is proposed to be laid. He should observe/find out the existing underground utilities/construction and propose an alignment along which the pipeline is to be laid.

3.9.2 He should make all efforts to keep the pipe as straight as possible with the help of ranging rods. Wherever there is need for deviation, it should be done with the use for necessary specials or by deflection in pipe joints.

3.9.3 The alignment as proposed should be marked on ground with a line of white chalk and got approved from engineer In charge. The contractor will than prepare an L-Section along this alignment showing the location of proposed pipe line. The L-section should also be got approved from the site Engineer. The position of fittings, valves, shall be shown on the plan.

3.9.4 **Alignment and the L-sections:**

The alignments-section (depth of laying) and location of specials, valves and chambers may be changed at site in co-operation with and after approval of the Engineer in charge.

3.9.5 **Transportation of pipes and specials:**

3.9.5.1 The contractor has to transport the pipes and other materials form supplier to the site of laying as indicated by the engineer in charge. Pipes should be handled with care to avoid damage to the surface, internal lining and the socket and spigot ends, deformation or bending.

3.9.5.2 Pipes shall not be dragged along the ground or the loading end of a vehicle. Pipes shall be transported on flat bed vehicles/trailers. The bed shall be smooth and free from any sharp objects. The pipes shall rests uniformly on the vehicle bed in their entire length during transportation. Pipes shall be loaded and un-loaded manually or by suitable mechanical means without causing any damage.

3.9.6 Cranes or chain pulley block or other suitable handling and lifting equipment shall be used for loading and un-loading of heavy pipes. However, for pipes up to 400 mm nominal bore, skid timbers and ropes may be used.

3.9.6.1 Where using crane hooks at sockets and spigot ends hooks shall be broad and protected by rubber or similar material, in order to avoid damage to pipe ends and lining. Damage to lining must be repaired before pipe laying. Pipes shall not be thrown directly on the ground.

3.9.7 **Bedding of the pipes:**

3.9.7.1 The pipe shall be laid out along the proposed alignment in a such a manner that they do not create any problem to public and are not damaged.

3.9.7.2 The trench bottom shall be even and smooth so as to provide a proper support for the pipe over its entire length, and shall be free from stones, lumps, roots and other hard objects that may endure the pipe or coating. Holes shall be dug in the trench bottom to accommodate sockets so as to ensure continues contact between the trench and the entire pipe barrel between socket holes.

3.9.8 **Laying and jointing of DI pipes:**

3.9.8.1 Pipes should be lowered into the trench with tackle suitable for the weight of pipes.

For smaller sizes, up to 200 mm nominal bore, the pipe may be lowered by the use of ropes but for heavier pipes suitable mechanical equipment have to be used.

3.9.8.2 All construction debris should be cleared from the inside of the pipes either before or just after a joint is made. This is done by passing a pull-through in the pipe, or by hand, depending on the size of the pipe. All persons should vacate any section of trench into which the pipe is being lowered.

3.9.8.2.1 On gradients of 1: 15 or steeper, precautions should be taken to ensure that the spigot of the pipe being laid does not move into or out of the socket of the laid pipe during the jointing operations. As soon as the joint assembly has been completed, the pipe should be held firmly in position, while trench is back filled over the barrel of the pipe.

3.9.8.2.2 The designed anchorage shall be provided to resist the thrusts developed by internal pressure at bends, tees, etc.

3.9.8.2.3 Where a pipeline crosses a watercourse, the design and method of construction should take into account the characteristics of the watercourse to ascertain the nature of bed, scour levels, maximum velocities, high flood levels, seasonal variation, etc. which effect the design and laying of pipeline.

3.9.8.2.4 The socket and spigot end of the pipes shall be brushed and cleaned. The chamfered surface and the end of the spigot end has to be coated with a suitable lubricant recommended by the manufacturer of the pipes. Oil, petroleum bound oils, grease or other material which may damage the rubber gasket shall not be used as lubricant. The rubber gasket shall be inserted into the cleaned groove of the socket. It has to be checked for correct positioning.

3.9.8.2.5 The rubber gaskets shall be kept in their original packing and stored in cool conditions/not exposed to the direct sunlight, should only be taken out when needed.

3.9.8.2.6 The two pipe shall be aligned properly in the pipe trench and the spigot end shall be pushed axially into the socket either manually or with a suitable tool specially designed for the reassembly of pipes and as recommended by the manufacturer. The spigot has to be inserted up to the insertion mark on the pipe spigot. After insertion, the correct position of the socket has to be tested with a feeler blade.

3.9.8.2.6 Deflection of the pipes if-any-shall be made only after they have fully been assembled. The deflection shall not exceed 75% of the values indicated by the pipe manufacturer.

3.10 Joints

3.10.1. In the case of push-on with or without centering rings.

3.10.1.2 The lengths of the spigot necessary for jointing shall not be less than the length of the socket of the jointing pipe.

3.10.1.3 In case of push-on-joint the spigot end of fitting, if any, shall be suitably chamfered to facilitate smooth entry of spigot in the socket of the pipes or fittings fitted with rubber gasket.

3.10.1.4 In case of flange and mechanical joint casting, the flange shall be at right angle to the axis of the joint. The bolt holes shall be either cored or drilled.

3.10.1.5 The centre of bolt holes circle shall be concentric with the bore circle and shall be located of the centre line. Unless otherwise specified by the purchaser. Where there are two or more flanges, the bolt holes shall be correctly aligned between them.

3.10.1.7 For high pressure mains, requiring working pressure greater than 2.4 MPa, suitable flexible joint may be preferred where the joint is restrained against axial movement.

3.10.1.8 Push-on-joint fittings are normally not used for sizes above DN 1600.

3.11.1 Jointing of Ductile Iron Pipes

Two main types of joints are used with Ductile Iron pipes and fittings.

i. Socket and spigot flexible joints.
    1. Push on joints.
    2. Mechanical joints.

ii. Rigid flanged joints.

3.11.2 Flexible Joints:

The spigot and socket flexible joint should be designed to permit angular deflection in direction and axial movement to compensate for ground movement and thermal expansion and contraction. They incorporate gasket of electrometric materials and the joints may be of the simple push-on-type or the type where the seal is affected by the compression of a rubber gasket between a seating on the inside of the socket and the external surface of spigot. Joints of the latter type are referred to as mechanical joints. Both push-in and mechanical joints are flexible joints. Flexible joints require to be externally anchored at all changes in direction such as at bends, etc., and at blank end to resist the thrust created by internal pressure and to prevent the withdrawal of spigots.

3.11.3 Flanged Joints:

Flanged joints are made on pipes having a machined flange at each end of pipe. The seal is usually affected by means of a flat rubber gasket compressed between two flanges by means of bolts which also serve to connect the pipe rigidly. Gaskets of other materials, both metallic and non-metallic are used for special applications.

3.11.4 Jointing procedure:

Procedure for jointing will vary according to the type of joint being used. Basic requirements for all types are:

a) Cleanliness of all parts

b) Correct location of components

c) Centralisation of spigot within socket and

d) Strict compliance with manufacturer's jointing instructions.

The inside of sockets and the outside of spigots should be cleaned and wire brushed for a distance of 150 to 225mm. Glands and gaskets should be wiped clean and inspected for damage. When lifting gear is used to place the pipe in the trench, it should also be used to assist in centralizing the spigot in the socket.

Where the pipeline is likely to be subjected to movement due to subsidence or temperature variations, the use of flexible joints is recommended. A gap should be left between the end of the spigot and the back of the socket to accommodate such movement.

3.11.5 Rubber Gaskets

The material of rubber gaskets for use with mechanical joints and push-on-joints shall conform to IS: 5382, unless otherwise agreed between the manufacturer and the purchaser. Dimensions of the rubber gasket shall be as per manufacturer's Own design.

3.12 Anchoring of the pipeline:

Thrust block shall be provided at each bend, tee, taper, end piece to prevent undue movements of the pipeline under pressure. They shall be constructed as per design of engineer-in-charge according to the highest pressure during operation or testing of the pipes, the safe bearing pressure of the surrounding soil and the friction coefficient of the soil.

3.13 Measurement

The net length of pipes as laid or fixed should be measured in running meters correct to a cm. specials should be excluded and enumerated and paid separately. The portion of the pipe within the collar at the joints should not be included in the length of pipe work.

5. HDPE Pipes, MDPE Pipes & Specials and Zero Velocity Valves

5.1 Applicable Codes

The following standards, unless otherwise specified herein, shall be referred. In all cases the latest revision of the Codes shall be referred to. If requirements of this specifications conflict with the requirements of the standards /Codes, this specification shall govern.

Table No.-5.1

Code No.	Title/Specification
IS 4984 /2016	High Density polyethylene pipes for Water Supply
IS 5382	Rubber sealing rings for gas mains, water mains and sewers
IS 7634	Laying & jointing of polyethylene (PE) Pipes
ISO 4427	Medium Density Polyethylene Pipes for Water Supply
IS 2530	Methods of test for polyethylene moulding materials and polyethylene compounds
IS 4905	Methods for random sampling
IS 9845	Method of analysis for the determination of specific and/or overall migration of constituents of plastics material and articles intended to come into contact with foodstuffs.
IS 10141	Positive list of constituents of polyethylene in contact with food stuffs, pharmaceuticals and drinking water.

Specification of Pipes:

5.2 Colour

5.2.1 The colour of the pipe shall be black

5.2.2 Each pipe shall contain minimum three equi spaced longitudinal stripes of width 3 mm (Min) in blue colour. These stripes shall be more than 0.2 mm in depth. The material of the stripes shall be of the same type of resin, as used in the base compound for the pipe.

5.3 Dimensions of pipes and ovality of pipe

5.3.1 Ovality shall be measured at the manufacturer's end as the difference between maximum outside diameter and minimum out-side diameter measured at the same cross section of the pipe, at 300mm away from the cut end. For pipes to be coiled, the ovality shall be measured prior to coiling For coiled pipes, however, re-rounding of pipe shall be carried out prior to the measurement of ovality.

5.3.2 Outside diameter, tolerance and ovality of pipes shall be as per table 5.2. Tolerance and ovality is given below

Table 5.2
(Refer Table No. 2 IS 4984-2016)

S.No	Outside Diameter (mm)	Tolerance (only positive tolerances) (mm)	Ovality (mm)
1	20.0	0.3	1.2
2	25.0	0.3	1.2
3	32.0	0.3	1.3
4	40.0	0.4	1.4
5	50.0	0.5	1.4
6	63	0.6	1.5
7	75.0	0.7	1.6
8	90.0	0.9	1.8
9	110.0	1.0	2.2
10	125.0	1.2	2.5
11	140.0	1.3	2.8
12	160.0	1.5	3.2
13	180.0	1.7	3.6
14	200.0	1.8	4.0
15	225.0	2.1	4.5
16	250.0	2.3	5.0
17	280.0	2.6	9.8
18	315.0	2.9	11.1
19	355.0	3.2	12.5
20	400.0	3.6	14
21	450.0	4.1	15.6
22	500.0	4.5	17.5
23	560.0	5.0	19.6
24	630.0	5.7	22.1
25	710.0	6.4	24.9

5.4 Wall thickness as per allowable hydrostatic design stress-

5.4.1 The minimum & maximum wall thickness of pipe for the PE100 grade of pipe as per IS: 4984 for PN6, PN8 & PN10 shall be as per table 5.3.

Table No.-5.3
(Refer Table No. 5 IS 4984-2016)

Nominal Dia	Wall Thickness of Pipes					
	PN6		PN8		PN10	
DN	Min	Max	Min	Max	Min	Max
1	2	3	4	5	6	7
20	-	-	-	-	-	-
25	-	-	-	-	-	-
32	-	-	-	-	2.4	2.9
40	-	-	2.4	2.9	3.0	3.5
50	2.3	2.8	3.0	3.5	3.7	4.3
63	2.9	3.4	3.8	4.4	4.7	5.4
75	3.5	4.1	4.5	5.2	5.6	6.4
90	4.1	4.8	5.4	6.2	6.7	7.6
110	5	5.7	6.6	7.5	8.1	9.2
125	5.7	6.5	7.5	8.5	9.2	10.4
140	6.4	7.3	8.4	9.5	10.3	11.6
160	7.3	8.3	9.6	10.8	11.8	13.2
180	8.2	9.3	10.8	12.1	13.3	14.9
200	9.1	10.3	12	13.4	14.8	16.5
225	10.3	11.6	13.5	15.1	16.6	18.5
250	11.4	12.8	15.0	16.7	18.4	20.5
280	12.8	14.3	16.8	18.7	20.6	22.9
315	14.4	16.1	18.9	21.0	23.2	25.8
355	16.2	18.1	21.2	23.6	26.2	29.1
400	18.2	21.2	23.9	27.7	29.5	34.2
450	20.5	23.8	26.9	31.2	33.1	38.8
500	22.8	26.5	29.9	34.6	36.8	42.6
560	25.5	29.6	33.5	38.8	41.2	47.6
630	28.7	33.3	37.7	43.6	46.4	53.6
710	32.3	37.4	42.4	49.0	52.3	60.4

5.5 Length of straight Pipe & marking on pipe

5.5.1 The length of straight pipe used shall be more than 6 m or as agreed by Engineer in charge. Short lengths of 3 meter (minimum) up to a Maximum of 10% of the total supply may be permitted.

5.5.2 Each straight length of pipe shall be clearly marked in indelible ink/paint on either end and for coil at both ends or hot embossed on white base every meter throughout the length of pipe/coil with the following information:
(a) Manufacturer's Name / Trade-mark,
(b) Designation of pipe
(c) Lot No./Batch No.
(d) BIS certification marking on each pipe.

5.6 Coiling

5.6.1 The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented.

5.6.2 Pipe beyond 110 mm dia shall be supplied in straight length not less than 6m

5.7 Appearance

5.7.1 Pipe shall be free from all defect including indentation, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusion that due to Their nature degree or extent detrimentally affect the strength and Serviceability of the pipe.

5.7.2 The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and perpendicular to the axis of the pipe.

5.8 Marking:

5.8.1 Each straight length of pipe shall be clearly marked in indelible ink/paint on either end and for coil at both ends or hot embossed on white base every meter throughout the length of pipe/coil with the following information:
(a) Manufacturer's name/Trade-mark.
(b) Designation of pipe
(c) Lot number/Batch number.

5.8.2 BIS Certification Marking

Each pipe may also be marked with Standard Mark.

5.9 Testing of Pipe:

5.9.1 HDPE pipes are subjected to following tests:-

5.9.1.1 Internal pressure creep rupture test

5.9.1.2 Longitudinal Revision Test

5.9.1.3 Overall Migration Test

5.9.1.4 Density

5.9.1.5 Melt Flow Rate (MFR)

5.9.16 Carbon Black Content and Dispersion

5.10 Handling, Transportation storage and Lowering of pipes.

5.10.1 If transportation of HDPE pipes from a distance greater than 300km than pipes shall be received only when bare coils of pipe have been wrapped with hessian cloth.

5.10.2 The truck use for transportation of the PE pipes shall be exclusively used of PE pipes only with no other material loaded-especially no metallic, glass and wooden items. The truck shall not have sharp edges that can damage the pipe.

5.10.3 At the time of opening coils it must be remembered that the coiled under tension and must be open in control manner. Straight length should be stored on horizontal racks giving continuous support. Loss/damages during transit, handling, storage will be to the Contractor's account.

5.10.4 During handling, transportation, storage and lowering, all sections shall be handled by such means and in such a manner that no distortion or damage is done to the section or to the pipes as a whole.

5.10.5 Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 60º C.

5.10.6 Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.

5.10.7 Scores or scratches to a depth of greater than 10 % or more of wall thickness are not permissible; any pipes having such defects should be strictly rejected.

5.10.8 PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.

5.10.9 Only polyester webbing slings should be used to lift heavy PE (>315mm) pipes by crane. Under no circumstances, chains, wire ropes and hooks be used on PE surface.

5.10.10 Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.

5.11 Lowering, Laying of pipes

5.11.1 IS: 7634 shall be applicable. Before using the pipe following precautions/check shall be taken.

5.11.2 Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Engineer shall be laid.

5.11.3 While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. In most cases, the bedding is not required, as long as the sharp and protruding stones are removed, by sieving the dug earth, before using the same as a backfill material. While laying in rocky areas suitable bed of sand or gravel should be provided. The fill to about 10 to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, bed concrete 15 cm thick of grade M-15 or 20 cm thick sand bed as approved by the engineer may be provided.

5.11.4 As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets.

5.11.5 During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc.) and the branch connections. Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day).

5.11.6 For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom.

5.11.7 The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.

5.11.8 The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain pipe. Thus the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 20 times the OD of the pipe.

5.11.9 The installation of flanged fittings such as connections to sluice/air/gate valves and hydrant tees etc., requires the use of stub ends (collars/flange adaptor complete with backing rings and gasket. Care should be taken when tightening these flanges to provide even and balance torque.

5.11.10 Provision should be made at all heavy fittings installation points for supports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque on to the PE flange joint.

5.11.11 PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done.

5.11.12 However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.

5.11.13 Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95 % maximum dry density.

5.12 jointing of pipes

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as per IS4984 shall be selected considering site and working conditions, pressure and flow or liquid.

5.13. Belding:-

5.13.1 In case of sandy strata no separate bedding is required. However the bottom face/trench bed where pipe shall be placed shall be compacted to provide a minimum compaction corresponding to 95 % of maximum dry density. The pipe bedding should be placed so as to give complete contact between the bottom of the trench and the pipe.

5.14 Back Filling

5.14.1 Backfilling should be placed in layers not exceeding 15cm thickness per layer, and should be compacted to a minimum of 95% maximum dry density. The refilling should be done on both sides of pipe together & height difference in earth fill on each side should not be more to cause lateral movement of pipe.

5.14.2 Most coarse grained soil are acceptable. This may comprise of gravel or sand. However silty sand, clayey sand, silty and clayey gravel shall not be used unless proposed to be used in conjunction with gravel or clean sand.

5.14.3 It is very important that the pipe zone backfill material dies not wash away or migrate ink to the native soil. Likewise, potential migration of the native soil in to the pipe zone backfill must also be prevented.

5.14.4 Heavy earth moving equipment used for backfilling should not be brought until the minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or 120 cm in the case of wheeled roaders or roller compactors.

5.15. Compaction:-

5.15.1 Vibratory methods should be used for compaction. Compaction within distances of 15 cm to l45 cm from the pipe should be usually done with hand tempers. The backfill material should be compacted not less than 95 % of maximum dry density.

5.16 Fittings and specials

All HDPE fittings/specials shall be fabricated or injection moulded at factory as per IS: 8360 (Part-I & Part-III) and as per IS: 8008 (Part-I to Part-IX) fittings will be butt welded on the pipes or other fittings by use of heat fusion.

5.17 HDPE bends and tee.

HDPE bends and tee shall be plain square ended conforming to IS: 8360 (Part I, II & III). Bends may be fabricated by jointing several small section of pipe to reach the required angel. Tees may be moulded or fabricated from pipes elements.

5.18 HEPE Reducer must be moulded and shall be plain square ended as per IS:8008 (Part-1 & VII)

5.19 HDPE stub ends-

HDPE stub ends shall be square ended conforming to IS: 8008 (Part-I & VII) specification stub ends will be welded on the pipe. Flange will be of slip on flange type as given in clause 15.16 below.

5.20 Slip on Flanges

Slip on flange shall be metallic flanges covered by epoxy coating or plastic powder coating. Slip-on-flanges shall be conforming to standard mating relevant flange of valves, pipes etc Nominal pressure rating of flanges shall be PN10

5.21 Jointing Procedure

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7643 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with butt fusion

welding using automatic or semi-automatic, hydraulically operated, superior quality butt fusion machines which will ensure good quality butt fusion welding up to of HDPE pipes.

8.21.1 The commonly used joints are as follows:-
8.21.1.1 Insert type joints.
8.21.1.2 Compression fittings.
8.21.1.3 Fusion welding.
8.21.1.4 Threaded Joints
8.21.1.5 Flanged joints, and
8.21.1.6 Telescopic joints.

5.21.2 "There are insert type of fittings of both Plastic and Metals available for use with PE pipes. In corrosive locations plastic fittings are preferred because of their high resistance to corrosion. In less corrosive conditions gun metal fittings are frequently used and in normal or slightly corrosive environments, brass fittings are commonly employed. In certain cases, threaded malleable cast iron fittings are used.

5.21.3 Insert Type Joints

5.21.3.1 These are commonly used for MDPE pipes where in a serrated PE or metallic fitting is inserted into the pipe and tightened by a clip.

5.21.3.2 The outer serrations of HDPE/metal insert type fittings lock into the PE pipes to prevent their coming out under sudden pressure surge. If the pipe bore is slightly undersized, a little heating by immersion in boiling water in case of MDPE and oil bath (1300C) in case of HDPE would soften the pipe to enable insertion of fittings. If the bore of the pipe is loose, the bore clip of worm drive type will secure the fitting and ensure a leak proof joint. The insertion of these fittings into the bore of the pipe is done with hand pressure only. As a measure of safety, worm drive type clip should be used in all cases. This type of jointing is used normally in small diameter pipes up to 110mm.

5.21.4 Compression Fittings

5.21.4.1 They are used for MDPE and HDPE joints. They are detachable joints and are made of metals or plastics.

5.21.4.2 In the majority of cases the metal fittings are based on the type of compression fittings commonly used with copper tubes. In this type of joint the dimensions of the pipe are generally not altered. The joint is effected by an internal liner and a compression ring or sleeve which shrinks and therefore compresses the pipe wall on to the liner, thus gripping to the wall of the pipes. The liner and compression sleeve may also be a integral unit

5.21.4.3 In other case the flared pipe wall is compressed on a conical insert either by two male and female threaded metallic nuts or by backing loose flanges. The water seal is made by compression of ends of PE flared pipe between sloping surface of metallic nuts/flanges and conical inserts.

5.21.4.4 Compression Joints with Collar/Pipe Ends and Flat Gaskets Aluminium alloy or brass fittings with male and female coupling parts are available for jointing with metallic fittings. The male and female ends of the coupling are inserted face to face on two ends of the pipes to be jointed. Collars are made on the pipe ends by heating the ends with hot plate or electric coil. The two collars are brought together and the female end of the coupling is

tightened on the male end. A water tight seal is made between the flanges. This is a detachable type of jointing and is practicable up to 50mm dia pipes.

5.21.5 Fusion Welding

5.21.5.1 Fusion welding is commonly used in HDPE and is permanent type of joint.

5.21.5.2 Procedure of Butt Welding of HDPE pipes.

5.21.5.3 The pipe should be cut square and the face of the pipe should be slightly scraped prior to welding to remove oxidized layer. At the time of welding, leveling of the pipes is essential particularly in case of larger diameter pipes. Welding temperature should be 2000C and surfaces of heating mirror should be 2100 ± 50C [heating mirror is a metallic plate heated up to the required temperature either by electrical coil embedded inside or by blow torch. The word mirror has come because this heating plate radiates heat]

The pipes to be welded should be held on either side of the heating mirror with only contact pressure of about 20 kPa(0.2 kgf/cm²). When the rim of molten material is found, the pipes are removed from the heating mirror and immediately the joint is made by application of moderate pressure of approximately 1 to 2 kg/cm² for 2 to 3 seconds. The initial heating time for achieving molten rim, varies from 1 to 5 min depending upon the pipe wall thickness and size.

5.21.5.3.1 Cautions

(a) It is essential to see that the rim formed is not excessive.

(b) While jointing, the pressure should be maintained until the joint is luke-warm and after the pressure is relived, the joint allowed to cool completely.

(c) The mirror should be kept exactly around 2100C which needs about 30 minutes time (for electrical mirror). It is also essential to see that the temperature is maintained constant by the proper setting of regulator. For detecting the correct temperature crayon chalk is used. For example at 2100C the colour of crayon dot on the mirror changes within 2 seconds. But the dot made should be thin and if not, time taken will be more, indicating a wrong temperature.

5.21.5.4 Strength - A satisfactory butt welded joint of HDPE will have the strength factor of one. Temperature is of primary importance and weld efficiency may decrease if the temperature does not fall within the range of 200 ± 100C.

5.21.6 Flanged Joints

5.21.6.1 These are used for jointing MDPE and HDPE pipes particularly of larger size to valves and vessels and large size metal pipes where strength in tension is required.

5.21.6.2 It consists of flanges either loose or welded to the pipe ends. It is recommended that suitable metallic backing plates be used to support the polyethylene flanges to enable them to be bolted together. Injection moulded polyethylene flanges with metal inserts of 6 to 9 mm thickness may also be used. In most cases, sealing is improved by incorporating a natural or synthetic rubber gasket between polyethylene flanges.

5.21.7 Telescopic Joint

5.21.7.1 Any joint (socket and spigot type) that permits sliding of the free end (spigot end) inside the socket with a rubber or suitable gasket, without any leakage is called telescopic joint.

5.21.7.2 The socket could be an integral part of the pipe at one end or two ends or a special coupler into which the free ends (spigot ends) of the pipes are pushed to achieve a water tight joint.

5.21.7.3 These joints are normally weak in longitudinal pull and hence need anchoring wherever such a tendency of longitudinal pull is likely in the pipe line. In the case of telescopic joints, one external anchorage is generally necessary at each end of the pipe line, at valve and at all changes of direction. The supports of the side connection should ensure that excessive lateral bending does not occur. In small diameter the coupler itself could be modified to have a split, threaded, grip type gasket of hard materials in addition to "O" ring type of rubber gasket (for water tightness) to prevent any slipping out of the free end of the pipe in longitudinal pull.

5.22 Test to Establish Perfectibility/portability of work

Specimen of pipe shall be tested to establish the suitability for use in carrying portable water

(i) Smell of the extract
(ii) Clarity of the colour of the extract
(iii) Acidity and Alkality
(iv) Global migration UV absorbing material Heavy metals
(v) Unreacted monomers (styrens) and biological tests

5.23 Hydraulic Test

After laying the pipe hydraulic test shall be done to conform the quality of work and material. There shall not be any signs of localized swelling, leakage or weeping. It should conform to IS: 4984 & IS 7634.

5.24 Measurement

The net length of fixed pipe shall be measured in running meters correct to a cm. The portion of the pipe inside the joints shell not be included in the length of pipe work. Specials shall be excluded and measured and paid separately under the relevant item.

IV(b). LAYING AND JOINTING OF PIPES

1.1 General

The specification for laying and jointing shall generally conform with IS: 783-1985

1.2 Earthwork excavation

General

Before commencing the work, and also during the progress of the work, the contractor shall give notice to the concerned authorities viz., the Panchayat, the Municipalities, the Railways, the Electricity Board, the Telegraph Department, the Traffic Department attached to the Police and other Departments or Companies, as may be required to the effect that the work is being taken up in a particular locality and that necessary diversion of traffic may be arranged for. The contractor shall co-operate with the department concerned and provide for necessary barricading of roads, protection to existing underground cables, etc. met with during the excavation of trenches. The contractor shall also provide at his own expense watch and light during the day and the night and put required notice towards such as "Caution" "Road Closed for Traffic"etc. He should also provide and maintain at his own expense the necessary supports for underground cables, etc. to afford the best protection to them in consultation with the authorities in charge of the properties and to their best satisfaction.

1.2.1 Trench excavation

The width and depth of excavation of trench shall be as per relevant BIS. The rate for excavation shall include charges for shoring, strutting, bailing and pumping water whenever necessary and no extra payment shall be made for any of these contingent works

Excavation and refilling for the socket hollows shall be paid for as excavation and refilling for trenches in soil of appropriate classification. The supply of river sand required for refilling should be paid for separately if provided in BOQ as separate them.

The Contractor shall deposit the surplus earth if any from trench work at proper place as may be directed by the Engineer and no extra rates shall be paid

Wherever earthen road or gravel road is cut for the laying of pipes, the contractor shall restore the surface after the pipes and specials are laid and jointed with available materials to the satisfaction of the Engineer without extra cost either for cutting or relaying. The clause shall not apply to the cutting of concrete or macadam or brick surfacing or black top roads. The pipes shall be laid to correct levels and gradients, as may be directed by the Engineer, after fixing the sight rails as in Clause No.106 of TNBP without extra cost.

If the floor of the trench is other than rock, hard clay or boulders, the floor shall be rounded to fit the curve of the pipe to form an even bedding for the pipe for a width equal to hold the outer diameter of the pipe.

If the floor of the trench is in rock, hard or clay which will otherwise not provide uniform support for the pipe, the floor shall be excavated below the proposed bottom level of the pipe to a depth of 20cm and the trench shall be refilled with approved soil or river sand as may be directed by the Engineer and properly compacted to a level of 10cm above bottom of the pipe. If river sand is used for refilling, the sand shall be paid for separately if provided in BOQ as a separate item.

1.3 Hard rock

"Rock requiring blasting" shall exclude all rock such as soft rock, disintegrated rock, small boulders, all of which can be removed either with pick axe or craw bards and shall apply to rocks of different kinds which cannot be removed by any of these means. In case of difference of opinion, the Engineer's decision as to which rock shall be considered as "rock requiring blasting" shall be final.

Refilling of the trench in reaches where the excavation is in rocky soil shall be with approved soil which is surplus from trench work operations elsewhere along the alignment or which shall be obtained from new borrow pits.

It is to be distinctly understood that if surplus soil from trench work elsewhere along the alignment is used no extra payment shall be paid for conveyance of the soil to the refilling site. No payment will be made for any excess earth brought to site and it shall be disposed off by the contractor at his own cost. Hard rock which is blasted and removed will be measured and paid for on stack measurements with a percentage deduction of 40% for voids. The stacking shall be as directed by the Engineer.

1.4 Lowering of pipes and jointing of pipes and specials

1.4.1 Laying and jointing shall be in accordance with Clause 9.1, IS: 783-1985 for laying of concrete pipes. All pipes and fittings shall be carefully handled and lowered into the trench by means of mobile cranes. Any other method of handling shall be got approved by the Executive Engineer concerned. The pipes and specials should be handled by flat rubber boots. Iron chain or iron crow bards should not be used under any circumstances for handling the pipes and specials at any stage. The sockets shall face opposite to the direction of flow of water in the pipe. Pipes shall be normally laid so that the spigot end enters the socket of the last pipe that is, socket faces and direction of laying. The socket and spigot ends of pipe shall be cleaned of all extraneous matter especially clay or grease. Rubber ring shall be clean and dry.

1.4.2 Pipes shall be laid true to the lines and grades given on the plans. The rubber rings shall be kept evenly positioned on the spigot groove, and when satisfied that pipe and ring are correctly positioned, the pipe shall be forced right home to the full depth of the joint. Inside the joint, the two pipe ends shall be in close proximity.

1.4.3 Baling or pumping out of water from trench including shoring, strutting and removing such while laying, jointing and testing shall be done by the contractor at his expense.

1.5 Special Fittings

1.5.1 Special fittings have to be located at the exact chainage as shown on plans. It might entail in the necessity of laying short pipes in specified length. The number of gaps should be got approved by the Executive Engineer concerned.

1.5.2 Jointing between the special and pipe shall be done with rubber rings.

1.5.3 The construction of all anchor blocks at bends, 'Y's and Tees shall be done by the contractor. It shall be his responsibility to check for the adequacy of the anchor block.

5.6 Testing pipes on position

5.6.1 The finished pipeline shall be tested in convenient sections between stop valves. The test gap and short reaches which could not be tested simultaneously as a continuous reach due to circumstances prevailing during execution may be subjected to the pipeline static pressure or maximum working pressure plus surge pressure which maybe created during testing the short reaches and test gap whichever is higher as the case may be. The Executive Engineer's decision regarding the test pressure at field for the above test gap and short reaches will be final. When testing the pipeline hydraulically, the line shall be filled completely with water and kept filled for a week. The pressure shall then be increased gradually to full test pressure and maintained at this pressure for one hour. In testing pipelines, a seepage allowance of 2.5 litres per kilo metre per hour per centimetre diameter of the pipe shall be permissible.

5.6.2 Joint testing

When testing the finished pipe line hydraulically after filling the pipeline section under test with water it shall be left under operating pressure for a certain length of period which will depend upon initial permeability, absorption movement of the pipeline under pressure and the quantity of air trapped. More water shall be pumped from a calibrated container until the required test pressure is reached, the test pressure shall be maintained throughout the test by means of continued pumping using a pressure relief valve. The excess water coming from the relief valve shall be returned to the calibrated container. The rate of loss of water from the container shall be determined at regular intervals. The pipeline is satisfactory provided the successive measurement show a diminishing quantity.

An allowance of 3.00 litres per millimetre diameter of pipe per kilometre of pipeline per day per each 30 metre head of pressure applied shall be allowed.

The field test pressure to be imposed should be not less than the greatest of the following.

i) 1 ½ times the maximum sustained operating pressure.
ii) 1 ½ times the maximum pipeline static head; and
iii) Sum of the maximum sustained operating pressure or the maximum pipeline static pressure and the maximum calculated surge pressure.

Subject to a maximum equal to the works test pressure for any pipes and fittings incorporated in the pipeline. However, the line test pressure, in no case, shall exceed the hydrostatic proof test pressure. Pressure gauges shall be inserted at both ends of the line and test so that leakage can be precisely calculated.

5.7 Back filling trenches

5.7.1. The initial back fill shall be of selected materials suitable for tamping under the pipes and down at the sides. Earth shall be placed by hand in 7.5cm layers and rammed well until the backfill material reaches 15cm above the crown line of the pipe. Mechanical rammers may also be used.

5.7.2. The remainder of the trench shall be filled carefully with ordinary excavated material without rock and rammed property.

5.7.3. Refilling can be done leaving the joints portion exposed, after laying

5.8 River crossings

5.8.1 All the supporting structure for pipeline to be taken above M.F.L. (Maximum Flood level) in river. The contractor shall furnish detailed drawings showing the type of bedding needed to support the pipe.

5.9 Railway crossings

Required permission for laying, jointing and testing the pipeline across the railway lines will be obtained by the Employer. The contractor will carry out the work according to the specifications and stipulations made by the Railway authorities.

5.10 Road crossings

Wherever pipeline has to cross roads or cart tracks, it shall be done through a culvert or bridge, wherever necessary.

5.11 Distance indicators

The Employer shall supply and fix indicators at all points of change of direction, at all valves and at every one kilometre intervals along the pipeline. Indicators shall consist of 10 cm x 10cm pre-cast concrete posts 1.25 metre length set 0.75 metre into the ground and painted white above ground level. The description shall be written in blue at one face of the pre-cast post.

5.12 Drawings

The drawings are only indicative. The site conditions will only be the governing factor for manufacture, laying and payment.

V. PUMP SETS AND ACCESSORIES

General

1) All the materials used shall conform to the relevant BIS and should be delivered at site of work. The contractor is responsible for safe custody of machinery and other equipments under this contract till handing over to the employer.

2) The rates should include all the minor items of civil works, if any required for installation complete.

3) All necessary civil works for condition of all equipments and accessories offered by the contractor under this contract should be done by the contractor.

4) Test certificates for machinery and equipments should produced along with supply.

5) The bidder should enclose the performance curve duly indicating the duty point for the size of the impeller selected (family curve should not be furnished.). The performance curve should furnish complete range of operation and the curve should be authenticated by the manufacturer or his authorised dealer. In the event of noon compliance the offer shall be summarily rejected.

6) The contractor shall make necessary arrangements to get of electricity from TNEB for operating the machinery and equipment. Necessary vouchers in original for the payment made to the EB shall be produced to the employer by the contractor which shall be reimbursed by the employer.

7) Before supply of machinery, equipments and other accessories prior approval of the engineer should be obtained giving the name of makes and other details required.

8) Obtaining approval of electrical layout diagram for the installation of all the equipments (transformer, generators, pump sets and other accessories) and obtaining safety certificate on completion of work from Chief Electrical Inspector to Government of Tamil Nadu arranged and got approved by the contractor at his cot.

9) The contractor should get the layout approval in time before execution and for the size and capacity of the equipments before the supply of the same. After execution of the Safety Certificate if any modification or alteration suggested by the Chief Electrical Inspector on the installation work done by the contractor should be carried out by the contractor at his cost.

10) All the materials should be supplied as per BOQ and should be of standard makes mentioned below: -

SL. No.	Description	Make
1)	Centrifugal pump	Kirloskar, Jyothi, best and Crompton Mather and Platt, Inorthington, Flow More or equivalent
2)	Turbine Pump	Kirloskar, Jyothi Best and Crompton Mather and Platt, Inorthington, Flow more Fair Banks Morse or equivalent.
3)	Submersible pump and motor	KSB, Calama, Waterman, Atlanta or equivalent
4)	Make of motor	Jyothi NGEF, GEC, Crompton and Greeves, Siemens or equivalent
5)	Make of transformer	Kirloskar, GEC Indo TECH, Hindustan or equivalent

6)	Diesel Generator	Kirloskar, GEC of equivalent
7)	Starter	L&T, Cutler Hammer, Siemens, MEI or equivalent
8)	Switch fuse and circuit breakers	L&T, Cutler Hammer, Siemens, MEI or equivalent
9)	Cables	Finolex, Unista, Uniflex of equivalent.
10)	Valves	Kirloskar, Venus, Upadyaya CALSONS or equivalent

11) The right of choosing the make among the makes offered by the contractors rest with the employer only.

12) The submersible pumps centrifugal pumps, turbine pumps submersible motors, motors for turbine and centrifugal pump set transformer, generators, Panel Boards to be supplied by the firm will be inspected by the Inspecting Agency fixed by the Employer at the manufacturers premises and test certificate will be issued. The contractor should make necessary arrangements for the inspecting staff at his own cost for testing the above pump sets.

All tests necessary to ensure that the plan and machinery or equipments complies with the specification and guarantees shall be carried out at site and at the contractor's cost and such test shall be carried out within one month of completion of erection. Should the result of these test not done within the margin specified, the test shall reported within one month from the date of plant is ready for retest and the contractor shall repay to the Engineer all reasonable expenses to which he may be put by such test.

13) If the completed plant or any portion thereof is found to be defective the Engineer shall give the contractor a notice in writing to verify such defects. If the contractor fails to rectify the defects within the specified period the Engineer will rectify the defects at the contractor's risk and cost.

2(a) TURBINE PUMP

The pump shall be of manufacture's latest standard design to give maximum efficiency when operated under the most exacting conditions at medium speed 1000/1500 RPM, conforming to IS 1710-1989 as amended upto date. The equipment shall conform to the following specifications:

I Impeller

The impeller shall be of bronze. They shall be turned and bered to gauge accurately finished and hydraulically balanced on the own shaft for maximum lifting capacity without overloading the prime mover irrespective of water level fluctuations. The impeller shall be locked to the shaft with sleeves and lock nuts.

II Impeller Shaft

The shall be carbon steel of ample size and stiffness to transmit power without strain or vibration.

III Line Shaft

The shaft shall be of special grade steel having exceptionally high torsion strength. The shaft shall be in standard length of 1.50M/3.M suitably coupled. The shaft shall be held in proper vertical position by suitably provided bearings of high quality phosphor bronzer.

IV Bearings

The line shaft shall be supported by oil lubricated/water lubricated bearings and the bearing retainers shall be designed for noiseless operation shaft coupling shall be specially machined for true alignment of the driven shaft

V Column Pipes

Heavy steel column pipes with machine cut in 1.5M/3M length of suitable diameter shall be provided. The bowl designs shall be such as to provide the straightest possible water passage to minimize friction and turbulence

VI Name Plate

Each pump shall be provided with a brass name plate with duty conditions and with all other particulars clearly engraved in it.

VII Performance Curves

Performance curves for the pump indicating the head in metres. Efficiency and BHP absorbed at the pump shaft against the output in litres per minute shall be furnished. The pump offered shall have working range of plus 10% of the operating head. The performance curve should be duly signed.

The performance curve must contain the following

a. Discharge (full range) Vs. Total head in meters.
b. Discharge (Full range) Vs. Pump efficiency in percentage
c. Discharge (Full range) Vs. overall efficiency percentage (Pump to Motor)
d. Discharge (Full range) Vs. BHP absorbed in KW
e. Discharge (Full range) Vs. power input in KW

2(b) MOTOR

I Type of Motor

The motors (suitable for turbine pump) shall be vertical hallow shaft AC Squirrel cage induction motor with drip proof screen protected continuous using suitable for operation in the range of 360/440 volts 3 phase 50 cycles and the speed 1000/1500 rpm

II Output of motors

The motor shall be capable of developing the mechanical output for the required conditions and shall have continuous normal rating to suite the maximum load when operated at the pump speed. The efficiency and power factor shall be to suit the wide range at load conditions and shall be designed and manufactured in accordance with relevant BIS.

III Bearings

The motors shall be provided with suitable bearings of ample size readily available from stocks in India. The bearings shall be accurately fitted and provided with moisture and dust proof bushes. The contractor shall state the name of the manufactures and the bearing No.

IV Overload

The motors shall be capable of withstanding the overload specified in the relevant condition.

V Temperature Rise

The temperature rise in windings shall not exceed over an ambient temperature after a full load continuous run of 12 hours. The temperature rise shall not reach a value where there is risk of injury to any insulated materials of adjacent part irrespective of that has been mentioned above

VI Earth Terminals

Provision shall be made for suitable double earth copper connections on base plate or motor frame and the earth terminal shall be fixed with lugs suitable for the size of earth wire in accordance with the rules of the Indian electricity Act

The motor HP shall be such that it safely take the load when the total head is reduced by the rise of water level in river during flood conditions in the river

The HP of motor offered shall have a margin of 10% above the BHP absorbed by the pump set at duty point and also above the maximum HP absorbed by the pump offered.

VII Starting

The motor shall give full load torque when taking 1 to 1.5 time of full load current

VIII Capacitor

Capacitor shall be designed to conform to 0.95 lagging power factor for motor with control switches. The test certificate from TESTING AGENCY has to be furnished. The motor shall have a name plate giving the following information.

a) Induction motor (Squirrel cage)
b) Name of the manufacturer
c) Manufacturers number and frame reference
d) Type of enclosure
e) B.H.P
f) Rated output in K.W.
g) Rated Voltage and winding connections
h) Number of Phases
i) Frequency in HZ
j) Current approximate in amperes at rated output
k) Speed in revolutions per minute at rated output

3(a) CENTRIFUGAL PUMPS

The pumps shall be designed, manufactured, erected, tested and commissioned as per standards laid down by IS 1520 1980 and as amended from time to time. The standard accessories required for may be supplied along with irrespective of whether such items are specifically mentioned or not in the specification. The design should ensure the noise pollution level below the permissible limit. The rotating parts are to be statically and dynamically balanced. The name plate in stainless steel should indicate the sl. No. discharge, head, speed specific gravity of water to be pumped pump input, motor rating, make etc.

The casing should be free from blow holes, cracks and other imperfections conforming to relevant standard.

Bearing housing shall be of such design to exclude entry of water bearing may used of oil lubricated or grease lubricated type.

The shaft design should ensure the deflection not exceeding. 1 mm per meter length. The flexible tyre type rubber coupling is recommended for coupling pump and motor of horizontal mounting.

Painting may be done as per relevant Bureau or Indian Standard Specification.

I. Casing

The casing shall be coarse grained, cast iron split along with the horizontal central line separately machined free from bow holes or other defects. The suction and delivery branches shall be casted integral with the lowest half of the casing so as to permit the removal of the impeller for inspection and repairs without disturbing suction and delivery pipe connections and the pump alignment with the motor.

II. Impellers

The impeller shall be of prosper bronze steel. It shall be turned and trimmed to gauge and hydraulically balanced on its pump shaft to ensure the same for running without vibration to suit the required duty to meet the conditions under which the pumps are to be operated.

III. Impeller Shaft

The shaft shall be of stainless steel of ample size and stiffness to transmit maximum power without strain or vibration. It should be turned and ground to the exact diameter and key fitted to prevent the impeller rotating with any play. The shaft shall be protected from contact with water at the stuffing box with readily renewable phosper bronze sleeves.

IV. Stuffing Box

The stuffing boxes shall be ofamp0le depth and size for the packing and shall be provided with lantern rings and connections for sealing water and pressure to prevent leakage of air.

V. Bearings

The Impeller shall be supported by ball or roller bearings mounted in housings. The bearing caps shall be removable and the bearings shall be ample size to ensure cool running with a minimum of attention and shall be provided with an efficient lubricating system. The bearing shall be of standard type of design which is readily available from stocks held in India.

VI. Accessories

Each pump shall be provided with the following accessories.

i) Lifting Hook
ii) Priming funnel
iii) Approved type of lubrication system
iv) Drip water pipes
v) Pressure gauge as specified
vi) Compound gauge as specified

VII. Name Plate

Each pump shall be provided with name plate bearing the following particulars clearly marked on it.

Make
Litres per minute
No. of Stages
Revolution per minute
Diameter of suction branch
Index No.
Total head in metres
Diameter of delivery branch

VIII. Base Plate

The base plate shall be of extended type for accommodating the pumps and the motors and it shall be rigid substantial casting with machined faces for the feet of the pumps and motor and it shall be faced on the underside.

IX. Coupling

The shaft coupling for connecting up the Impeller shaft with the motor shaft shall be of flexible type. It shall be made of cast iron turned over to obtain perfect balance, bored to shaft size and securely keyed to the shaft.

IX. CharacteristicsCurves

Performance curves for the sump indicating the head in meter, efficiency, B.H.P. observed at pump set against the output in litres per minute shall be furnished.

3 (b)MOTOR

I. **Typeof Motor**

The motors (suitable for turbine pump) shall be vertical hallow shaft AC Squirrel cage induction motor with drip proof screen protected continuous using suitable for operation in the range of 360/440 volts 3 phase 50 cycles and the speed 1000/1500 rpm

II. Output Motors

The motor shall be capable of developing the mechanical output for the required conditions and shall have continuous normal rating to suite the maximum load when operated at the pump speed. The efficiency and power factor shall be to suit the wide range at load conditions and shall be designed and manufactured in accordance with relevant BIS.

III. Bearings

The motors shall be provided with suitable bearings of ample size readily available from stocks in India. The bearings shall be accurately fitted and provided with moisture and dust proof bushes. The contractor shall state the name of the manufactures and the bearing No.

IV. Overload

The motors shall be capable of withstanding the overload specified in the relevant condition.

V. Temperature Rise

The temperature rise in windings shall not exceed over an ambient temperature after a full load continuous run of 12 hours. The temperature rise shall not reach a value where there is risk of injury to any insulated materials of adjacent part irrespective of that has been mentioned above

VI. Earth Terminals

Provision shall be made for suitable double earth copper connections on base plate or motor frame and the earth terminal shall be fixed with lugs suitable for the size of earth wire in accordance with the rules of the Indian electricity Act.

VII. Technical Data

Bidder shall complete as fully as passible the attached annexures which should be returned duly filled in signed.

The motor HP shall be such that it safely take the load when the total head is reduced by the rise of water level in river during flood conditions in the river

The HP of motor offered shall have a margin of 10% above the BHP absorbed by the pump set at duty point and also above the maximum HP absorbed by the pump offered.

VIII. Starting

The motor shall give full load torque when taking 1 to 1.5 time of full load current

IXI. Capacitor

Capacitor shall be designed to conform to 0.95 lagging power factor for motor with control switches. The test certificate from TESTING AGENCY has to be furnished. The motor shall have a name plate giving the following information.

a) Induction motor (Squirrel cage)
b) Name of the manufacturer
c) Manufacturers number and frame reference
d) Type of enclosure
e) B.H.P
f) Rated output in K.W.
g) Rated Voltage and winding connections
h) Number of Phases
i) Frequency in HZ
j) Current approximate in amperes at rated output
k) Speed in revolutions per minute at rated output

4(a) SUBMERSIBLE PUMP

The pump shall be of latest standard designed to give maximum efficiency when operated under most exacting condition at speed 1500/3000 rpm. The equipment shall confirm to the following specifications as per IS 8030 – 1996 / IS 220/94

I. Pump Bowl

The pump bowl shall be manufactured to offer resistance to corrosion. The bowls may be equipped with replaceable bearing.
The bowl assembly shall bear a name plate giving the following information.

a) Name of the manufacturer or Trade Mark
b) Serial Number of the Pump set
c) Pump Type
d) Number of stages
e) Total head
f) Capacity
g) Speed

II. Impellers

The impellers shall be open or closed or semi closed type. They shall be turned and accurately finished and balanced on their own pump shaft for maximum lifting capacity without over loading the prime mover irrespective of water level fluctuations. The impeller may be of the enclosed or semi enclosed type and shall be properly balanced. Dynamic balancing is recommended. Enclosed impellers may be equipped with sealing rings on their hubs.

III. Pump Shaft

The pump shaft be stainless steel of ample size and stiffness to tranmit maximum power without strain or vibration. The pump shaft shall be guided by bearings provided below and above the impeller shaft assembly. The shaft without protecting sleeves shall have a surface finish of 0.75 micron.

IV. Bearing Sleeve

The bearing sleeve shall be of leaded bronze.

V. Discharge Casing

The discharge casing shall be manufactured to offer resistance to corrosion.

VI. Suction Casing

The suction casing shall be manufactured to offer resistance to corrosion. The opening in the suction case of the entrance shall be of proper size and shape to reduce loss. The suction case shall be fitted with a strainer made of corrosion resistant materials. Suitable guard shall be provided just above the suction case bearing to prevent the entry of foreign matter into the suction case.

VII. Coupling

Suitable coupling arrangements shall be provided in case of directly coupled pump sets.

VIII. Non-Return Valve

Non return valve shall be provided above the pump discharge case.

IX. Characteristic Curves

The performance curves for the full range of operation indicating the head in meters, efficiency and BHP absorbed at the pump shaft against the output in liters per minute shall be furnished.

4(b) SUBMERSIBLE MOTORS

I. Type

The submersible motor shall be wet type, squirrel cage induction motor suitable for operation on 360/440 Volts, 3 phase 50 cycles AC supply and capable of developing the required HP at a speed 1500/3000 RPM. The motor windings and the bearing bushes of the rotor shaft shall be lubricated by pure water or oil, filled in the motor before erecting the pump sets. The motor shall confirm to IS 9283 – 1979.

The motor shall be connected by means of cable glands rubber seals etc. from inside of bore well to arrest the entry of sand and other foreign matter.

The motor shall be provided with a breathing attachment like bellows diaphragm etc. to compensate the volumetric variation due to changes in the temperature. The motor shall be made of corrosion resisting materials or suitably treated materials to resist corrosion under normal condition.

II Bearings

The thrust bearing shall be of adequate size to withstand the weight of all rotating parts as well as imposed hydraulic thrust. These shall be lubricated suitably. The thrust bearing housing shall be provided with a drain plug to empty the oil pure water filled into thrust bearing housing rotor.

III Motor

The rotor shaft shall be provided with shaft protective sleeves having a surface finish of 0.75 micron.

IV Earthing Arrangements

The earthing of motor shall comply with IS: 3043-1966 code of practice for earthing provision shall be made for double earth copper connection. Two separate lead should be taken to two separate earth pits located outside the pumphouse.

V Temperature Rise

The installation should be perfect so as to limit the temperature rise in windings.

VI Output

The motor shall be capable of developing the Mechanical output for the required conditions and shall have continuous normal rating to suit the maximum load when operated at the pump speed.

VII Technical Data

The motor HP shall be such that to safely take the load when the total head is reduced by the rise of water level.

The HP of the motor offered shall have a margin above the HP absorbed by the pump set at duty point and also above the maximum BHP absorbed by the pump sets at duty point and also above the maximum BHP absorbed by the pump set offered.

VIII Overload Capacity

The motor shall be capable of withstanding the overload specified in the relevant condition of BIS.

IX. Starting

Motor shall give full load torque when taking 1 to 1.5 times full load current. The motor shall have a name plate giving the following information.

a) Induction motor
b) Name of manufacturer
c) Manufacturers No. and Frame reference
d) Type of enclosure
e) BHP
f) Rated voltage and winding connections
g) Rated output in KW
h) Number of phases
i) Frequency in HZ
j) Current approximate in amperes at rate outs put
k) Speed in revolutions per minutes at rates output
l) Current approximate in amperes at rates output
m) Speed in revolutions per minute at rates output

X Spare Parts

Supply of spares and tools shall be made as per the list prescribed in BOQ with index card.

XI Tools

Standard tools for the maintenance of the equipment's shall be supplied as detailed

D/E spanners	1 set
Ring spanners	1 set
Bearing puller	1 No
Grease gun	1 No
Hand Gloves tested for electrical operation	1 pair
Ball peen hammers	1 No
Screw drivers	1 set
Electrical tester	1 No
Electric meager	1 No

XII Completion Plans

The successful bidder shall be requested to furnish completion plans in triplicate within one month from the date of the first testing of the plants. The plan should show the entire layout of the plant executed. Two copies of plan should be supplied to the Employer and one to be framed and suspended in the Head works. The contractor shall in addition to the above furnish detailed specifications of the equipment provided to the Employer with all technical data.

XIII Maintenance Manual

The periodical maintenance schedules for each equipment shall be given with reference to the hours of operation. Detailed information about the spare parts (part name, identification number etc.) should be given. The copies of the manuals should be furnished within one month from the data of commissioning.

VI. ANNEXURES

I) Pump characteristics

II)

a) Turbine pumps

b) Motors for Turbine

III)

c) Centrifugal pump

d) Motors for Centrifugal pump

IV)

e) Submersible pump

f) Motors for Submersible pump

(THE ABOVE ANNEXURES ARE APPLICABLE SHOULD BE FILLED IN AND DULY SIGNED AND ENCLOSED WITH THE BID DOCUMENT– COVER I)

ANNEXURE - I
Pump Characteristics

Sl. No.	Description	Technical Details	Remarks
a.	Capacity in LPM (discharge)		
b.	Total head in metres		
c.	Net positive suction head required		
d.	HP absorbed by the Pump		
	i) at duty point		
	ii) at max BHP point given in the range of curve furnished		
e.	HP of the motor offered		

Note:

The motor must not get over loaded, at Positive low head condition due to Maximum W.L. conditions in Borewell / well.

ANNEXURE II (a)

TURBINE PUMPS

1. Name of manufacturer

2. Model

3. IS reference

4. Type

A. PUMP DETAILS

1. Nature of Lubrication :

2. Suitability for collector well/ collection well with a depth of m :

3. Stages :

4. Bowl outer dia in mm :

5. Discharge in LPM :

6. Total head in metres :

7. Speed in RPM :

8. Power input at duty point HP/K.W :

9. Maximum power input required for entire of operation :

10. Pump set efficiency at duty point in % :

11. Shut off head in metre :

12. Minimum submergence :

B. Column Assembly

1. Dia in mm :

2. Length in metre :

3. Type of joint (flanged or screwed) :

TENDERER

C. SIZE

4.a i) Oil tube if necessary dia …..m
ii) Material

b. i) Line shaft dia …..m
ii) Material

2. Discharge head

Surface / Underground

3. Delivery size in mm

4. Impeller

i) Material
ii) Type

5. Balancing of impeller Dynamic / Static

Floor space required ….. Sq.m

6. Weight of pump heaviest part bowl assembly
Weight of complete pump

7. Type of scaling rings

8. Type of impeller shaft sleeves

9. Type of bearing, make and reference number

10. Are the bearing external

11. Materials of bearings

12. Whether the performance curve is attached

13. Does the characteristics curve conforms to
Indian standard specifications

14 What is the nature of drive

15. Type of coupling

16. Weight of the motor

17. Does the pump and its accessories conform to IS

ANNEXURE – II (b)

MOTOR FOR TURBINE PUMP

1. Rated output HP :

2. Make :

3. Description type :

4. System Voltage :

5. Current in Maps at rated output :

6. Current rating at full load :

7. Class of insulation :

8. Permissible Temperature rise over

   45 degree Ambiant temperature

9. Efficiency at 100% load

   75% load

   50% load

10. Power factor 1/2 Load

    3/4 Load

    Full Load

11. Type of Enclosure

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12. B.I.S Reference :

13. Type of Rotor :

14. Type of Starting :

15. Rotor current

a) Max Starting

b) Normal full Load

16. Overload capacity

25%

50%

100%

17. Operating torque

18. Starting current

19. No. of pole

20. Bearing Make & Number

21. Type of coupling

22. Whether motor conform to

B.I.S specifications

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23. Weight of motor

ANNEXURE – III (a)

Centrifugal Pumps

1.	Type & Make	:	
2.	B.I.S. reference	:	
3.	Stages	:	
4.	Suction diameter in mm	:	
5.	Delivery diameter in mm	:	
6.	Materials	:	
i)	Casing	:	
ii)	Bearing	:	
iii)	Impeller	:	
iv)	Base Plate	:	
7.	Bearing No.	:	
8.	Speed in RPM	:	
9.	Method of lubrication	:	
10.	Balancing of Rotating parts	:	
11.	Gland Rope size	:	
12.	NPSHR in metre	:	
13.	SHUT off head in metre	:	
14.	Type of coupling	:	
15.	Materials of coupling	:	

16.	Weight of (I) the pump (ii) Heaviest part of the pump	:	
17.	Space required in Sq.m.	:	
18.	The clearance required/ between two strainers, bottom, floor and strainer.	:	
19.	Type of impeller	:	
	i) Type of sealing rings	:	
	ii) Bearing make & number	:	
20.	Are the bearing internal or external	:	
21.	Are the characteristics of pumps attached	:	
22.	Does the characteristics conform to B.I.S.	:	
..23.	Nature of driver	:	
24.	Length of pumpset	:	
25.	Accessories conform to B.I.S.	:	
26.	Whether Performance chart enclosed	:	

SL No.	Description	Head in Metres			Dis charge in Lpm.	Speed in RPM	Efficien cy %	BHP
		Suc Tion	Deli very	Total				
1.	At any point							
2.	At LWL condition							
3	At MWL condition							
4.	At shut off head							

.28.	Are the following accessories provided	:	
a.	Priming funnel and Union	:	
b.	Air Release cocks and drain cocks	:	
c.	Drip water pipes	:	
d.	Compound gauge to suction and delivery branch	:	

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e.	Are the gauge graduated in metre head of water, if so, give range	:	
f.	What arrangement is adopted for preventing air being a drawn into the pumps	:	

ANNEXURE – III (b)

Motors for Centrifugal Pumps

1	Name of the Manufacturer	:		
2	Type of Motor	:		
3	Output brake horse power	:		
4	Number of phases	:		
5	Cycles	:		
6.	Voltage	:		
7.	Speed at full load	:		
8.	Rating	:		
9.	Class & insulation	:		
10.	Stator current (Normal full load Phase)	:		
11.	Current	:		
	a) Normal full load	:	Amps	per phase
	b) Maximum starting	:	Amps	per phase
12	Efficiency	:	Load	Tolerance
			Full	%
			3/4	%
			1/2	%
Note	: Manufacturer's Certificate should be enclosed			
13	Overload capacity	:		
	a) 25%			
	b) 50%		Will be furnished later	
	c) 100%			
14	Power factor	:	Load	Tolerance
			Full	%
			3/4	%
			1/2	%

15.	Temperature rise		
	a. With 12 Hrs. of full speed run with 45°C ambient temperature at the place	:	Stator Rotor
16.	Starting torque	:	
	a. In percent of full load torque	:	
	b. Starting currenting percent of Normal full load current system	:	
17.	Details of motor	:	
	a. Number of poles	:	
	b. Type of enclosure	:	
	c. Type of Motor	:	
18.	Bearing manufacturer		
19.	Type and size (Driving end)		
20.	Type and size of bearing at non-driving end		
21.	Size of coupling and its type		
22	Does the motor conform to BIS		
23	Specification reference		
24	Weight of motor		
25	Degree of protection of motor		

ANNEXURE IV (a)

SUBMERSIBLE PUMPS

1	Name of the Manufacturer	:	
2	Type of Pump and Model	:	
3	Number of Stages	:	
4	Material of Strainer	:	
5	Delivery Branch dia (in mm)	:	
6.	Total Discharge in LPM	:	
7.	Materials of Casing	:	
8.	Type of Impeller	:	
9.	Materials of Impeller	:	
10.	Materials of Impeller Shaft	:	
11.	Type of bearings	:	
12.	Are the bearings external or internal		
13.	Material of bearings	:	
14.	Makers Name and Code No. of bearings	:	
15.	Whether Moving parts are balanced	:	
16.	If so, type of balancing	:	
17	BHP of the pump		
18	Efficiency of the pump	:	
19.	Weight of the Pump	:	
20.	Diameter of the Pump	:	
21.	Pump Speed	:	

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22	Are the characteristics curves of the pumps attached	:	
23.	Total Head	:	
24.	Does the Pump conform to BIS Specification	:	
25.	Specification Reference	:	
26.	Whate is the Nature of the drive	:	
27.	Type of Coupling	:	
28.	Weight of the heaviest part of the Pump	:	
29.	Weight of the Pump Complete	:	

ANNEXURES-IV (b)

MOTOR (FOR SUBMERSIBLE PUMP SETS)

1	Name of the Manufacturer	:	
2	Type of Motor	:	
3	Brake Horse Power of the Motor	:	
4	Number of Phases	:	
5	Cycles	:	
6.	System Voltage	:	
7.	Frequency	:	
8.	Speed at Full Load	:	
9.	Full Load Current	:	
	a) Normal Full Load b) Maximum Starting	:	…… Amps …… Amps
10.	Efficiency	:	Load Percent Tolerance as per BIS
			Full ¾ ½
11.	Over Load Capacity		
	a) 25%	:	
	b) 50%	:	
	c) 100%	:	
12.	Power Factor		Load Percent as per Full 3/4 ½

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13	HP of the Motor	:	
14.	Number of Poles	:	
15.	Type of Enclosure	:	
16.	Type of Rotor	:	
17.	Bearing Manufacturer	:	
18.	Type, Number and Size of bearing (Driving End)	:	
19.	Size of Coupling & its type	:	
20.	Does the Motor conform to BIS Specification	:	
21.	If so, state the No.	:	
22.	Weight of Motor	:	
23.	Total weight of the Pump & Motor	:	
24.	Diameter of the Pump set	:	
25.	Overall efficiency of the Pump set	:	

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VII. Maintenance of the Projects

1) It is the sole responsibility of the contractor to maintain the entire project successfully for the (DLP) maintenance period of 12 months

2) The following measures are to be taken essentially by the contractor

- Necessary maintenance crew with supervisory staff shall be deployed. The staff pattern proposed by the contractor for the maintenance of the completed project should be got approved by the Employer one month before the issue of completion certificate. The entire strength of maintenance crew with the supervisory personnel should be available from the first day of the maintenance period.

- The contractor should keep all spares required for replacements at the headworks, pumping main, distribution system, pump sets etc., readily available to ensure uninterrupted water supply to the beneficiaries.

- All the equipments that goes out of order during the course of the maintenance period shall be rectified / replaced immediately to ensure uninterrupted water supply. If any equipment / machinery is found to be defective either due to manufacture or due to unsatisfactory maintenance, the same should be replaced by the contractor at his cost.

- The contractor is responsible for the incidence of any theft; malpractice etc within the project area during the maintenance period and the contractor shall keep the Employer indemnified.

- During the period of maintenance, all costs towards labour, spares, consumables, repairs and renewals shall be on to the account of the contractor.

- The electrical energy charges payable to TNEB during the maintenance period shall be borne by the Employer.

- Complete quality service shall be ensured by the contractor during the maintenance period.

- Necessary log books indicating the quantity of water pumped, and maintenance carried out and repairs attended with details of spares changed shall be maintained by the contractor on a day to day basis and produced to the Engineer-in-charge whenever called for.

- Immediately after verification of satisfactory functioning of the scheme be the Implementing division within a period of 3 months, the scheme may be handed over to the TWAD Board Maintenance Division even while the implementation contract concluded with the Contractor is alive. The operation and maintenance clause in the implementation contract can be continued to be done by the contractor until the total expiry of contract period (i.e.) **12 months** specified in the implementation contract and the enforcement of the contract with regard to the maintenance clause of the contract will be by the Maintenance Division.

- Completed schemes after twelve months of Contractor's maintenance shall be handed over to the local body by following due procedures laid down in this regard by the Government along with appropriate presentation to the local body about the scheme details and its maintenance.

- After handing over the scheme shall be maintained by the Contractor under joint supervision by the TWAD Board and the local body for the next six months.

If commissioning is delayed due to other reasons not related to the deficiency of the Contractor, the pending payment shall be released against Bank Guarantee.

X. Reference to Specifications / Code of Practice

Description	BIS No.
Ordinary Portland Cement (33 Grade)	269 – 1976
43 Grade Ordinary Portland Cement	8112 – 1989
Pozzolona Portland Cement	1489 – 1991
Hydrophobic Portland Cement	8043 – 1978
Rapid Hardening Portland Cement	8041 – 1990`
Low Heat Portland Cement	12600 – 1989
Standard sand for testing of cement	650 – 1966
Methods of Test for Pozzolonic Materials	1727 – 1967
Methods of sampling and test for water & waste water (Physical & Chemical)	3025 – 1984 (Part I to 37)
Methods of Sampling hydraulic Cement	3535 – 1986
Methods of Physical tests for hydraulic cement	4031 – 1988 (1 to 14)
Methods of chemical analysis of hydraulic cement	4032 – 1985
Aggregates coarse & Fine from Natural resources for concrete	383 – 1970 4082/1977
Sand for Masonry Mortar	2116 – 1965 1542 / 1977
Methods of tests for aggregates for concrete	2386 – 1963 (Part 1 to 8)
Part I – Particle size and shape	2386 – 1963 (Part-I)
Part – II – Estimation of deleterious Materials & Organic impurities	2386 – 1963 (Part – II)
Part III – Soundness	2386 – 1963 (Part – III)
Methods of sampling of aggregates for concrete	2340 – 1986
Specifications for test sieves Part I – Wire cloth test Sieves	460 – 1978 (part – I)
Common Burnt clay building bricks	1077 – 1976
Mild Steel and Medium tensile steel bars and hard	432 – 1982
Drawn steel wire, concrete reinforcement, Part I Mild Steel & Medium Tensile Steel Bars Part II Hard drawn steel wire	
High Strength deformed steel bars and wires for Concrete reinforcement	1786 – 1985
High Tensile Steel for PSC Pipes	1784 – 1986 (Part I)
Bending and flexing of bars for concrete reinforcement	2502 – 1969
Recommendation for detailing of reinforcement In reinforced concrete works	5525 – 1969
Methods for tensile testing steel wire	1521 – 1972
Methods of test for determining modulus of elasticity	2854 – 1964
Glossary of terms relating to cement concrete	6461 – 1972 (Part 1 to 12)
Methods of test for strength of concrete	516 – 1959
Methods of sampling and analysis of concrete	1990 – 1959
Methods of testing bond in reinforced concrete pull out test	2770 -1967
Methods of test for permeability of cement Mortar and concrete	3085 – 1965

Description	BIS No.
Methods of test for splitting tensile strength of concrete cylinders	5816 – 1970
Methods of tests for determining setting time of concrete by penetration resistance	8142 – 1976
Code of practice for construction of Pile foundations (concrete piles) Driven cast-in-situ concrete piles Bored cast –in-situ piles Driven pre-cast concrete piles Bored pre-cast concrete piles	2911 (Part (I) Sec 1 – 1979 Sec 2 – 1979 Sec 3 – 1979 Sec 4 – 1984
Code of practice for construction of raft foundation	2950 – 1981
Design Aids for reinforced concrete	SP 16 – 1980
Explanatory Hand Book on codes for earthwork Engineering	SP 22 – 1982
Explanatory Hand Book on IS Code 456 – 1976	SP 24- 1983
Hand Book on causes and prevention of cracks in buildings	SP 25 – 1984
Hand book on concrete reinforcement and detailing	SP 34 –1987
Brick Masonry	2212 –1962
Construction of Stone Masonry	1957 – 1967
Asbestos cement pressure pipes	1592 – 1989
Concrete pipes with and without reinforcement	458 – 1988
P.S.C. pipes (including fittings)	784 – 1978
Methods of tests for concrete pipes	458 – 1988 3597 – 1985
Materials for M.S. Specials	226 – 1976 & 2062 – 1980
Specification for M.S. Specials for P.S.C. Pipes	
Specification for Steel cylinders reinforced concrete pipes	1916 – 1989
Methods of tests for concrete pipes	3597 - 1985
Special for steel cylinders reinforced concrete pipes	3597 – 1985
Cast iron specials for asbestos cement pressure Pipes for water, gas & Sewage	5531 – 1988
Methods of test for asbestos cement products	5913 – 1989
Dimensional requirements of rubber sealing ring for CID joints in asbestos cement pipe	10292 – 1988
Centrifugally Cast (Spun) Iron pressure pipes for Water, gas and sewage including fittings	1536 – 1989
Specification for Centrifugally Cast (Spun) D.I. Pipes for Water, Gas and Sewage	8329 – 1990
D.I. fittings for pipes for water gas & Sewage	9523 – 1980
Dimensional requirements of rubber gaskets for mechanical joints and push on joints for the use with C.I., D.I. Pipes	12820 – 1986
C.I. Specials for Mechanical and push on flexible joints for pressure pipe lines for water, gas & sewage	13382 – 1992
Horizontally cast iron double flanged pipes for water, Gas and Sewage	7181 – 1986
Cast iron fittings for pressure pipes for water, gas and sewage	1538 – 1976 (Part 1 to 24)
Cast iron detachable joints for use with asbestos cement pressure pipes	8794 – 1988

Description	BIS No.
Rubber rings for jointing C.I. pipes, RCC Pipes & AC Pipes	5382 – 1969
Rubber rings for jointing P.S.C. Pipes	5382 – 1985
Rubber rings for jointing AC pipes with AC couplings	10292 – 1985
Pig lead (caulking lead)	782 – 1978
Hemp yarn	6587 – 1966
Rubber insertion to be used in jointing CIDF Pipes	638 – 1979
Bolts & Nuts to be used in jointing CIDF Pipes	1363 – 1967
Unplasticized PVC Pipes for potable water supplies	4985 – 2000
Injection moulded PVC socket fittings with Solvent cement joints for water supplies	7834 – 1987 (Part I to 8)
Fabricated PVC fittings for potable water supplies	10124 – 1988 (Part I to 13)
Methods of test for unplasticized PVC pipes for potable water supplies	12235 – 1986 (Part I to 11)
Sluice valves for water works purposes (50 to 300mm Dia size)	780 – 1984
Sluice valves for water works purposes 300 to 1200mm Dia size)	2906 – 1984
Surface boxes for sluice valves	3950 – 1979
Manhole covers for sluice valves	1726 – 1974
Laying of Asbestos Cement Pressures Pipes	6530 – 1972
Laying of concrete Pipes	783 – 1985
Laying of Cast – Iron Pipes	3114 – 1985
Laying of PSC Pipes	126 of APSS & 783 – 1985
Laying of DI Pipes	12288 – 1987
Laying and Jointing of unplasticized PVC Pipes	7634 – 1975 (Part 3)
Batch type concrete mixer	1791 – 1968
Sheep foot roller	4616 – 1968
Safety code for excavation works	3764 – 1966
Safety code for scaffolds and ladders Part I – Scaffolders Part II – Ladders	3696 – 1966 (Part I) 3696 – 1966 (Part II)
Safety code for piling and other deep foundations	5121 – 1969
Safety code for working with construction machinery	7293 – 1974
Tamil Nadu Building Practice	Volume – I Volume – II
Government of India Manual on Water Supply and Treatment	May 1999 (Revised)
Gravel for packing	4091 – 1967
Hard drawn steel wire	1785 – 1983 (Part I and II)
Structural Steel	226 – 1975
Hand rolled mils steel for concrete	1139 – 1966
Hard drawn Steel Wire	1566 – 1982
American Society for Testing of materials	
British Standard	2494 – 1955 Part I

Description	BIS No.
Welding Electrodes	814 – 1970
Steel Sheets	225 – 1975
Guniting	7322 – 1994
Welding Joints	3589 – 1966 and 2041 – 1962
Tensile Test	223 – 1950
Mechanical and Electrical works	
Turbine Pump	1710 – 1972
Submersible Pump	8030 – 1976
Submersible Motor	9283 – 1979
Earthing	3043 – 1966
Transformer	1180 – 1964
Generator	2253 – 4722
HDPE Pipes	4984 - 2016
OPVC Pipes	16647 - 2017