KARNATAKA URBAN WATER SUPPLY AND DRAINAGE BOARD

Providing 24x7 Water Supply System (Phase-I, Part-2) in water zones - 1, 8, 10, 17, 24, 28, H-10 & D-24 of Hubli-Dharwad twin city under UWSS.

Part-A

Study, Survey, Preparation of Base map, Conditional Survey, Assesment of NRW, Customer Survey, Analysis, Design & Drawing.

Part-B

Providing and Laying of 762, 660, 508 & 457 mm dia MS Feeder Mains.

Part-C

Providing & Laying of 250mm, 300mm and 400mm dia D.I. and 75mm, 90mm, 110mm, 160mm, 200mm dia HDPE pipeline for 24x7 distribution system.

Part-D

Operation and Maintenance of 24x7 distribution system for a period of 5 years.

ITEM RATE TENDER

CHAPTER-4

Special Specifications

Contractor Employer/Engineer

CHAPTER 4 : SPECIAL SPECIFICATIONS

1. GENERAL

1.1 Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be acceptable subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the documents

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

IS :	456	Code of practice for plain and reinforced concrete
IS :	458	Specification for pre cast concrete pipes (with and without reinforcement)
IS :	516	Method of test for strength of concrete
IS :	638	Specification for sheet rubber jointing and rubber insertion jointing
IS :	783	Code of practice for laying of concrete pipes
IS :	816	Code of practice for use of metal arc welding for general construction in mild steel
IS :	1367	Technical supply conditions for threaded steel fasteners
IS :	1387	General requirements for the supply of metallurgical materials
IS :	1500	Method for Brinell hardness test for metallic materials
IS :	1916	Specification for steel cylinder pipes with concrete lining and coating
IS :	2078	Method for tensile testing of grey cast iron

IS :	3597	Method of tests for concrete pipes
IS :	3658	Code of practice for liquid penetrant flow detection
IS :	5382	Specification for rubber sealing rings for gas mains, water mains and sewers
IS :	5504	Specification for spiral welded pipes
IS :	6587	Specification for spun hemp yarn
IS :	7322	Specification for specials for steel cylinder reinforced concrete pipes
IS :	8329	Specification for centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage
IS :	9523	Specification for ductile iron fittings for pressure pipes for water, gas and sewage
IS :	12820	Specification for dimensional requirements of rubber gaskets for mechanical joints and push-on joints for use with cast iron pipes and fittings for carrying water, gas and sewage
IS :	314	Code of practice for laying of cast iron pipes
IS :	374	Excavation work - Code of Safety
IS :	417	Code of practice for laying of glazed stoneware pipes
IS :	5822	Code of practice for laying of electrically welded steel pipes for water supply.
IS :	6530	Code of practice for laying of asbestos cement pressure pipes

1.2 Sign Board

The Contractor shall provide a sign board at the site of the Works of approved size and design which provides (i) the name of the Project (ii) the names and addresses of the Employer, the Contractor and the Consultant; (iii) the name and short description of the Project, (iv) the amount of the Contract Price ; and (v) the starting and completion dates.

1.3 Samples and Tests

Pursuant to Clause 36 of Chapter 2, the Contractor shall be responsible to develop a quality control program and to provide all necessary materials, apparatus, instruments, equipment, facilities and qualified staff for sampling, testing and quality control of the materials and the works under the Contractor. Without limiting the generality of the foregoing, the Contractor

shall either (i) establish a testing laboratory at the site of Works which is adequately equipped and staffed to carry out all sampling and testing in accordance with the requirement set out in the General Specifications and/or these Special Specifications and provide all field equipment and apparatus as necessary to conduct all specified in-situ tests and/or any Tests on Completion, or (ii) arrange for routine sampling, testing and reporting, as required, through a certified independent testing laboratory acceptable to the Engineer.

All costs of such sampling, testing and reporting of test results will be borne by the Contractor, and the Contractor shall include sufficient provisions in his tendered rates to allow for independent sampling and laboratory testing under the direction of the Engineer up to 5% of the required tests at no additional cost. The Contractor shall furnish certified copies of all test reports to the Engineer within 3 days of completion of the specified tests.

The Contractor shall, within 28 days after the date of the Letter of Acceptance, submit to the Engineer for his consent a detailed description of the arrangements for conducting the quality control programme during execution of the Works, including details of his testing laboratory, equipment, staff and general procedures. If following submission, or at any time during the progress of Works, it appears to the Engineer that the Contractor's quality control programme is not adequate to ensure the quality of the Works, the Contractor shall produce a revised programme which will be adequate to ensure satisfactory quality control.

1.4 Protection of Utilities

The Contractor is required to carefully examine the location of the Works and their alignments and to make special enquiry's with all authorities concerning all utility lines such as water, sewers, gas pipe, telephone (underground and/ or overhead) lines, electric cable (underground and/or overhead) lines, etc.; and to determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authentic records. The Contractor shall be wholly responsible for the protection and/or facilitating relocation of such utilities as may be required, and shall not make any claim for extra work or extra time that may be required to protect or facilitate relocating such utilities. If any major shifting or realignment of water, sewers, gas pipes, electric and telephone lines is necessary due to their interference with the proposed Works, the same may be done by the Employer. The cost of such relocation will be borne by the Employer.

In case the alignment of the pipeline crosses the high tension electrical transmission lines belonging to the Karnataka State Electricity Board (KEB) or other authorities, the Contractor shall take all precautions necessary to see that the work is carried out with care and safety, without disturbing such transmission lines. The Contractor will be responsible to carry out all construction activities in such reaches in consultation with the owners of such facilities. However, satisfactory completion of the entire work will be the responsibility of the Contractor.

1.5 Earth Work :

1.5.1 General

The earth work for laying of the water main shall generally carried out as per standard specifications for procurement of project works as

provided in chapters 10 of the Bid document with an additions and modification as enumerated in the special specification under this chapter.

The earth work for laying of water main shall include :

1) Removal of all surface obstructions including shrub, jungle, etc. and
2) Carrying out all necessary excavation as per specifications.
3) Providing & installing at place all sheathings, shoring & bracing to the trenches at necessary for the work and removal there of after the work.
4) Pumping and baling out water for progressive escalation and keep trenches dry during concreting, pipe laying and jointing process till the joints mature.
5) Providing for un-interrupted surface water flow during progress of work.
6) Arrangements for diversion of flows from storm drains, valleys or other success.
7) Protecting all pipes, conduits, culverts, roads, railway tracks, utility poles, fences, buildings and other public and private properties fouling the work.
8) Back filling excavated materials accept granular fill is recommended.
9) Removal and disposal of surplus soil from excavation after back filling.
10) Leveling and dressing of surplus soil from excavation or part of it in soil banks along with the trench as directed by Engineer.
11) Restoring all structures and properties injured or disturbed by the Construction activities to as near its original shape, as possible.
12) Restoring the surface of all roads, streets, valleys, walks, drives, easements, working spaces and right of way to condition as good as prior to providing, unless otherwise required by the Engineer, and introducing safety measures for carrying out the work in all respect.

2 SCOPE OF WORK:-

2.1 Pursuant to sub-clause 1.1 of Chapter-1, the scope of work under this contract includes the following –

Providing 24x7 Water Supply System (Phase-I, Part-2) in water zones - 1, 8, 10, 17, 24, 28, H-10 & D-24 of Hubli & Dharwad twin city under UWSS.

The scope includes survey, establishing sufficient Benchmarks, Design and preparation of working drawing and approval from competent authority, implementation & successful commissioning of 24x7 water supply system in water zones - 1, 8, 10, 17, 24, 28, H-10 & D-24 of Hubli & Dharwad twin city including providing and commissioning of House Service Connections and also operation and maintenance for a period of 60 months.

– **ITEM RATE**

Part-A - Study, Survey, Preparation of Base map, Conditional Survey, Assesment of NRW, Customer Survey, Analysis and Design, Drawing and Estimate.

Part-B - Providing and Laying of 762, 660, 508 & 457 mm dia MS Feeder Mains.

1. Replacing the Old 700 mm dia Hume steel Rising Main between Ch. 4470 to Ch. 6470 (L=2000 m) from Dhumwad Pumping Station to Kanvihonnapur WTP by Providing, Laying, Jointing, Testing and Commissioning 762 mm dia (OD) of M.S Pipeline.

2. Providing, Laying, Jointing, Testing and Commissioning 660 mm, 508mm & 457 mm dia (OD) M.S Feeder Main From Nrupathungabetta to Keshwapur, HDMC Park & Tabib Land Service Reservoirs in Hubli City.

Part-C- Providing and laying of 250mm, 300mm and 400mm dia D.I. and 75mm, 90mm, 110mm, 160mm, 200mm dia HDPE pipeline for continuous pressurised Water Supply (24x7) distribution system

1. Providing, Laying, Jointing, Testing & Commissioning of DI & HDPE Water distribution network and House Service Connections in Water Zone - 8 from ESR at Mahadevi layout for 24x7 Water Supply (Phase-I, Part-2) in Hubli city.
2. Providing, Laying, Jointing, Testing & Commissioning of DI & HDPE Water distribution network and House Service Connections in Water Zone- 10 from N R Betta GLSR for 24x7 Water Supply (Phase-I, Part-2) in Hubli city.
3. Providing, Laying, Jointing, Testing & Commissioning of DI & HDPE Water distribution network and House Service Connections in Water Zone H-17 from ESR at Gabbur for 24x7 Water Supply (Phase-I part-1) in Hubli city.
4. Providing, Laying, Jointing, Testing & Commissioning of DI & HDPE Water distribution network and House Service Connections in Water Zone - 24 from ESR at Gulaganjikoppa for 24x7 Water Supply (Phase-I, Part-2) in Dharwad city.

5. Providing, Laying, Jointing, Testing & Commissioning of DI & HDPE Water distribution network and House Service Connections in Water Zone - 28 from GLSR at Saraswatpur for 24x7 Water Supply (Phase-I, Part-2) in Dharwad city.

6. Providing pressure relief valves & water meters for the distribution system executed in Water Zone- 1 from ESR at Tabib land for 24x7 Water Supply (Phase-II) in Hubli city.

7. Providing, Laying, Jointing, Testing & Commissioning of DI & HDPE Water distribution network and House Service Connections in Water Zone D-24 from ESR at K C Park for 24x7 Water Supply (Phase-I, Part-2) in Dharwad city.

8. Providing, Laying, Jointing, Testing & Commissioning of DI & HDPE Water distribution network and House Service Connections in Water Zone H-10 from proposed 15 LL RCC ESR at Keshwapur for 24x7 Water Supply (Phase-I part-2) in Hubli city.

Part-D- Operation & maintenance for a period of 60 months of the proposed 24 x 7 distribution system in water zones - 1, 8, 10, 17, 24, 28, H-10 & D-24 of Hubli & Dharwad twin city under O & M of Hubli-Dharwad water supply system including 12 months defect liability period.

Key map showing the various components of the system is presented in Chapter –9, Drawings consists of ;

2.1 Survey, establishing sufficient Benchmarks, Design and preparation of working drawing and approval from competent authority before execution for providing 24x7 water supply in water zones - 1, 8, 10, 17, 24, 28, H-10 & D-24 of Hubli & Dharwad twin city including providing and completing House Service Connection in Hubli-Dharwad city and also operation and maintenance for a period of 60 months including 12 months defect liability period.

2.2 Earth work excavation laying of bedding wherever specified, laying of pipes jointing, testing & commissioning of all pipe lines, back filling the trenches and restoring and making good all surfaces which are damaged during excavation.

2.3 Fixing and connecting all pipeline fixtures such as valves, bends, tees, blank flanged, tail pieces, flow meter/electro-mechanical equipments/level indicators and controllers / pressure gauges/ NRV's /PRV's /equalizers / booster/ piezometers / pressure gauges pumps if necessary etc.

2.4. Construction of all appurtenant structures such as pipe supports, valve chambers, thrust blocks and anchor blocks etc.,

2.5. Dismantling and reconstruction of structures such as culverts, storm water drains, roads etc., and utility lines such as water supply pipe lines, sewer lines coming in the way of the pipeline alignment.

2.6. Testing and commissioning of the pipe line and house service connections after laying and jointing.

2.7. Construction of suitable culverts at valley points as directed by the Engineer.

2.8. Operation & Maintenance during the defect liability period of all the pipelines as well as the other works under the scope of the tender for 12 months after commissioning, the contractor has to set right the defect of any kind in the manufacture, laying and jointing of all the pipelines and in the other works in this scope of tender.

2.9 All work shall be done as per the specifications. The works shall include providing all materials, equipments, labour, tools, plants, transport etc., and all other services necessary for the complete construction including necessary sub-soil investigations.

2.10 The alignment of the pipeline and other typical details of pipe bedding, valve chambers, thrust blocks, pipe supports, and the general arrangement of reservoir are furnished in Chapter 9: Drawings. Further details shall be furnished in the construction drawings during the construction stage.

3.0 Detailed Specification:

Part-A - Study, Survey, and Preparation of Base map, Conditional Survey, Assesment of NRW, Customer Survey, Analysis and Design & Drawing.

Survey & preparation of base map.

Reconnaissance survey, Demographic study and Data collection in wards.

Conducting Topographical survey of all the roads in water zones - 1, 8, 10, 17, 24, 28, H-10 & D-24 of Hubli-Dharwad twin city.

Detailed survey & analysis is to be conducted as per actual site conditions and maps to be developed with all relevant details on the map
The details should include reduced levels w.r.t MSL for all infrastructures utilities like roads, details of existing drains, details of existing CD (size, Invert level), landmarks, boundary of individual properties abutting the roads, area name, ward nos., road names, visible features like railways, telephone, power lines, poles, big trees and other important related datas etc., complete.

Water supply details like existing dia of pipeline, length, pipe materials, mainline, feeder mains, distribution network, storage reservoirs, appurtenances like valves, pumps, boosters etc, details of House service connections and any other data and details pertaining to water supply should be incorporated.

The network of pipe lines of adjoining wards also to be included to the extent required for assessment for hydraulic isolation of these wards and also for providing alternate water supply lines to adjoining wards

Preparation of detailed draft drawings after completion of survey in different fields for different features.

Co-relating as per actual site conditions with satellite imagery, CDP & providing relevant drawings & designs & documents. Satellite Imagery. (The CDP plan and Satellite imagery will be supplied by Water Board).
NOTE:
i. All the roads or lanes shall be covered in the survey.
ii. 2 sets of hard copy and soft copy of draft drawing shall be submitted for approval from the competent authority.
iii. Whenever the instructions are issued to modify the drawing, the same must be incorporated.
iv. After finalisation of the draft drawings, Soft copy and 2 sets of hard copy shall be submitted for final approval.

Conditional Survey

Trial pits to a max depth of 1.5 m to assess the soil strata with refilling. (However, excluding cost of reconstruction of roads with WBM/Ashpalt/Concrete)
The conditional survey of the existing pipelines has to be ascertained at MINIMUM interval of 1 sample for 2000 m each or more. The condition of pipe shall be ascertained by digging physically at various points and drawing a sample for testing. (The cost of pipeline reconnection shall be borne by contractor. Restoration of pipeline is also part of the work)
PVC pipelines
HDPE pipelines
MS/DI pipelines

NOTE
i. Board / ULB will only assist in drawing the pipe samples. The labour charges & material cost is to be borne by the contractor.

Assesment of NRW

The existing network will have to be assessed for NRW at least one point per zone .The water meter is to be procured by the contractor (Test charges only).
Hire charges of water meter of various dia for flow measurements for the test period.
NOTE
i. Formula NRW = [((a - b)/a)*100]
Where, a = Total water produced and put into the transmission and distribution system
b = Total water sold
ii. NRW is computed as the difference between the total water supplied to the zone and the total water sold expressed as a percentage of the total water. NRW comprises: a) Consumption which is authorised but not billed, such as public stand-posts; b) Apparent losses such as illegal water connections, water theft and metering inaccuracies; and c) Real losses which are leakages in the

transmission and distribution networks.d) Any other losses to be identified by the bidder.
iii. Daily quantities should be measured through metering, and records on the transmission and distribution system should be maintained. The total supply for the month should be based on the aggregate of the daily quantum. Only treated water including borewellwater input into the distribution system should be measured. If water is distributed from multiple points, the aggregate of that quantity should be considered. This quantum should include water supplied directly from any other sources and put into the distribution system if any.
iv. The actual volume of water supplied to customers who are billed for the water provided. Ideally, this should be the aggregate volume of water consumed as per which consumers have been billed. However, in the absence of a complete and functionally effective metering regime, alternate methods of measurement need to be evolved, with lower but acceptable levels of reliability with the approval of the employer.

Customer Survey

Customer survey to be conducted for each house/building properties to cover the ownership details, house connection details, no of residents, occupation status of plot, people habits, consumption pattern, etc.

Design & Analysis & Training

Existing Network preparation & Design verification & solution.

Analysis of adequacy of existing water supply network for 24X7 model based on available survey maps/data, hydraulic designs for Transmission mains, linking feeders, feeder mains, storage reservoirs and distribution net work system, pumping machinaries etc., complete along with relevant designs and drawings including site visits, collection of any additional data if required, discussion with local bodies and Board authorities. Network analysis shall be carryout by using Water Gem/Bentley software or any advanced & latest software in accordance with the CPHEEO recommendations as decided by the Board. (Available Maps if any with Board will be provided to the successful bidder for reference only) However the bidder shall prepare the soft copy and hard copy of the zones after detailed Revised Design for new network

Analysis of adequacy of existing water supply network as above, finalizing the adequacy and deficiencies in the existing system and redesign for 24X7 model based on prepared maps/data, hydraulic designs for Transmission mains, linking feeders, feeder mains, storage reservoirs and distribution net work system, pumping machinaries etc., complete along with relevant changes required based on site visits, collection of any additional data if required, discussion with local bodies and Board authorities. Network analysis shall be carried out by using Bentley Water Gem V8i select series with a minimum of 5000 nodes licensed software or any advanced & latest software in accordance with the CPHEEO recommendations as decided by the Board.

Scope includes study of complete water supply distribution network from source point of water i.e., GLSR/OHT proposed to be supplied to the above wards.

Colletion of data, processing of data & Preparation of input data for the software decided by the Board. Processing and simulating (hydraulic modelling) for 24/7network analysing system.Preparation of District Metering Areas along

with property bulk water, pressure and water quality (residual chloriene) measurements.

Establishments of source reservoir point, design of feeder, rising mains from the nearest viable reservoir to the service reservoir to the network.Effect of 24/7 system to the adjoining wards and action to be taken for improving water supply to the adjoining areas.Pre - feasibility reports and Detaied Project Report to be submitted and got approval must be obtained from the Board.

NOTE:

i. Whenever the instructions are issued to modify, the same are to be incorporated in the draft and final reports.

ii. After finalisation of draft and final report from the Board , a Soft copy and 3 - Sets of hard copy shall be submitted.

iii. All existing and proposed details such as feeder mains, distribution network (pipe material, diameter of pipe, condition of pipe, depth of pipe etc; with valves) Pumping machineries existing reservoirs and the proposed water supply details as per the design shall be incorporated in the drawings with different fields.

iv. The provision of Hydraulic isolation of proposed wards from the adjoining non 24 x 7 wards and also providing alternate supply lines to the affected adjoining wards has to be incorporated.

v. Minimum Professional Manpower Required & Break-Up schedule of manpower to be got approved from the competent authority. The following is the break-Up schedule of man power:

a. Experienced Enginering Graduate in Civil/Hydraulic Engg./Environmental Engg./ Post-Graduaduates / or Engg. Graduate specialised in Hydraulic modelling, Net work Analysis/Designing with certificates from reputed institutions who are capable of analysing & designing the network with minimum experience. - 2 nos. for 3 months.

b. Specialised Engineer as a team leader for the above group of design Engineers.- 1 no. for 3 months

c. Experienced Engineering Graduates - 4 Nos. for 3 months

d. Diploma Holders - 6 Nos. for 3 months

e. Public appraisal team - 1 MSW holder for 3 months

f. Environmental impact assessment team (Separate) - 1 no. for 3 months

f. Literate assistants - 6 Nos. for 3 months

NOTE:

i. For part-A work, the Board will not provide any consumables, computers, printers, survey equipment, flow meters, man power or transit charges for any activities.

ii. However the space for working will be provided for computer lab at Sub-division/Division/CE(N) office at Dharwad.

iii. The contractor shall impart training to departmental engineers mimimum three nos., to use & operate the Bentley Water Gem select series 3 licensed software as approved by the employer.

Drawings

Preparation of Auto-CAD drawings/equivalent with all data for the above water zones, providing hard copies of drawings, designs, cost estimates, etc. as deemed to be necessary of a detailed project report.

NOTE:

i. Required nos. of soft copies & hard copies shall be provided as specified by the board.

3.1 M.S.PIPELINE

Manufacturing, providing, transporting, rolling, lowering, laying & Jointing, testing, commissioning of ERW (Electric Resistance Welded) / SAW (Submerged Arc Welded) MS pipes (Fe-410 grade) conforming to IS 3589-2001 with latest amendments including perfect linking and welding of joints to correct position including cost and conveyance of pipes and materials with all lead and lifts, cost of all labour and giving satisfactory hydraulic test as per IS 3589-2001 with latest amendments for test pressure and working pressure both at factory and site etc complete as per detailed specifications with inside CM 1:1.5 lining of minimum 10 mm thick and out side minimum 25 mm thick coating in CM 1:3 over 50 x 50 mm weld mesh of 13 gauge, including loading and unloading of pipes for the diameter and specified thickness of plate, including bailing out of water wherever necessary as directed by the Engineer-in-charge. (Contractor will make his own arrangement of water for testing)

The approximate length of pipe, thickness of plate, thickness of internal lining and thickness of external gunniting are as stated below:

Sl. No.	Clear outer dia of MS pipe/ shell before external gunitting	Thickness of pipe	Thickness of internal lining in CM	Diameter of pipe after internal lining [ID]	Approximate length of M.S. pipes	Type of welding
1	762 mm	6.40 mm	12mm	725.20 mm	2000 m	ERW / SAW
2	660 mm	6.40 mm	12mm	623.20 mm	3000 m	ERW / SAW
3	508 mm	6.40 mm	10 mm	475.20 mm	600 m	ERW / SAW
4	457 mm	6.40 mm	10mm	424.20	2600 m	ERW/ SAW

*** NOTE: No Negative Tolerance in respect of thickness is permissible.**

1. Each pipe shall be in lengths of 6 to 12 Mtrs based on availability, ease in handling, Transportation & laying.

2. The surfaces of the MS pipe shall be cleaned thoroughly with sand blasting before any lining or gunniting is done.
3. The steel pipes shall be manufactured with bevelled ends suitable for jointing by butt welding at the ends, all around the periphery in accordance with IS 3589/2001 Clause 15.
4. The MS pipe to be provided shall be of ERW/SAW confirming to IS 3589/2001 with latest amendments. The manufacturing process for MS pipe should be Electric fusion arc Welding (Automatic Submerged Arc Welding)
5. The internal lining for the MS Pipe shall have smooth finish.
6. The MS pipes should be hydraulically tested and should be capable of withstanding the maximum test pressures at factory confirming to IS 3589 / 2001 with latest amendments.

3.2 INTERNAL LINING AND EXTERNAL GUNITTING:

The cement Mortar and Cement concrete used for pipes and specials shall be confirming to the specifications mentioned in the chapter 10 of Standard Specifications. The Maximum size of the aggregate shall be 1/3rd thickness of concrete cover inside the steel pipe or 10mm whichever is less. The concrete mix shall be have a minimum cement content of 450 Kg/m3 and minimum characteristic compressive strength of 25 N/mm2 at 21 days. The Cement Mortar shall have a minimum cement content 600 Kg/m3 and charters tic compressive strength of 25 N/mm2 at 21 days as per clause 15.5.3.2 of standard specifications (Chapter 10.)

3.3 <u>MS Specials:</u>

Manufacturing, providing, transporting, rolling, lowering, laying and jointing, testing and commissioning of MS specials of 8mm thick conforming to IS 7322:1985 with latest amendments, perfect linking and welding of joints to correct position including cost and conveyance of materials with all lead and lifts, cost of all labour and giving satisfactory hydraulic test as per IS 3589:2001 with latest amendments for test pressure and working pressure both at factory and site etc., complete as per detailed specifications with inside lining two coats of food grade epoxy painting of approved make with each coat of 250 micron, thick (after dry) over one coat of food grade epoxy primer of approved make with minimum of 50 micron thick (after dry) and outside 25mm thick coating in CM 1:3 by providing 50 x 50mm weld mesh including loading and unloading of pipes for the following category to suit MS / RCC / DI pipes.

The weight of the MS shell only be considered before lining and coating for arriving at the rate. The thickness of plate will be specified by the engineer. (Contractor will make his own arrangements for procuring water for testing).

3.4 Testing

3.4.1 **MS Pipes & Specials**

3.4.2 **Hydrostatic Testing after manufacturing:** After manufacturing the pipes. Before giving any lining or coating, each pipe section shall be given a hydrostatic test at factory, in accordance with Clause 13 of IS 3589/2001 with latest amendments.

3.4.3 **Field Hydrostatic Testing -** After laying the pipe, leaving the joints exposed for inspection and testing, the rising main shall be tested in sections of not more than 500m each. The field test pressure shall be as per relevant IS with latest amendments. Pipes or fittings which are found defective shall be replaced and joints found leaking shall be redone, without any extra payment. The testing shall be done as per Clause 15.5, 16.3, Chapter 10, Standard Specifications for Procurement of Project Works. The water and any other equipment required for testing shall be arranged by the contractor at his cost. The water used for testing shall be of approved quality.

3.4.4 **Testing of Weld Joints**

In addition, 5% of weld joints shall be subjected to Ultrasonic test as per IS: 4260.

3.4.5 **Laying of pipe**

Pipes shall be laid underground with a minimum earth cover of 1.00M. Pipes shall be laid in sections of 500m each, laying of pipes shall be as per Clause 15, Chapter 10, and Standard Specifications for Procurement of Project Works. All pipes, fittings and materials shall be tested and approved by the Engineer before being laid. Any pipes, fittings or material failed before they are tested and approved shall be removed and replaced with tested and approved material.

3.5 Ductile Iron Pipes and Fittings

3.5.1 General

Ductile iron pressure pipes and fittings shall be Class K-7 and shall comply with IS 8329 and IS 9523. All fittings shall be socketed unless specified otherwise.

2. Materials

The materials used in the manufacture of pipes and fittings shall comply with IS 8329 and IS 9523.

3. Tests

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

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

4. Joints

3.5.4.1 Spigot and Socket Joints

These shall have sockets which are integral with the pipe and incorporate an elastomeric rubber ring gasket conforming to IS 12820.

3.5.4.2 Flanged Joints

These shall comply with dimensions and drilling details in IS 8329 for PN 10 flanges. All flanged joints between steel and ductile iron pipe work shall be electrically isolated joints. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. All materials shall be supplied by a specialist manufacturer and be to the approval of the Engineer.

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3. Cement Mortar Lining

All pipes and fittings shall be internally lined with cement mortar in accordance with ISO 4179/IS: 11906. Cement mortar lining shall be applied at the factory in conformance with the above mentioned standards. No admixtures in the mortar shall be used without the approval of the Engineer.

3.5.5 Coatings

3.5.5.1 General

Ductile iron pipes and fittings shall be zinc coated with bitumen over coatings, all in accordance with the following Specifications. Buried pipes and fittings shall also have a site or factory applied polythene slewing. Coating shall not be applied to pipe and fittings unless its surface is clean, dry and free from rust. Pipe coatings shall be inspected on site and any damage or defective areas made good to the satisfaction of the Engineer.

2. Zinc Coating

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

3. Bitumen Coating

Bitumen coating shall be of normal thickness 75 microns unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions. Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe. The bidder should make his own arrangements for procuring water for testing purpose.

6. Laying of DI Pipe

The DI pipes should be conveyed rolled, lowering in to the trenches, laying true to line leveling, with perfect linking at joints, testing and commissioning including loading and unloading at both destination and cuts of pipe wherever necessary including jointing of DI pipes and specials(including cost of specials) with rubber gaskets conforming to relevant ISS including cleaning the socket, spigot ends with soap solution and applying soap solution to the spigot and socket ends before insertion of jacking and fixing in perfect condition. The pipe should be hydraulically tested confirming to relevant ISS. The bidder should make his own arrangements for procuring water for testing purposes.

3.5.7 HYDRAULIC TEST PROCEDURE FOR DUCTILE IRON PIPE

1. The hydraulic test for DI pipeline should follow the procedure explained in CPHEEO manual. However the same has been presented in simplified manner through following paragraphs.

2. Before standing any test, the system shall be visually inspected to ensure that the recommendations for the correct installation procedure have been complied with and that the pipeline together with appliances, valves and fittings are laid in the prescribed manner.

3. The entire sketch shall be backfilled as per specifications, leaving about 0.5m spaces on the either side of the joints, fittings and valves etc.

4. All control valves fitted on the pipeline to be tested shall be positioned open for the duration of the testing and open ends temporarily closed with watertight fittings. The upper end plug/fitting should have an arrangement of CI pipe filled with stopcock for release of air while filling the pipeline, as indicated in enclosed figure-1.

5. Two pressure gauge duly calibrated (Calibration certificate not older than 6 months) shall be fixed, one at the lower end (pressure gauge-1) and the other (pressure gauge-2) at the upper end of the pipeline. The gauges shall be fixed in such a way that it is convenient to note the readings.

6. Not more than 1500m length of pipe preferably between valve to valve shall be taken for testing at a time and shall be filled from the lower end with water slowly and carefully either by hand pump or power driven pump(positive Die placement type) to avoid site pressure and also for easy ventilators of an from the pipeline. Ventilation at the high points may be required to purge air pockets while the test section shall be filled. Ventilation may be provided by loosening flanges or by using an valves. Re-tightening shall be done for any loosened flanges before applying the test pressure. The test pressure shall be applied gradually at the rate of 1Kg/cm2 min at the lower end. The gauge at the lower end shall show the higher test pressure. The upper end gauge shall indicate a relative valve duly accounting for the static head difference i.e. difference in elevation between the upper end and lower end of the test section. (if the difference in elevation shall be of about 30m and test pressure shall be of 35 Kg/cm2 registered at the lower end gauge(pressure gauge-1) then the corresponding pressure at the upper end gauge (Pressure gauge-2) shall show 35-3 – 32 Kg/cm2.

7. The test pressure shall not be less than the maximum of the following
   1.5 times the maximum sustained operating pressure
   1.5 times the maximum pipeline static pressure
   Sum of the maximum pipeline static pressure and the maximum surge pressure subject to maximum equal to the work test pressure for any pipe fittings incorporated.

8. The test phase shall be of 4 hours duration. The pressure gauge reading shall be recorded at both ends at an interval of half hours. After completion of 4

hours of test phase, measured unions of make up water shall be added return to twist pressure.

The quantity of makeup water should not per day for each 30m in head of pressure applied if the amount of makeup water added does not exceed the calculated quantity, the pipe shall deemed to pass the hydraulic test.

9. After the successful test, the water shall be drained through the scour valve to the natural drain point without causing nuisance to the public.

10. Recording of the Test should be done in the format enclosed as Appendix-1

11. Contractor: should make arrangement for all the materials as given in Appendix-2 before testing.

APPENDIX-1

HYDRAULIC TEST FOR DI PIPES.

Lab Ref.No._____

Date:_____

Package Name:		Package No._____
Contractor Name:		Contract No._____
Daily Log Ref._____ Date:_____ _	Tested as per CPHEEO_____	Date Tested._____

Contractor Employer/Engineer

Sl. No	ID (mm)	Stretch	Length (m)	Applied Test Pressure (Kg/cm2)	Test Phase Reading After				Quantity of make up water added after 4 hrs in liter/Km	Observations
					1 hr	2 hr	3 hr	4 hr		

Comments of the Engineer/Consultant:

Any rectification to be done by Contractor

Signature of the Engineer/Consultant Signature of Contractor Engineer

Signature of Engineer,

APPENDIX-2

List of Material required for Hydraulic Testing of DI Pipes:

1. Pressure Gauge with calibration certificate not older than 6 months old
2. Air Vent
3. Power supply/DG set in case of mechanical pump
4. Measuring jar to measure make up water
5. Storage for make up water
6. Stop cocks
7. Blind flanges with suitable GI piping arrangement
8. Arrangement of water for testing.

Contractor Employer/Engineer

6. HDPE pipeline

Supplying HDPE pipeline PE 100, PN 10 pipes conforming to IS IS 4984:1995 with latest amendments and conveying to worksite, rolling and lowering into trenches, laying true to line and perfect linking at joints, jointing of HDPE pipes and specials (including cost of specials) with jointing of approved type, testing and commissioning, including loading and unloading at both destinations and cuts of pipes wherever necessary. Encasing the pipe all-round to a depth of not less than 15cms with soft gravel or selected earth available from the excavation, etc., complete giving hydraulic test as per relevant ISS with all lead and lift testing and commissioning. The rate is inclusive of required specials and fittings etc and giving necessary hydraulic test to the required pressure as per ISS (Contractor will make his own arrangements for procuring water for testing)

3.6.1 Field Hydrostatic Testing:-

After laying the pipe, pipeline shall be tested. The testing shall be done as per Clause 15.5,16.3 Chapter 10,Standard Specifications for procurement of Project works. The water and any other equipments required for testing shall be arranged by the contractor. The water used for testing shall be approved quality.

3.6.2 Laying of pipe:-

Pipes shall be laid in underground with minimum earth cover of 1mtr.Pipes shall be laid in sections of 500m each. Laying of pipes shall be as per clause 15, chapter10 Standard Specifications for procurement of project works. All pipes, fittings and materials shall be tested and approved by the Engineer before being laid. Any pipes fittings

3.6.3 Procedure for Butt Fusion Welding for HDPE pipes.

With a clean dry cloth wipe the inside and outside surfaces of the two pipe ends to be joined to remove dirt, moisture and foreign materials. It is important that the ends protruding past the clamp jaws be absolutely clean and free of any kind of contaminations.

Install pipe in the welding machine clamps. Ends should extend approximately one inch past alignment clamps for facing. Check alignment and adjust as required to get perfect alignment of the meeting surfaces.

Pipe ends should be perfectly faced by facer or square-cut with appropriate tools meant for the same. Remove any burr on the meeting faced / square-cut ends by a knife. Do not touch the meeting pipe ends by hand, which may contaminate the meeting surfaces due to dirt or perspiration or body oil.

Bring the two pipe ends together after facing, to see the alignment once again and ensure the alignment is perfect.

Separate the two pipe ends and insert the heater plate between the two pipe ends. Bring the movable pipe section against the heater plate until both pipe-ends are in full and firm contact with the heater plate.

As soon as the pipe ends are firmly in contact with the heater plate, immediately remove the pressure given to the clamp to remove the pressure on pipe ends on heater plate. If the pressure on the pipe is maintained during heating, the melt will be squeezed away from the pipe ends and create a concave effect in the pipe ends and this will weaken the joint.

Heat the pipe ends until properly sized melt bead are formed on both pipe ends. As the pipe melt against the heater plate during the heating period, the molten plastic will swell and form melt beads around the pipe ends. The melt beads should be the same size on both ends and uniformly sized all the way around,

The butt fusion temperature is normally situated between 200^0C to 235^0C depending on the variable factors.

Pipe Size	Approximate one side melt bead width
Less than 90mm OD pipes	1.60mm
90mm OD to 180mm pipes	3.20mm
200mm to 250mm OD pipes	4.75mm
280mm to 630mm OD pipes	6.25mm

Please note the meld bead width values given above are indicative only and depending on wall thickness of the pipe, the material grade, production type, temperature of the heater plate and the applied fusion-cycle, the melt well head width may vary.

After melting has been completed as described above, separate the pipe ends, just enough to remove the heater. Quickly observe the parts to be joined to ensure sufficient and uniform melting patters. Then quickly bring the pipe ends together with the fusion jointing pressure. Join the pipe ends within a time of (3+0.0dn) seconds with a maximum 6 seconds for diameters up to and including dn 250 mm and a maximum of 12 seconds for diameters above dn 250 mm.

To ensure a good quality joint, it should have a smooth symmetrical bead shape around the entire pipe circumference as shown in the following figure A. The bead depression “A” shall not extent below the pipe surface.

If the molten plastic sticks to the heater, do not continue with jointing. Allow the pipe ends to cool and start all over again from the beginning the prefacing / square cutting.Fusion jointing pressure would vary with pipe size, wall thickness and material grade.

The force applied will cause each bead to roll back on to the pipe, Insufficient or excessive roll back is one indication of a faulty joint flg. ‘B’.

While maintaining the pressure used in making joints, allow the joints to cool naturally for 30 to 90 seconds per inch of pipe diameter before removing from the clamps. Heavier walled (lower SDR) pipes require longer cooling time. However, the cooling time will vary depending on the prevailing climatic / environmental conditions.

On examining if the joint appears faulty, cut open the joint and start all over again from the beginning.

On satisfactory appearance, remove fused pipe from the welding clams. Allow the joint to cool under no pressure at least for 20 minutes after removal from welding clamps before subjecting the joint to testing, bending or backfilling stresses.

3.6.4 HYDRAULIC TEST PROCEDURE FOR THE HDPE PIPE LINES

1. Before standing any test, the system shall be visually Inspected to ensure that the recommendations for the correct installation procedure have been compared with and that the pipeline together with appliance, valves and fittings are laid in the prescribed manner.

2. The entire sketch shall be back filed as per specifications, leaving about 0.5m space on the either side of the joints, fittings and valves, etc.

3. All control valves fitted on the pipeline to be tested shall be positioned open for the duration of the testing and open ends temporarily closed with watertight fittings. The upper end plug/fitting should have an arrangement of GI pipe fitted with stopcock for release of air while filling the pipeline, as indicated in enclosed figure.

4. Two pressure gauges duly calibrated (Calibration certificate not older than 6 months) shall be fixed, on at the lower end and the other at the upper end of the pipeline. The gauges shall be fixed in such a way that it is convening to note the readings.

5. Not more than 1500m length of pipe preferably between valve to valve shall be taken for testing at a time and shall be filled from the lower end with water slowly and carefully either by hand pump or power driven pump(Positive Displacement Type) to avoid surge pressure and also for easy ventilation of air from the pipeline. Ventilation at high points may be required to purge air pockets while the test section shall be filled. Ventilation may be provided by loosening flanges or by using Air valve. Pre. Lightening shall be done for any loosened flanges before applying the test pressure. The test pressure shall be applied gradually at the rate of 1Kg/cm2/min at lower end. The gauge at the lower and shall show the lost pressure whereas the upper end gauge shall indicate a corresponding value accounting for the static head difference i.e difference in elevation between the upper end and lower end of the lost section(if the difference in elevation shall be of about 30m and test pressure shall be 9Kg/cm2 registered at the lower end gauge(pressure gauge 1) then the

corresponding pressure of the upper end gauge (pressure gauge 2) shall show 9-3=6Kg/cm2)

6. The test pressure shall not be loss of and a trial runs the rated pressure of the pipe under use (in general maximum rated pressure in distribution system is about 6Kg/cm2.Thereore 1.5 times of 6 i.e. 9 Kg/cm2 pressure shall be considered as test pressure for all the distribution system pipeline).

7. The test procedure shall consist of two phases, viz., initial expansion phase and test phase, During the initial expansion phase(about 4 hours).The test section shall be pressurized to the test pressure i.e 1.5.times the rated pressure and sufficient make-up water shall be added after each hour for four hours to return to the test pressure.

8. The Test phase shall be of 3 hours duration. The pressure gauge reading shall be recorded at both ends at an interval of half hour for 3 hours. After 3 hours of test phase, measured amount of make up water shall be added to return to test pressure. If the amount of make-up water added does not exceed the values in the Table 1 – Test phase Makeup water amount for HDPE pipes, enclosed,. the pipe shall be deemed to pass the hydraulic test.

9. The total test time including initial pressurizations, initial expansion and time at test pressure shall not exceed eight hours if the pressure test can not be completed due to leakage or equipment failure etc the test section shall be de-prescribed and allowed to relax for at least eight hours before brining the test section up to test pressure again.

10. After the successful test, the water shall be drained through the scour valve to the natural drain point without causing to the public.
11. Recording of Test should be done in the format enclosed as Appendix-1

12. Contractor should make arrangement to all the materials as given in Appendix-2 before testing.

Test Phase Make-Up Water Amount for HDPE Pipes

Diameter of PNS HDPE pipes as per IS Standards		**Make up Water Allowance after 3 hours in Liters per 100 M of Pipe**
Outer Diameter	**Avg.**	
50	44.9	2.2
63	56.7	2.5
75	67.4	2.6
90	81.1	3.5
110	99.3	4.0

125	112.8	6.0
140	126.3	7.2
100	144.4	9.4
160	162.5	11.0
200	180.6	12.4
225	203.1	16.6
250	225.8	21.9
260	252.9	25.9
315	284.5	35.8
355	320.7	43.9
400	350.6	53.1
450	405.7	62.0
500	451	78.4
560	504.9	98.2

Source: Plastic Pipe Institute (PPI)

3.6.5The agency should get approval for hydraulic design of distribution system after conducting detail survey.

Appendix – 1

HYDROSTATIC TEST FOR HDPE PIPES

Lab Ref. No._____

Date_____

Package Name		Package No.
Contractor Name:		Contract No:
Daily Log Ref ---------- Date ----------.____		Date Tested

Contractor Employer/Engineer

Sl. No	OD (mm)	ID mm)	Stretch	Length(m)	Applied test pressure(Kg/cm2)	Test phase reading after			Quantity of make up water added after 3 hrs in litre/ 100m	Observation
						1 hr	2 hr	3 hr		

Comments of the Engineer/Consultant. _____

Any rectification to be done by the contractor._____

Signature of the Engineer/Consultant

Signature of the Contractor

Appendix – 2

List of Material required for Hydraulic Testing of HDPE Pipes

2) Pressure gauge with calibration not older than 6 months
3) Air vent
4) Power supply/DG set in case of mechanical pump
5) Measuring jar to measure make up water
6) Storage for make up water
7) Stop cock
8) Blind flanges with suitable GI piping arrangement
9) Arrangement for water for testing.

Contractor

Employer/Engineer

3.6.6 Electro Fusion Tapping HDPE Saddle and Electro Fusion Fittings

The electro fusion fittings should comply with the following specific requirements.

3.6.6.1 It shall comply with the requirements of BS EN 12201-3, BS EN 1555-3 or ISO 8085-3.

3.6.6.2 All the fittings shall be of SDR 11 rating.

3.6.6.3 The Electro fusion couplers used for drinking water applications should have undergone type test by WRc-NSF, U.K. according to BS 6920 in any of their Certified Laboratories like WRc-NSF/GW/KIWA/SPGN and certificate of Compliance to be produced for the following parameters.

a. Odour and Flavour of Water.
b. Appearance of Water.
c. Growth of Micro Organism
d. Extraction of substances that my be of concern to Public Health (Cyto Toxicity)
e. Extraction of Metals.

3.6.6.4 All the Electro fusion couplers and other fittings shall be manufactured by injection moulding using virgin compounded PE 80 (MDPE) polymer having a melt flow rate between 0.5-1.1 grmas/10 minutes and shall be compatible for fusing on either PE 80 or PE 100 distribution mains manufactured according to the relevant national or international standards. The polymer used should comply with the requirements of BS 3412 and / or BS EN 12201-1.

The Electro fusion couplers intended for water distribution applications shall be coloured blue for the clear identification of the services.

3.6.6.5 All the Electro fusion couplers should be individually packed so that they can be used instantaneously at site without additional cleaning process. The protective packing should be transparent to allow easy identification of the fittings without opening the bags.

3.6.6.6 The Electro Fusion coupler should be with only a single heating coil to fully Electro fuse the fitting to the adjoining pipe or pipe component as applicable. The heating coils shall be terminated at terminal pins of 4.0 or 4.7 millimetre diameter, protected with terminal shrouds. Each terminal shroud should be additionally protected with polyethylene shroud caps.

3.6.6.7 No heating element shall be exposed and all coils are to be integral part of the body of the fittings. The insertion of the heating element in the fitting should be part of the injection moulding process and coils inserted after the injection moulding process or attached to the body of the fitting as a separate embedded pad etc., are strictly not acceptable.

3.6.6.8 The pipe fixation shall be achieved by external clamping devices and integral fixation devices are not acceptable.

3.6.6.9 The brand name, size, raw material grade, SDR rating and batch identification are to be embedded as part of the injection moulding process. Each fitting should also be supplied with a Data Card or stickers with appropriate barcode as well as manual setting information for data transfer purpose. The barcode sticker should also include the fusion and cooling time applicable for the fitting for the manual setting of a manual fusion control box.

3.6.6.10 The fittings should be V-regulated type designed to fuse at a fusion voltage of 40 volts AC.

3.6.6.11 The heating elements should be designed for fusion at any ambient temperatures between -5 to +40 degree centigrade at a constant fusion time i.e without any compensation of fusion for different ambient temperature.

3.6.6.12 limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the terminals. The fusion indicators should not allow the escae of the molten polymeter through them during or after the fusion process.

3.6.6.13 All the sockets in the Electro Fusion fittings should include a method of tapping controlling the pipe penetration (pipe positioner / stopper).

3.6.6.14 The Electro fusion Tapping ferrule should be the top loading typing which are to be clamped on the mains for fusion using the custom made top loading clamps exerting 1500N (150 kilograms approximately) top load. Saddles with wrap around clamps made of polyethylene, nylon or any such other material will not be acceptable.

3.6.6.15 The tapping EF Tapping Ferrule should be supplied with suitable adaptors for proper positioning of the top loading clamp into the saddle.

3.6.6.16 The torque required to operate the cutter after fusion on the PE mains should not exceed 45 N-m.

3.6.6.17 The cutter should be designed in such a way that the cut coupon is not allowed to fall into the pipeline and is retained inside the body of the cutter providing a positive sealing of the hole in the cutter head for pressure testing.

3.6.6.18 The Electro fusion tapping Ferrules, will have female threaded outlet to connect compression Metal insert Male thread, adaptor fitting for further extension of connection.

3.6.6.19 The threaded outlet should be from sizes ½" to 2" BSP to suit the required House Service Connections.

3.6.6.20 The outlet should be reinforced with female threaded metal inserts of Brass MOC.

3.6.6.21 The tapping on the PE mains shall be achieved by a custom built metal cutter supplied by the manufacturer one each for the standard packing box.

3.6.7 . COMPRESSION FITTINGS:

Compression fittings used for House Service Connection comply as per ISO 14236

3.6.7.1 Materials of Construction.

Compression fittings material shall confirm to ISO 14236 Clause-5

A. Body-Polypropylene
B. Nut/Cap-Polypropylene
C. Clip Ring-POM (Acetylic resin)
D. Packing bush-Polypropylene.
E. "O" ring-NBR
F. Threaded metal inserts –SS 304 with BSP Threads.

3.6.7.2 Pressure testing.

The pressure rating of compression fittings as per clause 8 of ISO 14236 which shall be PN16.

Dimensions :

The Dimension of compression fittings shall be as per clause 7.1 of ISO 14236.

3.6.7.3 Performance requirements :

The Dimension fittings shall be tested as per ISO 14236. Following Test methods shall be performed.

Clause 8.2.1 - Leak tightness under internal pressure.
Clause 8.2.2 - Resistance to Pull out.
Clause 8.2.3 -Leak tightness under Internal Vaccum.
Clause 8.2.4 - Long term Prssure Test for Leak tightness for assembled joint.
Clause 8.3.2.1 - MRS Value as per ISO 9080
Clause 8.3.3.1 - Resistance to internal pressure.

3.6.7.4 Effects on Quality of Water.

The Compression fittings for intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW / KIWA / SPGN / WRc-NSF and certificate of compliance to be produced for the following parameters.

a. Odour & Flavour of Water.
b. Appearance of Water.
c. Growth of Micro Organism
d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
e. Extraction of Metals.

For clear identification of the Water Services, the nuts of the fittings should be coloured blue white the body to be black. All fittings with threaded ends should be with BSP threads.

3.6.8.0 . Gun Metal/Brass BALL VALVES (STOP COCKS).

Gun metal Ball Valves used for HOUSE Service Connections shall comply to IS: 1703-89.

3.6.8.1 Material of Construction:

Ball Valve material shall confirm to relevant IS standards.

a. Body and Handle –Gun metal/Brass

3.6.9.0 . MDPE Pipes

These specifications are for MDPE Blue PE 80 pipes for House Service connections of Dia 20 mm to 32 mm OD.

3.6.9.1 Raw Material

Raw material used to manufacture MDPE Blue pipes shall be virgin natural Resin PE 80 containing those anti-oxidants. UV stabilizers and pigments necessary for manufacturing to ISO 4427 standard. The PE 80 Resin shall have MRS of 8 Mpa.

3.6.9.2Effects on water quality

The MDPE PE 80 Blue pipes shall confirm to clause 3.5 of ISO 4427 for conveyance of water for Human Consumption. Also the pipes intended for conveyance of potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW/KIWA/SPGN/WRc-NSF and certificate of compliance to be produced for the following parameters.

a. Odour and Flavour of water
b. Appearance of water
c. Growth of Micro Organism

d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
e. Extraction of Metals

3.6.9.3 Pressure Rating:

The pressure rating of MDPE Blue PE 80 pipes shall be confirming to clause 4.1of ISO 4427 1996.

3.6.9.4 Colour of Pipes

The colour of MDPE PE 80 pipes shall be Blue confirming to clause 3.2 of ISO 4427 : 1996.

3.6.9.5. Dimensions:

The pipe dimensions shall be as per latest revisions of clause 4.1 of ISO 4427: 1996 and pipes upto diameters 32 mm shall be supplied in coils of 300 mtrs. The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of ISO 4427 : 1996. Each pipe shall be of uniform thickness throughout its length. The wall thickness of the PE 80 pipes shall be as per the table given below:

Nominal Dia of MDPE pipe (mm)	PR rating	Wall thickness	
		Minimum	Maximum
20	PN 16	2.3	2.8
25	PN 12.5	2.3	2.8
32	PN 12.5	3.0	3.5

The dimension tolerances shall be as per ISO 4427 clause 4.1.3

3.6.9.6. Performance requirements:

The pipe supplied should have passed the acceptance test as per ISO 4427. The manufacture should provide the test certificates for the following tests.

1. Melt Flow Rate
2. Density
3. Oxidation and induction test
4. Hydrostatic Test
5. Pigment dispersion Test
6. Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacture. The employer will depute third party inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per QAP approved by Engineer in charge.

Training:

The contractor shall provide training to Engineer in charge regarding erection, functionality & other manufacturing problem in the original manufacture factory unit for 5 days.

3.6.10.0 BUTT WELDING PROCEDURE FOR PE PIPES (MDPE OR HDPE)

Jointing between MDPE / HDPE pipes and specials shall be done as per the latest IS 7634 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 of MDPE / HDPE pipes. For pipes 160 mm dia and above, Hydraulic Jack must be used in butt welding.

3.6. **10.1 PRINCIPLE**

The pipes to be joined are held in clamps which grips and re rounds the pipe, pipe ends are prepared by planning with an electrically driven trimmer. Then the pipe surfaces are heated using an electrically/powered non-stick heater plates. When molten, the pipe ends are brought together and held under pressure until cooled.

Procedure:

Step 1 :	Wipe the inside and outside surface of the pipe with clean dry cloth to remove any dirt on the pipe. Pipe ends shall be cleaned using knife edge.
Step 2 :	Install the pipes on the welding machine clamps. Check alignment. Adjust to get perfect alignment of the mating surfaces.
Step 3 :	Face the pipe ends using the electrically driven facer.
Step 4 :	Check alignment once again after facing.
Step 5 :	Insert the heater plate and bring the movable pipe end close to heater plate such that both the ends in firm contact with the heater plate.
Step 6 :	Heat the pipe until properly sized melt bead is formed on the both pipe ends.
Step 7 :	Remove the heater plate and bring close the pipe ends as quick as possible under the desired pressure.
Step 8 :	Allow the cooling time under pressure and then remove the clamps.
Step 9 :	Check the bead pattern to ensure a good quality joint.

3.6.11.0. BUTT FUSION JOINTING OF PE PIPES AND FITTINGS-

3.6.11.1 RECOMMENDED PARAMETERS

The AusPoly Technical Committee has prepared this publication as a guide to the butt fusion of polyethylene pipe using AS/NZS 4130 materials as a basis.

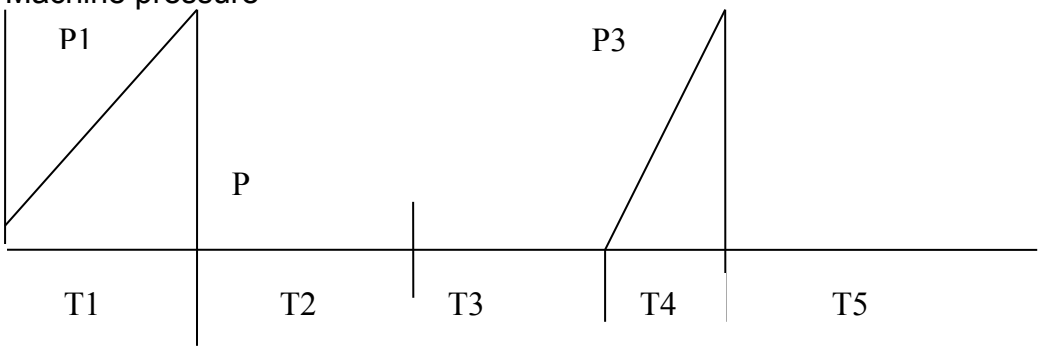
The user should always check the applicability of the Parameters to any given project and whether the version on hand is current. As the conditions of the use of welding equipment are outside the control of the committee, no liability / can be accepted by AusPoly in connection with the use of this table.

Butt Fusion Parameters		Units	Value	Comments
Heater plate temperature		Degree C	220 +15	

Pressure value : Bead up	PI	kPa	175+25	Insert this Value in the formula (note 6), and add drag pressure.
Approx bead width after bead up		mm	05+01 t	t = Wall thickness (see note 4)
Bead up time	T1	Second	Approx. 6t	Varies with ambient temp
Pressure value : Heat soak	P2	kPa	Drag only	
Heat soak time	T2	Second	15t	
Max. changeover time	T3	Second	3+0.01 D	D= pipe diameter (see note 5)
Max. time to achieve welding pressure	T4	Second	3+0.03 D	Pressure should be increased smoothly using most of the time allowed to reach weld pressure.
Pressure value : Welding and cooling	P3	kPa	175 +25	Insert this value in the formula (note 6) and add drag pressure
Welding & Cooling time t<15 mm	T5	Minute	10+0.51	Time in clamps
Welding & Cooling time t<15 mm	T5	Minute	1.5t	Time in clamps
Min bead width after cooling		mm	3+0.5t	Typical (see note 2)
Max bead width after cooling		mm	5+0.75t	Typical (see note 2)

3.6.11.2 Drawing

Machine pressure



3.6.11.3.Notes:

These parameters apply to the butt fusion PE80 or PE 100 polyethylene materials as specified in AS/NZS 4131

These parameters may also apply to the butt fusion PE80 to PE100, this may result in slightly different bead formation without reducing weld quality. If in doubt refer to the pipe maker.

Only pipes and fittings of the same diameter and wall thickness should be built fused together.

t=mean pipe wall thickness calculated from AS4130 min/max values, rounded to the nearest mm.

D=mean pipe outside diameter calculated from AS4130 min/max values, rounded to the nearest mm.

Pressure calculation formula : pipe annular areas

_____ x Pressure value.

hyd. Cylinder area

Where Pipe annuals area =(D-t) t

For ambient temperature > 25 0 c, cooling time must be increased by 1 minute p0 C above 250C.

For ambient temperature <50C, cooling time may be decreased by 1 minute p0C below 50C.

3.6.12.0. ELECTRO FUSION WELDING PROCEDURE.

The saddles and the couplers for HSC shall be joined using good quality EF welding equipment with bar code sensing facility.

Procedure.

Step 1 :	The surfaces on which EF fitting is to be joined shall be scrapped and cleaned properly using the scrappers.
Step 2 :	Removed the plastic covering on the fitting and immediately place the fitting on the pipe where the fitting is to be welded.
Step 3 :	Use proper holding tools to hold the fitting with the surface to be joined.
Step 4 :	Use bar code reader to sense the data on the fitting.
Step 5 :	Allow proper cooling time and then remove the clamps.

3.6.13.0. Specials and fittings (GI)

The fittings for GI pipes shall be of mild steel tubular or wrought steel fittings confirming to IS 1239 (Part-II). The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

3.6.14.0. Jointing.

The pipes shall be cleaned and cleared of all foreign matter before being joined. While joining the pipes the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few runs of spun yarn wrapped around the screwed end of the pipe. The end shall then be screwed in the socket, tee etc., with the pipe wrench. Care shall be taken that all pipes and fittings are properly joined so as to make the joint completely water tight and pipe are kept at all times free from dust and dirt during fixing. Butt from the joint shall be removed after screwing. After laying the open ends of the pipe shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

3.615.0 HDPE pipes

This specification covers the requirements for manufacturing, supplying, laying, jointing testing work site, of High Density Polyethylene (HDPE) pipe used for water supply and sewerage.

3.6.15.1 Applicable codes.

The laying of HDPE pipes and fittings / specials shall comply with all currently applicable status regulations, standard and codes. In particular the following standards, unless other wise specifies herein shall be referred. In all cases, the latest revision of the standards / codes shall be referred.- If requirements of this Specification conflict with the requirements of the standards / codes, this Specifications shall govern

IS : 4984-1995	Specification for High Density Polyethylene pipes for potable water supply and sewerage
IS : 14333-1996	Code of practice for HDPE pipes for sewerage applications
IS : 8008 (Part I to VII)	Injection moulded HDPE fittings for potable water supply, specific requirements for Bends, Tees, Reducers etc.,
IS : 8360-1977 (Part I to IV)	Specifications for fabricated HDPE fittings for potable water supply
IS : 7634-1975 (Part II)	Code of practice for plastic pipe work for potable water supply (laying and jointing Polyethylene pipes)

Other IS codes not specifically mentioned here but pertaining to the use of HDPE pipes shall form the Specifications

3.6.15.2 Maintenance

i) The HDPE pipes and fittings shall be of approved brand conforming to IS: 4984-1995 and IS : 8008 (Part I to VII) or IS, 8360 (Part I to IV) respectively and shall be free from defects.

ii) The pipes are manufactured in sizes from OD 20 mm to OD 1000 mm at pressure ratings of 2.50 PN, 4.00 PN, 6.00 PN, 10.00 PN, 12.50 PN and 16.00 PN.

3.6.15.3 Specials and fittings

HDPE specials and fittings shall confirm to the following IS.

IS : 8008-1995 (Part I to IV) Injection moulded HDPE fittings.

IS : 8360-1977 (Part I to IV) Fabricated HDPE fittings.

3.6.15.4 Dimensions and tolerances

The pipes and fittings shall be inspected before laying for defects, cracks etc., and any pipe fitting found unsuitable shall be rejected.

3.6.15.5 Inspection of pipes

The pipes and fittings shall be inspected before laying for defects, cracks etc., and any pipe fitting found unsuitable shall be rejected.

3.6.15.6 Laying and jointing of HDPE pipes and fittings.

Laying of pipes shall in general be in accordance with Clause 15.7 Specifications given in IS:7634 (Part 1) shall also be followed as applicable.

3.6.15.7 Notes :

i) If any damage is caused to the pipeline during execution of work or while cleaning / testing the pipeline as specified, contractor shall be held responsible for the same and shall replace the damaged pipeline and retest the same at his own cost to the full satisfaction of the Engineer.

ii) Water for testing of pipelines shall be arranged by Contractor at his own cost.

All the electro fusion fittings should be manufactured top quality virgin PE 100 resin which should be compatible with the distribution mains.

iii) The products shall comply with the requirements of EN 12201-3 EN 1553-3 or ISO 8085- with latest amendments

7. Valves

3.7.1 DI Sluice Valves

Supplying & Fixing of resilient seated soft sealing Board approved make sluice valves with body, bonnet of Ductile Iron of grade GGG50, wedge fully rubber lined with EPDM and seals of NBR and the valves should be of vaccum tight and 100% leak proof with face dimensions as per BS 5163-89/ IS 14846-2000/DIN 3202 F4\F5. The stem sealing should be with torodial sealing rings (Minimum 2 O-rings). All the valves should be with Electrostatic powder coating with inside and outside with pocket less body passage. The valves shall be supplied with suitable size galvanized bolts and nuts of required numbers of GKW/KITO/ NEXO/TECHMAN or any other equivalent approved brand jointing materials and conveying to work site, loading, unloading, stacking with all lead and lift and fixing the valves etc., complete and as directed by the Engineer incharge.

3.7.2. DI Air Valves

Supplying & Fixing of 50mm dia PN-10, Single Chamber Triple Function Tamper Proof (Both the Orifices to be housed in the single chamber) Air Valves with body and cover in Ductile Iron of Grade GGG50. All internal parts such as float, shell etc., all cover bolts of austenitic alloy steel, DN 50 float of HOSTAFLON and Gaskets and seals of EPDM. Epoxy powder coating (EP-P) inside and outside colour blue RAL5005. The valve should be designed for all the three functions i.e, 1. large orifice for venting of large air volumes on start up. 2. Large orifice for intake of large air volumes. 3. Small orifice for discharge of pressurized air during operation. The valves should be capable of venting at high velocities up to sound velocity by stabilized float and for Isolation Valve resilient seated soft sealing Board approved make sluice valves with body, bonnet of Ductile Iron of grade GGG40, wedge fully rubber lined with EPDM and seals of NBR and the valves should be of vaccum tight and 100% leak proof with face dimensions as per BS 5163-89/ IS 14846-2000/DIN 3202 F4\F5. The stem sealing should be with torodial sealing rings (Minimum 2 O-rings). All the valves should be with Electrostatic powder coating with inside and outside with pocket less body passage. The valves shall be supplied with suitable size galvanized bolts and nuts of required numbers of GKW/KITO/NEXO/TECHMAN or any other equivalent approved brand jointing materials and conveying to work site, loading, unloading, stacking with all lead and lift and fixing the valves etc., complete and as directed by the Engineer incharge.

3.8 Valve Chambers, Thrust Blocks/Anchor blocks etc.

The Contractor shall build Valve Chambers & Thrust Blocks/Anchor blocks and such other miscellaneous structures that may be required at the locations shown by the Engineer and as shown in the drawings or as may be otherwise specified or directed. The specifications of these ancillary structures shall generally be as enumerated in Clause 17 of the Chapter 10, Standard Specifications for Procurement of Project Works, unless otherwise specified in this Chapter or advised by the Engineer based on the site conditions.

The various structures shall be built as the pipe laying progresses and the Engineer at his discretion, may stop work entirely on the laying of pipe or construction of other structures, until the construction of the structures already approved by the Engineer are completed by the Contractor.

1. Pipe Supports

Pipe supports shall be constructed as per Clause 17.6 of Chapter 10, Standard Specifications for Procurement of Project Works, wherever needed, as per the directions of the Engineer. Pipe supports shall be of saddle type. Pipe supports shall also be provided for the stretches of the pipe, where the pipe is to be gradually brought above the ground for crossing any obstructions as shown in the drawings. The distance between pipe supports shall not exceed 5.0 m centre-to-centre.

Pipe supports shall be as per the approved designs and to be taken to a depth of at least 1. 30 mtrs. below ground level as shown in the drawing and shall have sufficient height above ground to be able to support the pipe. 20 mm dia tor steel clamp shall be provided all round the pipe and fixed to the pipe supports using appropriate means as shown in the drawings or as directed by the Engineer.
There shall be no joints at the location of the pipe supports. The joints shall be located on any one side of the support, at a minimum distance of 200 mm from the face of the support.

The successful bidder should execute the pipe supports as per the approved designs obtained from the Employer.

2. Thrust Blocks

Thrust blocks shall be provided for both horizontal and vertical bends greater than 5o, to effectively transfer the hydrostatic thrust developed during the operation of the rising main, to the ground. They shall be constructed at the locations shown in the alignment drawings, and are of the respective dimensions shown therein, depending on the angle of bends, and the pressures developed in the main. They shall be constructed as per Clause 17.5 of Chapter 10, Standard Specifications for Procurement of Project Works. The surrounding virgin land of the thrust blocks shall not be disturbed, to effectively transfer the thrust developed in the main.

3. Valve chambers

Stone masonry/RCC valve chambers shall be provided for all valves. The specifications of the valve chamber shall generally confirm to Clause 17.4 of Chapter 10, Standard Specifications for Procurement of Project Works. These valve chambers are of different sizes suitable for air valves & scour valves with RCC pre-cast slabs covering . They shall be constructed as per the details shown in the drawings. The stone masonry valve chamber with RCC pre-cast cover, shall be constructed as shown in the Drawings for all Valves. It shall have a opening in the side wall for access into it. Outside the valve chambers, for scouring of water, draft channels shall be provided.

3.9 Providing & Installing Bulk & Domestic Water Meters with Strainers

3.9.1 General Specifications

Technical Specification for Water Meters conforming to Class – B of ISO:4064 / IS 779 – 1994 and its latest amendments.

1. Domestic Water Meters (Multi Jet)/equivalent approved by the employer.

Technical Specifications for 15MM, 20MM, 25MM & 32MM – Multi-jet 'Class B' Domestic Water Meters

Specifications for Multi-jet meters for horizontal and/or vertical installation

3.9.2 Scope of Application

The meter will be used for the measurement of cold, chlorinated potable water.

3.9.3 Applicable Standards

The meter shall conform to both IS 779 and ISO (4064) standards with latest amendments. Valid EEC certification is necessarily for the manufacturing unit from where the meters would be supplied. This certificate shall be valid at least up to end of 2010 For EEC meters, the bidders should categorically mention the following:

- Name, address and contact details with phone, fax details of the EEC approval issuing authority.
- Validity of the approval.

Alternative to EEC certificate / Life cycle & accuracy test certificate conducted after May 2005 by FCRI / NABL should be enclosed with the tender documents as well as any other technical document which may help Board in assessing the meters technical merits and its suitability for the prevailing operating conditions.

Meter Type: The meters shall be:

- Multi-jet
- Inferential meters
- Super dry dial
- Hermitically sealed
- Class B
- Nominal size of water meters shall be 15mm, 20mm, 25mm & 32mm.

3.9.4. Material

All the materials used to construct/ manufacture customer meters shall confirm to Appendix B of IS 779 or clause 4.7 of ISO 4064-1. in particulars the following:

- Body shall be of Brass. Grade DCB2 of IS 1264 – 1989.
- Registration Box shall be made of brass. Grade DCB2 of IS 1264 – 1989.
- Cap ring shall be made of brass. Grade DCB2 of IS 1264 – 1989/Engg. Plastic
- Screws & studs shall be made of SS. 07Cr18Ni9 of IS 6911 – 1992.
- Strainers shall be made of HDPE
- Impeller shall be made of Engineering Plastic.
- Impeller shaft shall be either SS 07Cr18Ni9 of IS 6911 – 1992
- Nipples and nuts shall be of Brass LCB2 of IS 292 – 1983.
- The spindle and bearings inside the hydraulic chamber shall be made of polished stainless steel with hard metal tip and sapphire.

Materials which come in contact with the water supply shall withstand 2 ppm (parts per million) of chlorine residual in the water supply and shall be resistant to corrosion.

The water meter and accessories shall be manufactured from materials of adequate strength and durability. The materials, which come in contact with the potable water, shall not create a toxic hazard, shall not support microbial growth, and shall not give rise to unpleasant taste or discoloration in the water supply. However, the spindle and bearings inside the hydraulic chamber shall be made of polished stainless steel with hard metal tip and sapphire.

Furthermore the internal pressure cup should overlap the meter body. The lower case of the meter shall be painted with thermal painting internally and externally. The painting materials should be safe for human uses and not affect human health (Health certificates should be included in the bidding documents). The painting colour shall be agreed on later upon order award.

Construction: Meter shall be as per clause 9 of IS 779 – 1994 or relevant clauses of ISO 4064-1. Each meter will be supplied with two cylindrical nipples or tail pieces with connecting nuts. Threads on the connection shall conform to latest version of IS 2643 (part 1 to3) or ISO 228-1. All meters shall be supplied with an easily removable tubular inlet strainer. The Seal & Sealing wires shall be rust proof material like engineering plastic.

3.10 Service Connections

One Service Connection means one tapping from a distribution main/ sub-main including one tapping saddles, elbows, service pipe from tapping point to the chamber near property boundary or inside the property boundary as per the direction with U-ball valve.

The house connection using Medium Density Polyethylene pipes (MDPE) shall consist of the following;

3.10.1 Items for Option 1:

Electro Fusion Tapping saddle of PN 12.5 PE 100 compatible to the HDPE Mains of various diameters. The outlets should be reinforced with female threaded metal inserts of SS 304, metal inserted male thread elbow, MDPE PE 80 Blue pipes, 90 deg double compression elbows, Gunmetal/Brass ball valves of required sizes and water meter. The outlet size shall be either 15mm, 20 mm depending upon the type of Service Connection.

Electro fusion Tapping saddle shall be provided with a SS-304 Brass cutter with cutting edges for making hole / tapping on the Mains as shown in drawing and Fusion joint in such a manner that the 20-63mm dia outlet depending on requirement of the house service connections rotate able 360^0 to the axis of pipeline including maintaining the same for the period under O&M.

3.10.2 Items for Option 2:

Providing required sizes of HSC brass ferrule with union confirming to relevant IS make hole by drilling on top of DI distribution mains, fixing the ferrule for diameter 200 to 400mm and making the connection water tight etc.,

as shown in the drawing and as directed by the Engineer including cost of required specials, drilling charges, hydraulic testing, maintaining the same for the period under O&M.

From tapping on DI mains, metal inserted male thread elbow, MDPE PE 80 Blue pipes, 90 deg double compression elbows, Gunmetal/Brass ball valves of required sizes and water meter

3.10.3 **Items common for both options**:

From the outlet of Male Threaded compression Elbow, 15/ 20 mm MDPE Service Pipe shall be extended upto the RCC/BBM chamber at property boundary as shown in the drawing. At the end of the Service pipeline, 90 Deg Double Compression Elbow shall be fixed and MDPE Service pipe shall be connected. From the Service Pipe, a , Gunmetal/Brass Ball valve of necessary size with Compression joint at one side and Female joint at one side. The Ball valve shall be as per IS: 1703-89 and rated PN 16

The entire assembly shall be as per the enclosed drawing.

The connecting pipe shall be made out of MDPE conforming to ISO 4984 & ISO 4427-1996. This International standard specified the required properties of pipes made from polyethylene (PE) to be used for buried water mains and services and for water supply above ground both inside and outside buildings. In addition, it specifies some general properties of the material from which these pipes are made, including a classification scheme. Other relevant IS and International Standards applicable for the MDPE pipe shall be followed as approved by the Engineer.

The MDPE Pipes for drinking water applications should have undergone type test by WRc-NSF, U.K. according to BS 6920 and a certificate from either WRc-NSF or WRAS (Water Regulations Advisory Scheme) should be available evidencing this fact/equivalent institutions approved by the employer.

3.10.4 Technical Specifications for Electro Fusion tapping:

All the electro fusion fittings included in this document will be designed for use in water distribution system and be manufactured/supplied by manufacturers having latest ISO certification for their quality systems. The products should comply with the following specific requirements.

1. All the electro fusion fittings should (George Fisher/Wavin/Kimplast/ Equivalent) have Melt Flow Rate (MFR) in the range between 0.4 to 1.4 gms /10 min and shall be compatible for fusing on PE 100 distribution line manufactured according to the relevant national or international standards. The polymer used should comply with the requirements of BS 3412 and/or BS EN 12201-1.

2. All the electro fusion fittings should be manufactured in Blue PE80 - material which should be compatible with the distribution mains.

3. The tapping saddles to have drilling cutter which enable s tapping even below the maximum permissible operating pressure; the disc cut out of the pipe wall is permanently kept in the drilling cutter.

4. The products shall comply with the requirements of BS EN 12201-3: 2003, BS EN 1555-3 or ISO 8085-3.

5. All the fittings shall be of SDR 11 rating.

   The product group used for drinking water applications should have undergone type test by WRc-NSF, U.K. according to BS 6920 and a certificate from either WRc-NSF or WRAS (Water Regulations Advisory Scheme) should be available evidencing this fact/ equivalent institutions approved by the employer.

6. All the products shall be manufactured by injection moulding using virgin compounded PE 80 (MDPE) polymer having a melt flow rate between 0.5 – 1.1 grams/10 minutes and shall be compatible for fusing on PE 80 distribution mains manufactured according to the relevant national or international standards. The polymer used should comply with the requirements of BS 3412 and/or BS EN 12201 -1.

7. The fittings intended for water distribution applications shall be coloured blue for the clear identification of the services.

8. All the electro fusion products should be individually packed so that they can be used instantaneously at site without additional cleaning process. The protective packing should be transparent to allow easy identification of the fittings without opening the bags.

9. The electro fusion products should be with only a single heating coil to fully electro fuse the fitting to the adjoining pipe or pipe component as applicable. The heating coils shall be terminated at terminal pins of 4.0 or 4.7 millimeter diameter, protected with polyethylene shroud. Each terminal shroud should be additionally protected with polyethylene shroud caps.

10. No heating element shall be exposed and all coils are to be integral part of the body of the fitting. The insertion of the heating element in the fitting should be part of the injection moulding process and coils inserted after the injection moulding process or attached to the body of the fitting as a separate embedded pad etc. are strictly not acceptable.

11. The pipe fixation shall be achieved by external clamping /suitable devices as directed by the Engineer in charge.

12. The brand name, size, raw material grade, SDR rating and batch identification are to be embedded as part of the injection moulding process. Each fitting should also be supplied with a barcode sticker for fusion parameters attached to the body for setting the fusion parameters on an fusion control box. The barcode sticker should also include the fusion and cooling time applicable for the fitting for the manual setting of a manual fusion control box.

13. The fittings should be V-regulated type designed to fuse at a fusion voltage of 40 volts AC.

14. The heating elements should be designed for fusion at any ambient temperatures between -5 to +40 degree centigrade at a constant fusion time i.e. without any compensation of fusion time for different ambient temperatures.

15. A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the terminals. The fusion indicators should not allow the escape of the molten polymer through them during or after the fusion process.

16. All the sockets in the electro fusion fittings should include a method of tapping controlling the pipe penetration (pipe positioner/stopper).

17. The EF tapping ferrules should be the top loading type which are to be clamped on the mains for fusion using the custom made top loading clamps exerting 1500N (150 kilograms approximately) top load.
18. The tapping ferrules should be supplied with suitable adaptors for proper positioning of the top-loading clamp into the saddle.

19. The Torque required to operate the cutter after fusion of the PE mains should not exceed 45 N-m.

20. The cutter should be designed in such a way that the cut coupon is not allowed to fall into the pipeline and is retained inside the body of the cutter providing a positive sealing of the hole in the cutter head for pressure testing.

21. The tapping ferrules will have female threaded outlet to connect necessary compression fittings for further connecting MDPE Pipe in House connection.

22. The threaded outlet should be from sizes ½" to 1" BSP to suit the required House Service Connections.

23. The outlets should be reinforced with female threaded metal inserts of SS 304.

3.10.5 Installation and Fusion Jointing

The fusion jointing process shall be carried out as per the procedure outlined in the DVS220 standard, if not available equivalent standards acceptable to employer.

A protocol for each fusion joint to be printed to ensure the joint process carried out is error free. The electro fusion machine shall have the facility to record & make print for each joint.

The precautions & measures as mentioned by electro fusion fittings/machine manufacturer be taken up rigorously while making the joints in the field.

The related pipe jointing accessories such as proper pipe cutter, Universal scrapped clamping kits, Pipe cleaners, Top load tools(for tapping saddle installation), Pipe peelers supplied by the same electro fusion fitting/machine supplier shall be used to ensure perfect jointing.

The usage of tapping tools such as taping keys, tension clamps supplied by the same electro fusion fitting /machine supplier must be used to ensure perfect tapping of main lines.

The piping system will be tested as per the guidelines given by ISO standard. The guideline shall be furnished by the supplier of electro fusion fittings, tools and machines.

3.10.6 Electro fusion Welding Machine

Supplying delivery and testing at site (Fusion Provida/George Fisher/Equivalent approved makes of Electro fusion welding machine as under:

The electro fusion control unit shall be designed for use with any electro fusion fittings required upto 48V. The unit shall operate in three modes, Automatic, Manual and Barcode. The unit shall be complete with all accessories and shall have the following features as minimum.

Full output voltage and output current monitoring throughout the jointing cycle.

Automated output voltage (True RMS) level control between 10 and 48 VAC

Graphical display of output current and voltage levels.

Data logging facility for storing minimum 600 joint records and facility for data transfer and print out. Required software shall be provided.

Shall have Soft start feature to present shock loading on generators.
Temperature compensation facility.
Protection against fitting overheat.
The unit shall give user friendly step by step operator instructions and printing facility (in English & Kannada languages).
Shall have back-lit graphical display.
Shall have a single combined lead for all modes of operation.
RS 232 serial interface cable shall be provided along with the unit.
The machine shall be provided with barcode reader and adaptors if any required.
These unites are provided with 7 segment display unit to select the output voltage, Temperature, Fusion Time and Error message in case of malfunctions occurring before or during the Fusion.
The output voltage level control shall be between 10 and 44 VAC.

Specification

Operating Temperature Range (Min).	-10 to +50 Deg C

Operating Voltage Range (min)	190 V to 270 V, 45 to 50 Hz
Output Voltage	8 to 44 VAC 10 – 44 VAC (Barcode Mode)
Enclosure Protection	IP 54
Input Cable length	Minimum 12 meters
Output Cable length	Minimum 4 meters

3.10.7 COMPRESSION FITTINGS :

Compression fittings used for House service connection comply as per ISO 14236

3.10.8 Material of Construction

Compression fittings material shall confirm to ISO14236.Clause -5.

A .Body-Polypropylene

b. Nut / Cap –Polypropylene.

c. Clip Ring-POM (Acetylic resin)

d. Packing bush- Polypropylene

e. "O" ring - NBR

f. Threaded metal inserts –SS 304 with BSP Threads

3.10.9 Pressure testing

The pressure rating of compression fittings as per clause 8 of ISO 14236 which shall be PN16

3.10.10 Dimensions:

The Dimension of compression fittings shall be as per clause 7.1 of ISO 14236

3.10.11 Performance requirements

The compression fittings shall be tested as per ISO 14236. Following Test methods shall be performed.

Clause 8.2.1 -Leak tightness under internal pressure.

Clause 8.2.2 -Resistance to Pull out.

Clause 8.2.3 -Leak tightness under Internal Vaccum.

Clause 8.2.4 -Long term Pressure Test for Leak tightness for assembled joint

Clause 8.3.2.1 -MRS Value as per ISO 9080

Clause 8.3.3.1 -Resistance to Internal pressure.

3.10.12 Effects on Quality of Water

The Compression fittings for intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGM / KIWA / SPGN / WRc –NSF/ equivalent institutions approved by the employer and certificate of compliance to be produced for the following parameters :

a. Odour & Flavour of Water.

b. Appearance of Water.

c. Growth of Micro Organism

d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)

e. Extraction of Metals.

For clear identification of the water services, the nuts of the fittings should be coloured blue while the body to be black. All fittings with threaded ends should be with BSP threads.

3.10.13 Pipes – Galvanized iron

The pipes (tubes) shall be galvanized mild steel hot finished seamless (HFS) or welded (ERW) HRIW or HFW screwed and socketed conforming to the requirements of IS : 1239-90 Part – 1 for medium grade. They shall be of the diameter (nominal bore) specified in the description of the item, the sockets shall be designated by the respective nominal bores of the pipes for which they are intended.

Galvanizing shall conform to IS : 4736-1986 - The zinc coating shall be uniform adherent, reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare batches, black spots, pimples, lumpings runs, rust stains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanized in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS: 554-1985. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

All tubes shall withstand a test pressure of 50 Kg/sq. cm. without showing defects of any kind.

Fittings - The fittings shall be of mild steel tubular or wrought steel fittings conforming to IS: 1239 (Part –II) or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

3.10.14 Brass Ball Valve (STOP COCKS). - The ball valve shall be of Brass or Gun metal as specified conforming to IS: 1703-89. The ball valve shall be of following class:

a) **High Pressure -** Indicated by the abbreviation 'HP' for use on mains having pressure of 1.75 kg/sq. cm. or above. These shall remain closed at a test pressure of 13.5 kg/sq. cm.

Sl. No.	Diameter of spherical float	Nominal size of ball valve					
		15 mm	20 mm	25 mm	32 mm	40 mm	50 mm
1	High Pressure (mm)	127	152	203	229	254	305
3	Minimum weight of ball valve including back nut, body and piston (gms)	283	446	823	1149	1589	1852

Performance Requirements:

The Ball valves shall be tested as per ISO 4422.Folowing test methods will be performed.

Clause 7.1	- Resistance of Valve Bodies to internal pressure
Clause 7.2	- Crushing Test
Clause 7.3	- Endurance Test
Clause 7.4.2	- Seat and Packing Test
Clause 7.4.1	- Operating torque Test

The Ball Valves intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGM / KIWA / SPGN / WRc –NSF/ equivalent institutions approved by the employer and certificate of compliance to be produced for the following parameters :

a. Odour & Flavour of Water.

b. Appearance of Water.

c. Growth of Micro Organism

d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)

e. Extraction of Metals.

3.10.15 Bib cock and Stop cock - Brass: A bib cock (bib tap) is a draw off tap with a horizontal inlet and free outlet and a stop cock (stop tap) is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS: 781-84. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clock wise direction.

The bib cock and stop cock shall be polished bright. The minimum finished weights of bib tap (cock) and stop tap (cock) shall be as specified in Table below:

Size (mm)	Minimum finished weight	
	Bib tap (Kg.)	Stop tap (Kg.)
8	0.25	0.25
10	0.30	0.35
15	0.40	0.40

20	0.75	0.75

3.10.16 MDPE Pipes

These specifications are for MDPE Blue PE 80 Pipes for House Service Connections of Dia 15 mm to 200 mm OD.

1. Raw Material
   Raw material used to Manufacture MDPE Blue Pipes shall be Virgin Natural Resin PE 80 containing those anti – oxidants, UV Stabilisers & Pigments necessary for Manufacturing of pipes. The Density of Pipes shall be in the Range 0.926 to 0.940 g/ cm3 confirming to ISO 4427 Standard. The PE 80 Resin shall have MRS of 8 Mpa.

2. Effects on Water Quality :
   The MDPE PE 80 Blue Pipes shall confirm to clause 3.5 of ISO 4427 for conveyance of Water for Human Consumption. Also the pipes intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGM/KIWA/SPGN/WRc-NSF/ equivalent institutions approved by the employer and certificate of compliance to be produced for the following parameters

   a. Odour & Flavour of Water
   b. Appearance of Water
   c. Growth of Micro Organism
   d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
   e. Extraction of Metals

3. Pressure Rating:
   The Pressure rating of MDPE Blue PE 80 Pipes shall be confirming to Clause 4.1 of ISO 4427 : 1996.

4. Colour of Pipes:
   The Colour of MDPE PE 80 Pipes shall be BLUE confirming to Clause 3.2 of ISO 4427 : 1996.

5. Dimensions:
   The pipe dimensions shall be as per latest revisions of Clause 4.1 of ISO 4427 : 1996 and pipes upto diameters 200 mm shall be supplied in Coils of 300 mtrs. The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of ISO 4427:1996. Each pipe shall be of uniform thickness throughout its length.

The wall thickness of the PE 80 Pipes shall be as per the table given below:

Nominal Dia of		Wall thickness

M D P E P i p e (mm)	PR rating	Minimum	Maximum
20	**PN 16**	**2.8**	**3.3**
25	**PN 12.5**	**2.8**	**3,3**
32	**PN 12.5**	**3.6**	**4.2**

The dimension tolerances shall be as per ISO 4427 clause 4.1.3

6. Performance requirements
   The Pipe supplied should have passed the acceptance test as per ISO 4427. The manufacturer should provide the test certificates for the following tests.

1. Melt Flow Rate
2. Density,
3. Oxidation and Induction test,
4. Hydrostatic Test ,
5. Pigment dispersion Test,
6. Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute Third Party Inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per QAP approved by Engineer In charge.

7. Training:
   The contractor shall provide training to Engineer in charge regarding erection, functionality & other manufacturing problem in the original manufacture factory unit for 5 days.

3.10.17 M.D.P.E pipes for House service connections

1. M/s KIMPLAS PIPING SYSTEMS LTD
2. M/s Jain Irrigation Systems, Jalgaon
3. M/s George fischer
4. DURA LINE
5. MANEKYA S-LON

3.10.18. Electrofusion Tapping ferrule, Compression Fittings, U PVC Ball valves

1. KIMPLAS PIPING SYSTEMS LTD
2. PALAPLAST
3. PLASTITALIA
4. RECCALATI
5. M/s. George Fishcer
6. M/S Jain

3.10.19 Bulk Water Meters (Electromagnetic)

1. M/s Endress & Hauser
2. M/s Yokogawa

3. M/s ABB
4. M/s Emerson
5. M/s. Siemens
6. M/s. Krohne Marshall

3.10.20 Domestic Water meters

1. Elster
2. Sapple
3. Aquamet
4. Minol
5. Actaris/Itron
6. Ningbo
7. Arad

3.10.21. Pressure Regulating Valves:

Pressure regulating/ control valves must be Automatic Hydraulic Control Valves of diaphragm type and will work as pressure reducing valve for reducing of a higher upstream pressure to a constant lower downstream pressure, independent changes of the capacity or variations of the upstream pressure.

Or Pressure Control Valves for high diameters are automatic hydraulic control valve and work as pressure reducing valve for reducing of higher upstream pressure to a constant downstream pressure, independent charges of the capacity or variations of upstream, control valve through – passage design, rotationally symmetric flow path, annular flow cross section in any open position, linear regulating characteristics, Axial movement of plunger by means of crack shaft drive, with irreversible worm gear box, including position indicator.

1. This valve will include:

a. 2 flanges of pressure rating PN10;
b. main valve hydraulically operated;
c. controlled by a pilot valve;
d. central control box, to control the opening/closing and reaction speed;
e. a pressure gauge for commissioning;
f. The valve should have a position indicator, open speed regulator on pilot pipes, and able to receive 2 manometers.

2. Material of valve will be:

a. body of Ductile Iron;
b. main bearing of bronze;
c. other parts of stainless steel or copper alloy;
d. auxiliary circuit shall be in stainless steel or cupper alloy;
e. sealing and diaphragm of NBR or EPDM;

f. material pilot valve and central control box: all functioning parts of stainless steel and rubber parts of NBR;
g. The cover shall be able to remove for cleaning of floating equipment. Cover bolts and nuts have to be stainless steel.
h. Connecting rods with bronze/PTFE bearing bush

i. Corrosion protection:

Inside and outside of epoxy powder coating of 150 microns thick.

The globe valve will support a water temperature up to 50°C.

Flanges will be according to ISO 7005 PN 10 (EN 1092-2).

Dimension face to face must be according to ISO 5752-1, or EN 558-1.

Design data/ Size	100mm	150mm	200mm
Maximum upstream pressure	7 bars	7 bars	7 bars
Minimum upstream pressure	3 bars	3 bars	3bars
Downstream pressure	0.6 to 2 bars	0.6 to 2 bars	0.6 to 2 bars
Maximum flow capacity	20 l/s	40 l/s	70 l/s
Minimum flow capacity	2 l/s	4 l/s	7 l/s

Features and Benefits of the Pressure reducing valve shall be as follows

- Line pressure driven – Independent operation
- In-line serviceable – Easy maintenance
- Double chamber design
- Moderated valve reaction
- Protected diaphragm
- Flexible design – Easy addition of features
- Variety of accessories – Perfect mission matching
- "Y" or angle, wide body – Minimized pressure loss
- Semi-straight flow – Non-turbulent flow
- Stainless Steel raised seat – Cavitation damage resistant
- Obstacle free, full bore – Uncompromising reliability
- V-Port Throttling Plug – Low flow stability
- End Connections (Pressure Ratings): Flanged: ISO PN16, PN25 (ANSI Class 150, 300)
- Threaded: BSP or NPT
- Working Temperature: Water up to 80°C (180°F)
- Standard Materials: Body & Actuator: Ductile Iron
  Internals: Stainless Steel, Bronze & coated Steel
  Diaphragm: NBR Nylon fabric-reinforced

Seals: NBR

- Coating: Fusion Bonded Epoxy, RAL 5005 (Blue) NSF & WRAS approved or Electrostatic Polyester Powder, RAL 6017 (Green)

The Pressure Reducing Valve shall reduce higher upstream pressure to lower preset downstream pressure regardless of fluctuating demand or varying upstream pressure.

i. **Main Valve**: The main valve shall be a center guided, diaphragm actuated globe valve of either oblique (Y) or angle pattern design. The body shall have a replaceable, raised, stainless steel seat ring. The valve shall have an unobstructed flow path, with no stem guides, bearings, or supporting ribs. The body and cover shall be ductile iron. All external bolts, nuts, and studs shall be Duplex® coated. All valve components shall be accessible and serviceable without removing the valve from the pipeline.

ii. **Actuator**: The actuator assembly shall be double chambered with an inherent separating partition between the lower surface of the diaphragm and the main valve. The entire actuator assembly (seal disk to top cover) shall be removable from the valve as an integral unit. The stainless steel valve shaft shall be center guided by a bearing in the separating partition. The replaceable radial seal disk shall include a resilient seal and shall be capable of accepting a V-Port Throttling Plug by bolting.

iii. **Control System**: The control system shall consist of a 2-Way adjustable, direct acting, pressure reducing pilot valve, a needle valve, isolating cock valves, and a filter. All fittings shall be forged brass or stainless steel. The assembled valve shall be hydraulically tested and factory adjusted to customer requirements.

iv. Quality Assurance: The valve manufacturer shall be certified according to the ISO 9001

v. **Quality Assurance Standard.** The main valve shall be certified as a complete drinking water valve according to NSF, WRAS, and other recognized standards.

3.10.22 Electro-Magnetic Flowmeter

1) Manufacture,Supply & delivery, assembly at site, erection, electrification , testing, trial run and commissioning of brand new, best efficient full bore Electro Magnetic bulk flow water meters to measure both raw & pure water having minimum conductivity of 5 S/cm,of approved make or equivalent make and

conforming to relevant BIS or ISO Standards based on the origin of the goods, including the sensers, loggers,signal convertor, all other accessories and as per the following description . The acceptance/ routine tests shall be either conducted at M/s Fluid Control Research Institue,Palghat,Kerala/ any of the Laboratories approved by the National Accreditation Board for calibration Laboratories(NABL) or EEC pattern approval certificate/equivalent institutions approved by the employer.

Type of Flow Meter: Inline magnetic inductive, factory assembled and factory calibrated on a precision calibration rig. Alternate forms of measuring devices like insertion flow meters ,clamp on flow meters,turbine or PD flow meter are not acceptable

PRIMARY HEAD

Process Connection: Flanged end connections to ANSI B 16.5 class 150 lbs upto 600 mm size.Above 600 mm and upto 1000 mm flanged to AWWA class D(10 bar) pressure rating.Above 1000 mm upto 2000 mm flanges to AWWA class B(6 bar) pressure rating.

Temperatures: Ambient - upto 60 Deg C; Process - upto 90 Deg C.

Insulation of field coils: Class E

Electrode Design : Flat elliptical electrodes,solidly fitted and surface polished

Protection energy: IP 68, equivalent to NEMA 6

Materials of Construction :

Measuring tube-SS 304

Liner- P.T.F.E/Neoprene upto 400 mm size and KTW approved rubber above 400 mm size Electrodes Hastalloy ' C' - SS 316/ SS 316 Ti connecting flanges -Carbon steel Coil housing-Sheet steel with polyurethane paint

Terminal Box - Die-Cast aluminium with polyurethane paint

Signal Convertor :

Type: Digital microprocessor based with display

Mounting : Remote mounting with distance upto 300 mtrs from the primary head without any signal boosters.

Power supply: 230 VAC,50HZ, Single Phase/DC

Output signals: 1x 4.20 mA & 1x pulse outputs,, 1X status output for flow direction ,errors or trip point

Low flow cut off : Required upto 20 % flowrange adjustable in steps of 1%

Local Display : 2- line LCD Back-lit for actual flow rate ,forward,reverseand sum totalisers (7-digits),display engg.Units programmable to use defined unit.

Accuracy: +/- 0.5 % of measured value upto 600 mm size
+/- 0.8% of measured value above 600 mm size(Refer Note 2)
Lin earity +0.5 % of flowrate
Reliability +0.1 % of reading
+0.2% of full scale

Meter flow range : Fully programmable from front facia of instrument without opening the cover

Housing material : Polycarbonate,Die cast Aluminium

Protection category: IP 67 equivalent to NEMA 4/4 X

Cables: The special cable for signal and the coil supply cable both are required to be suplied (Refer Note 3) approximate length -50 mtr

Behaviour in case of flow reversal : Meters which may be subjected to an accidental reversal of flow shall be capable of withstanding it without any deterioration

or change in their metrological properties, and at the same time shall record such a reversal.

Sealing : Flow meters shall have protective devices which can be sealed in such a way that after sealing, both before and after the flow meter has been correctly installed, there is no possibility of dismantling or altering the flow meter or its adjustment device without damaging the protective devices.

Meter markings

The water meter shall be marked with the following identifications:

Direction of water flow with an arrow indicating the direction

Trade mark and / or name of the manufacturer.

The metrological class and Qn rate in m3 per hour.

The manufacturer's serial number of the meter permanently affixed to the meter's upper or lower case.

Stamped with the initial "KWB"

Working pressure

Approval marking and no. of approval certificate.

Year of manufacturing printed on the counter or engraved the head ring

Minimum sustainable pressure shall be PN 16 bar

Flow rate; Minimum, Maximum and transition flow shall be as per relevant standards.

Notes:

1) If the flow meter size works out to be smaller than the pipeline size,bidder shall offer suitable reducers and expanders. The reducers/expanders shall be of MS, smaller dia end flanged to suit the flow meter flanges and the larger dia end finished for welding to the pipe. The conical angle of reduction should not exceed 10 Deg.The bidder should guarantee that installation of such reducers and expanders immediately before and after the flowmeter will not affect the accuracy stated above for the flowmeter.
2) The accuracy of calibration of flow meters at the factory shall be better by a factor of 2 than the guaranteed acuracy. This higher accuracy should be reflected in the calibration certificate of the flowmeter(+/- 0.25% 0.5 % accuracy and +/- 0.4 % for 0.8% accuracy)
3) Bidder shall include 50 mtr cable length in the basic offer and quote additionally for unit rate per metre for both the special signal and the coil supply cable.

2) Supplying and fixing at site M.S Reducer/expander of 8mm thickness for pipes up to 600 mm dia and 10 mm thickness for pipes above 600 mm dia with flange thickness as per relevant ISS , with smaller dia end flanged to suit the flow meter flanges and the larger dia end finished suitable for jointing to M.S /D.I/C.I/PSC/HDPE pipes with necessary tail piece and other accessories. The offer shall include cutting of pipes and complete preparation of site. The conical angle of the reducer/expander should not exceed 10 degree. The reducer/expander should be coated with epoxy paint on both inside and outside. Released pipes shall be handed over to the Purchaser.

3) Construction of following size meter chamber including the items and specifications as shown below and dimensions as shown in the typical drawing.

3.1) For 2.0 m x 2.0 m x 2.0 m size meter chamber

(a) Earthwork excavation for foundation in all strata including depositing on bank including danger lighting wherever necessary with all lead and lift. Earthwork excavation includes excavation for providing and fixing of flowmeter including redcers/expanders and for construction of meter chamber

(b) Filling in foundation with sand and granite boulders of 100 mm to 150 mm in foundation including watering tamping etc, complete as per design, Specification & the direction of the Engineer-in-charge with all lead and lift

(c) Screed Layer - Providing and laying granite or basallt or trap jelly concrete CC 1:3:6 proportion for foundation (Screed layer) using 40mm & down size jelly for foundation laid in 15 cms.thick layers and well compacted including curing etc, complete with all lead and lift.

d) RCC M-20 side wall- Construction of RCC M-20 side wall alround 20 cms thick upto the ground level or the desired level.

(e) RCC M-20 Covering slab - Covering the top of the chamber with RCC M-20 slabs of minimum 6" thickness finished smooth on top surfaces.

(f) Providing & fabricating torsteel bars of all sizes for reinforcements for RCC work including conveying steel to work spot with all lead including cleaning, straightening, bending, fabricating, placing in position and tieing as per design including cost of binding wire hoisting etc., curing etc., complete with all lead and lifts.

(g) Refilling - Refilling pipeline trenches and foundation with selected available earth from treanch excavation and foundation including watering, consolidation in layers of 15 cms, thickness including disposing off the surplus earth with all lead and lifts.

5) Power supply to electro-magnetic flow meter – Battery operated with 2 internal batteries having a life span of 3 years.

6) Supplying and laying Data cable.

7) Supply & laying of suitable capacity signal cable

8) Supply & laying of suitable capacity supply cable

9) Supply and installation of calibration unit which includes training of purchaser's personnel

Conditions:

1) The offered flowmeter should be calibrated at the factory on calibration rigs having an accuracy at least ten times better than the flow meter accuracy guaranteed. Further the calibration rig accuracy should be traceable to National / International standards. The calibration facility should be accredited/certified by an independent authority of International reputation. This accreditation certificate for the calibration facility should be furnished along with the offers.

2) Each flow meter supplied should be accompanied by the calibration certificate

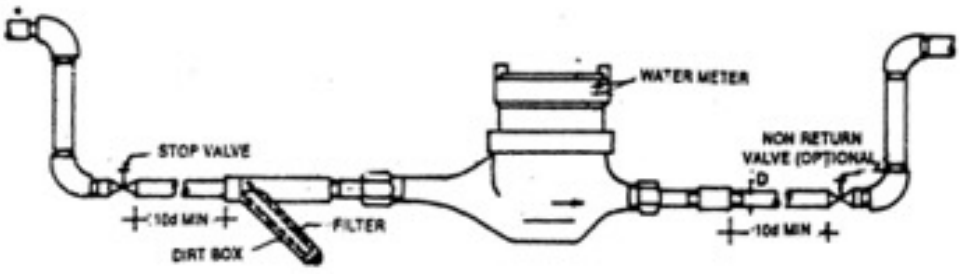
3) During Warranty, the supplier shall carry out the calibration of flow meters without any extra cost once in six months.

4) If the water meter were found to be defective during Warranty as per relevant standards then the entire cost of dismantling, testing and re-fixing including transportation charges would be borne by the supplier.

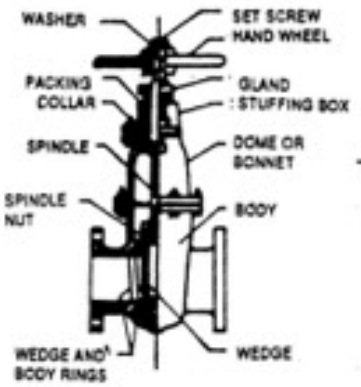
5) The flow meters shall have arrangements for servicing/repairing without resorting to dismantling the flanged joints or removing entire unit.

COCKS VALVES & METER

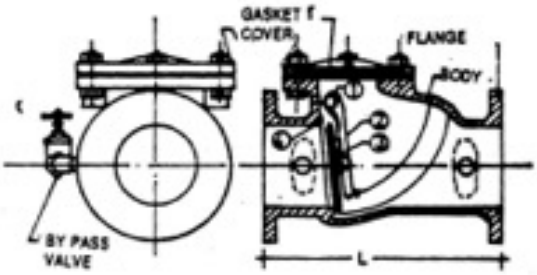
CLAUSES 20.2.2, 20.2.5, 20.2.6, 20.2.9
20.2.10, 20.2.17, 20.17
FIG. 2



WATER METER ASSEMBLY

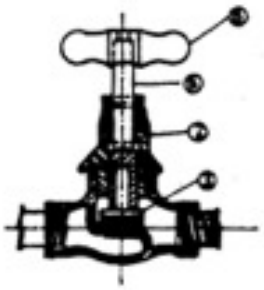


SLUICE VALVE

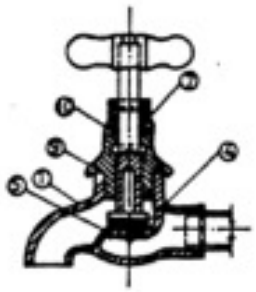


NON RETURN VALVE

(1) HINGE PIN
(2) HINGE
(3) DOOR
(4) BODY RING



STOP COCK

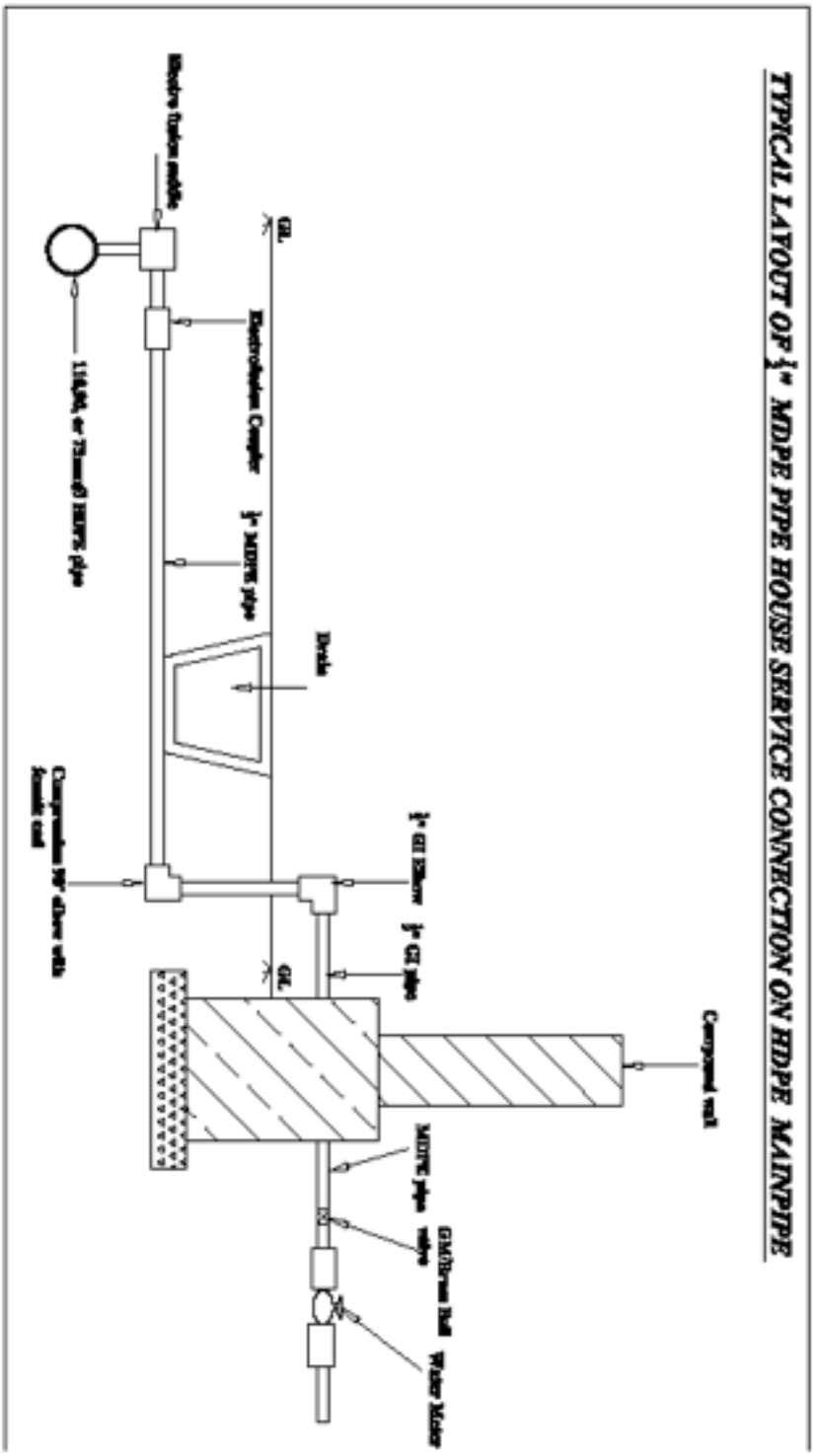


BIB COCK

(1) BODY (2) WASHER PLATE (3) NUT FOR WASHER
(4) BONNET (5) WASHER (6) SPINDLE (7) GLAND
(8) HANDLE (9) BONNET JOINT WASHER (10) GLAND PACKING

DRAWINGS NOT TO SCALE
ALL DIMENSIONS ARE IN MM

6) Erection of flow meter includes charges for excavation of earth and removal of the pipeline as directed by the Engineer-in charge. and handing over of released pipes to the purchaser. Any damages to the existing pipeline occurred while fixing the flow meter; the same shall be rectified by the supplier at his own cost and as directed by the Engineer -in -Charge.



5.0 EARTH WORK:-

5.1 GENERAL:-

The earth work excavation for laying of pipe shall be carried out, in general, as per Chapter 10, Standard Specifications for Procurement of Project Works, as specified in Sub-Clause 15.7.5.1 for rising main and Clause 5 for the reservoir. Any additions or modifications specified

in this Chapter shall be followed. The Contractor shall make all excavations required for laying and jointing of the pipeline and construction of pertinent structures as required by the project. Except where otherwise required by the project or instructed by the Engineer, all excavation shall be in open cut to the specified widths and depths. The Contractor is advised to satisfy himself with regard to the likely conditions that may be met with during the execution of the Works, with regard to the underground obstructions or conditions, necessary dewatering requirements etc., before quoting the rates.

5.2 **Classification of Excavation**

All materials involved in excavation shall be classified in four categories as follows:

5.3 Ordinary soil

This includes excavation in all types of soil including soil containing gravel, murrum, loose boulders, viz., ordinary gravelly soil, hard gravelly soil, wet soil, stiff slushy soil, chettu soil and calcareous strata, but exclusive of disintegrated rock, soft rock/shale;

5.4 **Soil Containing Disintegrated Rock, Soft Rock and Soft Shale, Medium Hard rock**

This category includes excavation in soil containing disintegrated rock, soft rock or soft shale which can be cut by shovel, lime stone, sand stone, hard shale and schist fissured rock, without resorting to blasting and no hand or mechanical chistelling is required.

5.5 **Hard Rock**

This category includes excavation in hard rock requiring hand or mechanical chiseling or blasting. In case of difference in opinion between the classification of rock requiring blasting and that requiring chiseling, wedging, the decision of the Engineer shall be final and binding on the Contractor.

5.6 **Limits of excavation**

The width of trench for laying of pipe lines DI/PVC/MS, shall be as per relevant IS codes with latest amendment. A minimum earth cover of 1.0 m shall be maintained above the pipe top, unless otherwise specified or shown in the alignment drawings. Any extra excavation required for providing suitable bedding for the pipeline or for maintaining the grade of the pipeline, shall be paid extra at actual, based on the quoted rates.

The Contractor shall be responsible to ensure that the widths and depths of the trenches do not exceed the limits shown in the construction drawings. Should the excavation occur beyond the dimensions specified therein, because of the negligence of the Contractor, the Contractor shall fill the excess space with granular material or concrete as directed by the Engineer. Nothing extra shall be paid to the Contractor on account of this.

5.7 **Trial pits**

Trial pits may be dug by the Contractor, without being directed to do so, along the lines of the trenches as shown on the drawings in advance of the excavations for the purpose of satisfying himself as to the location of under ground obstructions or soil conditions.

5.8 Slips and slides

Pursuant to Clause 5.8 of Chapter 10, Standard Specifications for Procurement of Project Works, the Contractor is responsible for proper protection of excavations made by him from any slips and slides. All slides and caving shall be handled, removed or corrected by the Contractor without any extra compensation at whatever time and under whatever circumstances they may occur. The excavations shall be made good and brought to necessary depth, width and levels without any extra cost.

5.9 **Stacking of excavated material**

Pursuant to Clause 15.7.5.1, item 7 of Chapter 10, Standard Specifications for Procurement of Project Works, the excavated material shall be stacked at least 600 mm away from the sides of the trench.

5.10 **Safety measures**

The Contractor shall provide adequate safety measures during excavation. They shall include :

1. Barricading all sides of the open trenches.
2. Red danger lights as can be easily visible from dusk to dawn at an interval of 20 m and at all the road crossings.
3. Traffic signals and display boards giving direction for diversion of traffic at the appropriate places as may be directed by the Engineer.
4. Adequately safe wooden plank / board or steel plate over the trenches at every 15 metres interval to facilitate crossing by the public residing on either side of the trench.
5. Round the clock watch and ward maintaining all safety regulations at the site of work and protecting the site from unauthorized intrusions.

11. Progress of Excavation of pipe trenches

The Contractor shall adjust excavation of trenches in such lengths that the pipes can be laid in such exposed portion of the trench within 3 days.

12. Shoring and Bracing

Pursuant to Clauses 5.7, 15.7.5.1 (item 9), 15.7.11 and 15.7.12 of Chapter 10, Standard Specifications for Procurement of Project Works, the Contractor shall supply, fix and maintain necessary

sheathing, shoring and bracing etc., in steel or wood, as may be required to support the sides of the PROVIDING, to protect workmen in the trench and to prevent any trench movement which might any way injure or delay the work, change the required width of the trench, make unsafe condition for adjacent pavements, utilities, buildings or other structures above or below ground.

Sheathing, shoring and bracing shall be withdrawn and removed as the backfilling is being done, except when the Engineer may agree that such sheathing, shoring and bracing be left in place, at the Contractor's request. In any case, the Contractor shall cut off any such sheathing at least 600 mm below the surface and shall remove the cut off material from the trench.

All sheathing, shoring and bracing which is left in place under the foregoing provisions shall be removed in a manner so as to not endanger the completed work or other structures, utilities or property, whether public or private.

13. Excavation in Rock

Excavation in rock shall be carried out to a depth, 150 mm more than the bottom level of pipe and to a width equal to the diameter of the pipe plus minimum working space on either side as given in drawing. Unless otherwise directed by the Engineer, rock excavation shall be progressed at least by 20 m in advance of the pipe length proposed to be laid.

5.14 **Blasting of Rock**

Excavation of rock by blasting may be carried out if permitted by the Engineer depending upon the location and circumstances. Contractor shall submit a detailed plan and methodology for such blasting operation to the Engineer for approval. The responsibility of the Contractor with respect to the use of explosives in blasting includes compliance with all laws, rules and regulations of the State or Local Municipalities governing the storage, use, manufacture, sales, handling, transportation or other disposition of explosives. All operations involving the handling, storage and use of explosives, shall be conducted with every precaution by trained and reliable men under experienced supervisors. Blasting shall not be undertaken until all persons in the vicinity have had ample notice and have reached positions out of danger there from. The Contractor shall take special precautions for blasting at and near the top of trench as well as for the proper use of explosives in the trench to prevent damage to surface, structures, water supply mains, sewers, storm drains or other buried structures. The Contractor shall advice the department in advance when charges are to be set off.

After blasting, the Contractor shall thoroughly seal the excavated trench/pit, remove all loose and shattered rock or other loose materials and make the excavation safe before proceeding with further work. The Contractor shall not be entitled to compensation for removal of loose or shattered rock or other loose materials resulting from the enlargement of the excavation beyond the required limits.

Rock requiring blasting or chiseling shall exclude all rocks such as soft rock, small boulders which can be removed either with pickaxe or crow bars, and shall apply to only rocks which cannot be removed by any of these means. In case of differences in opinion, the decision of the Engineer shall be final and binding on the Contractor.

5.15 **Excavation for Inlets, Junction Chambers and Other Appurtenant Structures**

The Contractor shall excavate as required for all structures with foundations to firm, undisturbed earth up to the level of the under side of the structure. If the excavation is in rock, the Contractor shall excavate all rock at least to the minimum limits shown on the standard details for trenches and to the grade of the bottom of inlets, junction chambers or other structures as required. Where the bottom of the structure is in rock, it should be ensured that no rock shall project above the lower surface of the concrete in such a manner so as to reduce the required thickness of concrete placed simultaneously as an integral part of the foundation and to the outside of structure foundation where structure is to be built. The Contractor shall excavate the trench / pit to provide necessary working space on all sides and for accommodating any sheathing, shoring or bracing etc.

5.16 Contractor's Responsibility

The Contractor shall be responsible for the adequate pumping, drainage and bailing out of water from the excavation. In case of failure to make such provisions or any other provisions which may result in unsuitable sub-grade conditions, the Contractor shall replace and repair the sub-grade as directed to the satisfaction of the Engineer, at his own cost and responsibility.

Should the Contractor select to use a gravel sub-grade to facilitate flow of water to pumps or other points of disposal, such gravel sub-grade shall not be measured or paid for as an extra item.

5.17 Works Included in Excavation

Pursuant to Clause 15.7.6.1 of Chapter 10, Standard Specifications for Procurement of Project Works, the following works as per specifications are also included in excavation and the term 'Excavation' shall construe to mean all such items of work. The quoted rates should include the same:

4. Provision of side space or additional space in the trench/pit for working and/or accommodating sheathing, shoring, bracing, etc.
5. Supply, installation and removal after the work, all sheathing, shoring and bracing required to protect the excavation where required or where such work is recommended by the Engineer.
6. Protection of excavations.
7. Providing adequate safety measures.
8. Additional work in connection with overhead wires and poles.
9. Excavations for socket hollows.

10. Change of trench location in accordance with Clause 15.7.7 of Chapter10.
11. Additional work in conducting blasting operations as required, in case the excavation is in rock.
12. Supplying and fixing of sight rails and boning rods in the trench to facilitate measurement of work.

5.18 **Bedding for the pipe**

Bedding shall be provided all along the stretch of the pipe line, which differs based on the area through which the pipe line passes. Pipe shall be generally laid on earth bedding. When rock is met with, it shall be provided with gravel/sand bedding. Concrete arch bedding shall be used in situations where the pipeline crosses the road below and the pipe may be subjected to damage from passing vehicles. However, the type of bedding to be provided shall be as decided by the Engineer. The various types of beddings are specified below :

5.19 **Earth Bedding**

The pipes shall be placed on the natural, undisturbed earth bedding, which has been carefully shaped to fit the lower part of the pipe for a width of at least 50 % of its external diameter. The trench shall be excavated to an extra breadth and depth, wherever weld joints are coming and the bedding shall be given to the weld joint such that it is relieved of all loads, permitting the pipe Chapter to be firmly bedded through out its length. Filling and removing earth or similar materials beneath the pipe to adjust with the grade will not be permitted except filling with compacted granular bedding material or murrum.

5.20 **Gravel Bedding**

Wherever rock is met with, it shall be removed upto 150 mm below the bottom level of the pipe to a minimum width equal to the width of the trench and the resulting space shall be filled up with good quality compacted gravel. The granular material shall be filled in the trench upto the level of ¼ the outer diameter of the pipe line, above the bottom of trench and well compacted. Unless otherwise directed by the Engineer, rock excavation shall progress at least 20 m in advance of the pipe length proposed to be laid.

5.21 **Concrete Arch bedding**

Wherev1er concrete bedding is proposed to be provided, it shall be provided as per the approved drawings or as directed by the Engineer. The sub-grade shall be prepared to dimension as shown in the Drawings. The pipe shall be provided with sand bedding below and concrete arch above. The dimensions and thickness of bedding etc., shall be as per the approved Drawings.

The bottom of the trench may be slopped on the sides or kerbed. The sand bedding shall be provided below the pipe. The sand used shall be clean, medium grained and free from impurities. The

sand shall be compacted by hand compaction, by watering and ramming, in layers not exceeding 150 mm.

The minimum thickness of concrete for the arch portion shall be as specified in the Drawings or as directed by the Engineer. Dry mix will not be permitted. The slump for concrete for the arch portion shall not be more than 25 mm. All water in the trench must be bailed out prior to taking up bedding work. When concrete is to be placed over the pipe for arch portion, it shall be placed carefully so as not to damage or injure the joints or displace the pipe. Back filling shall be done in a careful manner and at such time after the concrete is set, so as not to damage the concrete. Joints shall be avoided under the roads, but they shall be located on either side of the roads.

The concrete arch bedding shall only be used when the pipe line crosses the road below and where directed by the Engineer.

5.22 **Special Bedding in poor subgrades**

During the progress of work, if the sub grade is observed to be of poor quality which is unsuitable for laying the pipe line and which is not the result of the Contractor's negligence, the Engineer may direct the Contractor to strengthen the subgrade as per Clause 15.7.10 of Chapter 10, Standard Specifications for Procurement of Project Works. The strengthening shall be done either by crushed stone or local lime stone, with depth not exceeding 450 mm (ref. Clause 15.7.10.4 of Chapter 10, Standard Specifications for Procurement of Project Works); or by gravel, with depth not exceeding 225 mm (ref. Clause 15.7.10.5 of Chapter 10, Standard Specifications for Procurement of Project Works); or by concrete of mix 1:4:8 (ref. Clause 15.7.10.6 of Chapter 10, Standard Specifications for Procurement of Project Works).

6.0 Backfilling of Trenches and around foundations of structures

6.1 **General**

Pursuant to Clauses 5.15.4.1, 5.15.4.2, 5.15.4.3, 5.15.4.6 and 15.7.23.1 of Chapter 10, Standard Specifications for Procurement of Project Works, the Contractor shall use selected surplus spoils from excavated materials for backfilling. All fill material shall be subject to Engineer’s approval and shall be conforming to Clause 5.15.4.2 of Chapter 10, Standard Specifications for Procurement of Project Works. The excavated materials suitable for backfilling shall be stored not closer than 600 mm from the edge of the trench and shall not obstruct any public utilities or interfere with travel by local inhabitants or general public. Handling and storage of excavated materials must meet with the regulations of the Local Government Authorities. The detailed specifications for backfilling shall be as per Clause 8 of IS: 3114-1994

6.2 **Method of Backfilling**

Trenches and excavated pits for structures shall be backfilled to original ground level or to such other levels, as the Engineer may

direct. All backfilling shall be carried out in orderly manner expeditiously and consistent with good workmanship.

Backfill material put into the trenches/pits for backfilling, shall unless otherwise specified be compacted and built up as to minimize future settlement as much as is reasonably possible. For this, care shall be exercised in selecting backfill material free from large hard clay lumps, especially in cramped areas directly adjoining the walls of structures.

Backfilling in trenches shall be done as pipe laying progresses, with the permission of the Engineer, after the pipe or conduit is properly bedded, jointed and inspected and all measurements for the location of Y-Junctions, tees, etc., are properly recorded by the Engineer and sufficient time is allowed for the joint materials or cement concrete or mortar to set. However the joints shall be left open for inspection during testing, which shall be backfilled after successful completion of testing, after obtaining permission from the Engineer. Backfilling around and over the pipe, conduit, or structure shall be taken up uniformly on all sides and in the sequence and manner specified hereinafter, with care to avoid the displacement or damage to the pipe, conduit or structure.

For the purpose of backfilling, the depth of trench shall be divided into the following three zones measured from bottom to top of trench, as follows:

i. *Zone A* : From bottom of trench to the centre line of pipe,
ii. *Zone B* : From the level of centre line of pipe to a level of 300 mm above the top of pipe,
iii. *Zone C* : From a level of 300 mm above the top of pipe to the top of trench.

Backfilling in the trenches and around structures shall be carried out in horizontal layers of uniform thickness of not more than 150 mm when measured loose. As may be necessary to attain maximum compaction, the backfill material shall be moistened by sprinkling with water. After placing each layer of backfill material, the layer shall be thoroughly and uniformly compacted by means of mechanical or hand tampers. The compacting equipment and the manner of its use shall be subject to the approval of the Engineer.

After the backfill material is placed in Zone A and Zone B as specified above, the remaining portion i.e., Zone C of the trench may be machine backfilled. Even in this case the backfill material shall be placed in uniform horizontal layers of not more than 150 mm thickness. Small pebbles of size less that 50 mm, if any, shall be so distributed throughout the mass, that all interstices are solidly filled with fine material. The backfill material shall be tamped with mechanical tamping equipment, after moistening the backfill by sprinkling with water to obtain maximum compaction.

Machine backfill shall be so conducted that the material deposited in the trench shall not fall directly on top of the pipe from such a height as might result in damage to the pipe joints or alignment.

If the trench is subjected to conditions which might cause flotation of the pipe before sufficient backfill has been placed, the Contractor shall take the necessary precautions to prevent floatation of the pipe, conduit or structure.

Before final acceptance of the work, additional tamped earth shall be added to restore the settled trench surface to the required level of the adjacent earth surface or to the base of crushed rock wearing surface or to the finished earth base.

Pursuant to Clauses 5.15.4.2 and 15.7.5.1 (item 17) of Chapter 10, Standard Specifications for Procurement of Project Works, if from the excavated spoil, enough backfill material is not available, imported, selected and approved backfill material from the borrow pits is required to be placed for backfill, on approval of the Engineer. Pursuant to Clause 15.7.5.1 (item 16) of Chapter 10, Standard Specifications for Procurement of Project Works, backfilling of trenches where the excavation is in the rock shall be with the surplus soft soil, with all lead and lift.

6.3 Disposal of Surplus Excavated Material

The excavated material which is in surplus to the requirements after backfilling shall be removed and spread at places shown by the Engineer, with all lead and lift from the site of work, for which no extra payment shall be made. No surplus or excess material shall be disposed in a stream / channel nor in any place where the pre-construction surface drainage may have to be provided, without written permission of the Engineer.

7.0 Measurement and Payment for Excavation

1. For Excavation

The measurement for excavation shall be considering the allowable widths, depths with allowed side slopes (if any) for different classes of soils as per approved classification. The measurement for excavation shall be based on “neat line” dimensions as specified in the drawing or Specifications, for different types of soils and depth of excavation. The total volume of excavation shall be computed as a square bottomed trench of width equal to the outer diameter of the pipe, with minimum working space as given in the drawing, added to it, length up to the length of the trench being measured and depth of trench being average depth taken at 30 m intervals, between the level of bottom of trench and the original surface of the ground. The length of the trench shall be measured as per the actual length of pipes and fittings / specials laid at work site. However depth shall be measured at closure intervals at vulnerable places. The volume of excavation for structures like valve chambers, thrust blocks and anchor blocks etc.,

shall be computed and measured for payment as per the bottom area of the particular structure on outer periphery multiplied by the average depth between the level of the finished bottom of the structure and the original surface of the ground. The quantity shall be measured in cubic metres correct to two decimal places. The method of measurement for excavation for different classes of soils shall be as follows:

7.2 **In Ordinary Soil and Soil Mixed with Disintegrated Rock and Soft Rock / Shale**

In this category of soils, the excavation quantity shall be computed as specified above.

2. In Hard rock

In case of hard rock requiring chipping or chiseling, measurements shall be taken prior to and after chiseling and the volume of rock excavation shall be measured based on this difference. In case of excavation in hard rock by blasting, the quantity of rock excavated shall be stacked along the side of the trench, which will be cross checked with the trench dimensions. The excavation in rock shall be paid on stack measurements with a deduction of 40% in volume for voids. However, the payment for rock excavation by blasting shall be limited so as not to exceed the volume computed based on the trench dimensions as per specifications.

7.4 For Excavation in Combination of Ordinary Soil, Disintegrated Rock, Soft Rock/Shale and Hard Rock/Schist

Wherever the excavation is undertaken in combination of ordinary soil, disintegrated rock, soft rock /shale and hard rock, the hard rock part shall be measured and paid as explained in Sub-Clause 3.8.1.2 and the soil part shall be measured and paid for the total measurable excavated quantity deducting the quantity measured for the hard rock. The total computed volume of excavation shall be equal to the sum of the computed volumes for each category of excavation undertaken.

7.5 **For Bedding**

Pursuant to Sub-Clause 3.6.1 of this Chapter, the Contractor shall include the cost of earth bedding required for the pipeline in the tendered rate for pipe laying. For providing gravel and Concrete arch beddings in accordance with Sub-Clauses 3.6.2 and 3.6.3 respectively of this Chapter, the Contractor shall The surplus quantity of excavated earth shall be disposed off as specified in the Sub-Clause 3.7.3 of this Chapter without any extra cost. The quantity shall be measured in cubic meter correct to two decimal points.

8.0 Structural Concrete and Mortar

8.1 **Grade of Concrete**

8.2 Controlled Concrete

-- Deleted ----

3. Ordinary Concrete

In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume. The ordinary concrete shall be by volumetric mix as given in **Table-4** below. For cement which normally supplied in bags and is used by weight, volume shall be worked out taking 50 kg of cement as 0.035 cubic metre in volume. Shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for 'bulkage' shall be made as per IS:2386 (Part III).

Ingredients required for ordinary concrete containing one bag of cement for different proportions of mix shall be as given in **Table-4** below.

Table-4

Ingredients Required for Ordinary Concrete

Nominal Mix by volume Cement : Fine Aggregate : Coarse Aggregate **	**Total quantity of dry aggregates in kg (max) by mass per 50 kg of cement (to be taken as the individual masses of fine and coarse aggregates)**	**Quantity of water in litre (max) per 50 kg of cement *****
1:4:8	625	45
1:3:6	480	34
1:2:4	350	32
1:1.5:3	250	30

* In the designation of a concrete mix, letter 'M' refers to the mix and the number refers to the specified 28 days' works compressive strength of that mix on 150 mm cubes, expressed in N/ sq. mm.

** The proportions of the aggregate shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

*** The amount of water should be kept minimum required for proper workability. The quantity given in the column is not to be exceeded.

4. Design Mix Concrete

In case of Design Mix concrete, mix is required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume or weight. The design mix concrete shall be by weigh batch mix the cement requirement is given in table 5 below. For cement which normally supplied in 50Kg bags and is used by weight, volume shall be worked out taking 50 kg of cement as 0.035 cubic metre in volume. Shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume/weight as per design and in case it is damp, allowance for 'bulkage' shall be made as per IS:2386 (Part III).

Cement requirement for the proposed design mix concrete shall be as given in **Table-5** below.

Table-5

Nominal Mix by volume Cement : Fine Aggregate : Coarse Aggregate **	**Charectristic Cube strength after 28 days curing N/mm^2**	**Min Quantity of Cement per Cum of Concrete Kgs *****
M25	25	360
M30	30	400

* In the designation of a concrete mix, letter 'M' refers to the mix and the number refers to the specified 28 days' works compressive strength of that mix on 150 mm cubes, expressed in N/ sq. mm.

** The proportions of the aggregate shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

*** The amount of water should be kept minimum required for proper workability. The quantity given in the column is not to be exceeded.

9. Strength Requirement of Concrete

Where Ordinary Portland Cement conforming to IS.269 or Portland Blast Furnace Cement conforming to IS:455 is used, the compressive strength requirements for various grades of concrete controlled as well as ordinary shall be as given in **Table-6**. Where rapid hardening Portland Cement is used, the 28 days compressive strength requirements specified in **Table-6** shall be met at 7 days.

For controlled concrete, the mix shall be so designed as to attain in preliminary tests a strength at least 33 per cent higher than that required on work tests for concrete up to and including M 25, and 25 per cent higher for higher grades. Preliminary tests need not be made in case of 'ordinary concrete'.

Table-6

Strength Requirements of Concrete

Compressive test Strength on 150 mm cubes after testing in accordance with IS:516 (N/sq.mm)	
Minimum at 7 days	**Minimum at 28 days**
1:3:6	10
1:2:4	15
1:1.5:3	20
M25	25
M30	30

1. In all cases, the 28 days compressive strength specified in **Table-6** shall alone be the criterion for acceptance or rejection of the concrete.
2. Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in **Table-6**, such concrete shall be classified for all purposes as a concrete belonging to the lower of the two grades between which its strength lies.

10.0 Use of Plums in Ordinary Concrete

Stone Plums shall not be used unless specified in the drawings. When stone plums are used, the size may be from 150 to 300 mm. The maximum dimension of these stones or plums shall not exceed 1/3rd the least dimension of the members.

All plums shall be hard, durable, clean and free from soft materials or loose pieces or deleterious substances in them and shall not have sharp corners.

During concreting the first layer of concrete of the specified mix shall be laid to a thickness of at least two and a half times the thickness of the maximum size of plums to be used. The plums shall then be laid while the top portion of this concrete is still green but sufficiently stiff to prevent complete submergence of the plums under their own weight. These plums shall be about half embedded in the concrete and the remaining part exposed so as to form a key with the next layer of concrete. No plums shall be used for concrete-laid under water.

While placing the plums, care shall be taken to see that the clear distance between any two plums is not less than either the width or thickness of either of the plums. The distance from plums to the outer surface or from any steel reinforcement shall be equal to greatest width of the plum.

If plums of stratified stone are used, they shall be laid on their natural bed. Stones with concave faces shall be laid with the concave portion upwards. The thickness of the next and successive layers of concrete

shall be at least twice that of the largest plums. The total volume of plums shall not exceed 15% of the volume of the finished concrete.

11. Valves

All valves shall be fixed at the required locations with necessary bolts, nuts washers, gaskets, etc, complete and provided with cement concrete supports During the maintenance period the contractor has to set right the failure of the valves which are located at different points for all the works.

12. Pipe jointing:

The jointing of HDPE, DI /MS and PVC pipes and specials shall be made as per the standard specifications and as detailed in B.O.Q Valve Chambers, Thrust locks/Anchor blocks etc., The Contractor shall build Valve Chambers and such other miscellaneous structure that may be required at the locations shown by the Engineer and as shown in the drawings or as may be otherwise specified or directed. The specifications of these ancillary structures shall generally be as enumerated in Clause 17 of the chapter 10, Standard Specifications for Procurement of Project works, unless otherwise specified in this Chapter or advised by the Engineer based on the site conditions. The various structures shall be built as the pipe laying progress and the Engineer at his discretion, may stop work entirely on the laying of pipe or construction of other structures, until the construction of the structures already approved by the Engineer are completed by the Contractor.

13 Pipe supports

Pipe supports shall be constructed as per Clause 17.6 of chapter 10, Standard specifications for Procurement of Project Works, wherever needed, as per the directions of the Engineer, . Pipe supports shall be of saddle type. Pipe supports shall also be provided for the stretches of the pipe, where the pipe is to be gradually brought above the ground for crossing any obstructions as shown in the drawings. The distance between pipe supports shall not exceed 5.0m centre to centre.

Pipe supports shall be as per the approved designs and to be taken to a depth of at least 1.30 mtrs below ground level as shown in the drawing and shall have sufficient height above ground to be able to support the pipe 20mm dia tor steel clamps shall be provided all round the pipe and fixed to the pipe supports using appropriate means as shown in the drawings nor as directed by the Engineer.

13.1 Valve chambers

Stone masonry/RCC valve chambers shall be provided for all valves. The specifications of the valve chamber shall generally confirm to Clause 17.4 of Chapter 10, Standard Specifications for Procurement of Project Works. These valve chambers are of different sizes suitable for scour valves with RCC pre-cast slabs covering. They shall be constructed as per the details shown in the drawings. The stone masonry valve chamber with RCC pre-cast cover, shall be constructed as shown in the Drawings for all Valves. It shall have a opening in the side wall for access into it. Outside the valve chambers, for scouring of water, draft channels shall be provided.

13.2 **Structures for Crossing Canal / Nala and Other Miscellaneous Structures**

Structures for crossing the pipeline over canals/Nala and other miscellaneous structures not listed in these specifications but may be required to be built shall be as per construction drawings and as described in Chapter 6: Bill of quantities. The materials of construction of workmanship for those structures shall conform to the relevant Standard Specifications for Procurement of Project Works as given in Chapter 10. The measurement of quantities involved in these structures for payment shall be done as per dimensions of the respective drawings.

13.3 **Pipe line Connections**

The Contractor is responsible for giving suitable connections at the inlet and outlet ends of, service reservoir.

13.4 **Crossings of Roads and Culverts**

Under major roads, as directed by Engineer, the rising main shall be provided with concrete arch bedding. Steel pipe shall be used for such crossings and for culvert crossings. The details of such crossings shall be furnished in construction drawings.

5. Other Specials and Instruments

The Contractor is responsible to provide sufficient number of specials, as required for completing the work satisfactorily. The exact number of specials specified in Chapter 6: Bill of Quantities, may increase or decrease depending on the requirement.

14.0 Detailed Specification:

14.1 OVER HEAD TANKS (Shaft type)

(i) It is proposed to construct Shaft type RCC Over Head Tanks of 15.00 Lakh litres, capacity on 15Mtr. Staging at Keshwapur in Hubli city.

ii) The Over head tanks shall be constructed, tested, and commissioned as water retaining structure as per the requirement, criteria and specifications given in the following sub-clauses. The structural dimensions of overhead tanks given in the drawings are tentative and can change at the time of execution and the contractor should execute the OHT's at the same respective, unit rates as quoted in the Chapter-6, Bill of Quantities for the changed quantities also.

The specifications for construction of OHT's should be conforming to detailed specification given in BOQ (Chapter-6) and as mentioned in standard specifications vide Chapter-10 are applicable.

14.2 General :

1. Capacity and Staging : 15.00 lakh litres capacity 1 No. RCC OHT on 15M staging.
2. Shape : Shaft type.
3. Type of construction **:** RCC in M25, M30 grade concrete and CC 1:1.5:3 grade screed concrete as per IS 3370.

14.2.1 Structural Requirements :

1. Finishing of RCC surfaces
   (i) inside of side walls;
   bottom dome conical wall **:** in CM 1:3, 20mm thick
   (ii) inside of roof **:** in CM 1:3, 12mm thick
   (iii) outside surface **:** Form finish, smoothly rendered exposed faces shall be finished with two coats water proof cement paint of approved colour and shade over one coat of primer after scrapping the surface with wire brush etc.,

2. Concrete **:** CC 1:1.5:3 screed concrete and RCC in M25 & M30 grade as per IS 3370.

3. Steel reinforcement **:** The grade of steel shall be Fe 415 conforming to IS 1786. Tor Steel manufactured by VISL /SAIL / VSP / Kamadhenu TMT/TISCO/LLOYD or equivalent to be approved by employer.

14.2.2 Functional Requirements :

a)	Access	45 Cms wide 65 x 65 x 8mm angle iron with 20mm MS bars at 25 Cms center to center with 25 mm dia GI hand railing with angle iron props at 2 M. interval with 0.5 Mtr height and two coats of non poisonous anticorrosive bituminous paint.
b)	Ventilation	Finial as per approved Board drawing with copper mesh.
c)	Inspection door	60 x 60 Cms size MS frame and shutters with 3mm thickness including painting.
d)	Level indicator	Iron gauge plate 3mm to 4mm thick 0.23 M. width with copper floats indicators and flexible nylon wire, painting figures with approved enameled paint.
e)	Lightening arrestor	Aluminium strip 25 x 3mm size including grounding aluminum Embedded in one of columns with 40mm dia GI Conduit & specials etc.
f)	Puddle Flange	Suitable dia puddle flange both for inlet and outlet shall be provided in the bottom dome of the ESR itself with leak proof

Note : For all water retaining structures M30 proportion concrete shall be used as per IS 3370 with latest amendments.

i. Pipe and valves :

The OHT's shall be provided with

i. CI inlets, outlets and overflows pipes as per specification as detailed in BOQ.

ii. Providing and fixing iron gauge plate and RCC finial ventilators, MS ladder inside and outside the tank and inspection door, lightening arrestor and GI pipe hand railing, painting etc., complete.
iii. Construction of SS masonry valve chambers as shown in the drawing.
iv. Testing of OHT's for water tightness and
v. Providing inlets; overflow' scour pipes and 2 outlets for distribution.

14.3 Other requirements:

1. Before taking up the construction of the reservoirs, the site shall be cleared of all jungles, bushes and unwanted vegetation growth. After completion of plant, the entire site area shall be cleared of all left over material and debris.

2. After site clearance, the site shall be leveled and graded as per the gradation plan of the site, which will be made available to the contractor during construction.

3. After construction, the reservoir shall be subjected to water tightness test as per IS 3370. The contractor shall have arrange for water at his own cost for filling the reservoir for water-tightness test. Underground water if found suitable shall be permitted for testing. The water used for testing shall be of approved quality. The contractor shall rectify any defects and the structure shall be accepted only when it meets the required standards.

4. The drawing of OHT's & GLSR's enclosed to the bid document is as per the type design considering SBC of soil as 12T/m2. Hence, the SBC of the soil is to be got tested by the successful bidder before taking up the work at his cost. If the SBC of soil is less than 12T/m2, the bidder has to obtain approval to the design of overhead tanks before taking up the works.

5. The CI puddle flanges shall be conforming to IS 1538/1993, CI D/F pipe conforming to IS 1781/1996 and D/F bend conforming to IS 1538/1993.

15.0 Commissioning

After satisfactory completion of the pipeline, linking to service reservoir with necessary valve chamber, fixing of valves, house service connection & all the other works under the scope of the tender, the works shall be commissioned for operation.

16.0. **Operation & Maintenance**

16.1. The 24x7 Distribution network in selected Zones of the city and other allied works executed by the Contractor and the other works within the scope of the Contract **shall be operated & maintained for a period of 60 months including 12 months defect liability period from the date of successful commissioning of the distribution network in selected zones under the scope of tender.** During the initial period of 12 months, any defects of any kind in manufacture, laying, jointing and constructions etc., shall be rectified by the Contractor as per the same specification as that of the item of work done. If there are any damages to the materials supplied by the Bidder the same is to be replaced by the bidders. **The Defect Liability Period of the Contract will be 12 months from the date of successful commissioning of the entire distribution network under the scope of tender.**

16.2. O & M action plan is to be submitted by the contractor & got approved from the employer before the release of the 1st month payment for O & M.

Contractor Employer/Engineer