सत्यमेव जयते

भारत सरकार

GOVERNMENT OF INDIA

परमाणु ऊर्जा विभाग

DEPARTMENT OF ATOMIC ENERGY

निर्माण, सेवा एवं संपदा प्रबंध निदेशालय

DIRECTORATE OF CONSTRUCTION, SERVICES AND ESTATE MANAGEMENT



जन स्वास्थ्य अभियांत्रिकी कार्यों के मानदंड

SPECIFICATION FOR PUBLIC HEALTH ENGINEERING WORKS

DECEMBER 2023

तीसरा माला, विक्रम साराभाई भवन, अणुशक्तिनगर, मुंबई ४०० ०९४

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SPECIFICATION FOR PUBLIC HEALTH ENGINEERING WORKS - 2023

(भीतरी व बाहरी जन स्वास्थ्य अभियांत्रिकी)
(Internal & External Public Health Engineering)

तीसरा माला, विक्रम साराभाई भवन, अणुशक्तिनगर, मुंबई ४०० ०९४
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के. महापात्रा
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FOREWORD

The DCSEM specification for Public Health Engineering (PHE) works being published by DCSEM is very comprehensive and useful in execution of PHE works. This specification gives the standards for PH materials and also serve as guidelines to Engineers and contractors for specification of materials, execution of works and mode of measurements. The DCSEM PHE Specification was first compiled in 2008. Subsequently, additional specification of items were attached with tender as per requirement and current practices.

Many new plumbing materials which are presently used in various DCSEM works & projects have been incorporated in this specification.

I wish to place on record the effective involvement of Sh. Rajiv Nayan, Head (PCD) and the efforts of dedicated team of Public Health Design Section led by Sh. Sanjay R. Bagul (SO/G) and Smt. Seema B. Nair (SO/D) and all other Senior Engineers from Construction & Maintenance Sections of this Directorate for their valuable inputs in preparing and finalising this Specification.

My special thanks to Chief Engineer (C2), Chief Engineer (C1/ CQD) and Chief Engineer (ESG) for their valuable guidance from time to time.

I am sure that this Specification will be useful for PHE works to all concerned units engaged in building works in DAE in general and DCSEM in particular.

01/12/2023.
(K. Mahapatra)

Place: Mumbai.

Date : 1st December 2023.

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परमाणु ऊर्जा विभाग DEPARTMENT OF ATOMIC ENERGY
निर्माण, सेवा एवं संपदा प्रबंध निदेशालय DIRECTORATE OF CONSTRUCTION, SERVICES AND ESTATE MANAGEMENT
HEAD PLANNING, CO-ORDINATION & DESIGN
विक्रम साराभाई भवन, अणुशक्तिनगर, मुंबई / Vikram Sarabhai Bhavan, Anushaktinagar, Mumbai – 400 094

PREFACE

1. DCSEM Specification for Public Health Engineering works (PHE) 2023 is revised edition of existing DCSEM Specification for PHE Works-2008.

2. DCSEM Specification for PHE Works- 2023 will replace existing DCSEM Specification for PHE Works-2008. The specification of many items have been updated and improved by making them more comprehensive. Many new items using new materials are added.

3. Chapter wise salient features are as follows:

   3.1 **List of Indian Standard Codes:** Modified by deleting IS codesdiscontinued and by adding relevant IS codes.
   3.2 **Mandatory Test:** Reviewed and tests for items such as D.I pressure pipes, plastic pipes etc added.
   3.3 **Sanitary Installations**: Specification incorporated for wall hung WC, sensor based pillar tap/ urinal flush valve. Specification for faucets revised based on current practices.
   3.4 **Water Supply System:** Specification for Water quality pipes like HDPE, UPVC revised and specification for CPVC, PPR added. Specification for Ball valve, D.I. water quality piping works and specials also incorporated.
   3.5 **Drainage System:** Specification added for UPVC traps, HDPE sheet flashing, FRP composite frame & cover for manholes, D.I. frames and covers, Double wall corrugated (DWC) Drainage piping work.
   3.6 **Water Tank, Septic Tank, Upflow filter & Soak pit:** Specification for Sewage Treatment Plant/ Effluent treatment Plant added.
   3.7 New chapter for Rain Water Harvesting System is added incorporating specification related to general items required. Chapter on Fire Fighting System is deleted from PHE works Specifications which shall be dealt in separate Specification for Mechanical works.
   3.8 Recommended / preferred manufacturer list for materials is modified by deleting names of discontinued makes and by incorporating new makes.

4. Due care has been taken to prepare DCSEM Specification for PHE works 2023 as correctly as possible. It is, however, possible that some errors might haecrept in inadvertently. In case any error or omission is noticed, it maybe brought to the notice of **Head (PCD), DCSEM, V. S. Bhawan, Anushaktinagar, Mumbai-400094.**

Suggestions for improvement are always welcome.

Rajiv

(Rajiv Nayan)
Head (PCD).

Place: Mumbai.
Date : 1st December 2023.

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DEPARTMENT OF ATOMIC ENERGY

DIRECTORATE OF CONSTRUCTION, SERVICES AND ESTATE MANAGEMENT

SPECIFICATION FOR PUBLIC HEALTH ENGINEERING WORKS: 2023

(INTERNAL/EXTERNAL PH ENGG.)

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* * *

1. GENERAL INSTRUCTIONS

1.1 : GENERAL INSTRUCTIONS: The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein, and shall be guidance for proper execution of work to the required standards. **It may also be noted that the specifications are of generalised nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings.** The work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

Unless specifically otherwise mentioned, all the applicable codes and standards published by the Indian Standard Institution and all other standards which may be published by them before the date of receipt of tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc. Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued their to or revisions thereof, if any, upto the date of receipt of tenders. In case there is no I.S.I. specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, and requirements of the Engineer-in-Charge. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust etc. under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

Samples of various materials, fittings etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to each phase.

The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

The contractor shall clear the site thoroughly of all debris, surplus excavated materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-in-Charge before the work is considered as complete.

The Chief Engineer, DCSE, DAE, shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.

In case any difference or discrepancy between the specifications and the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specifications and drawing, the specifications shall take precedence. In case any difference or discrepancy between the specifications for Civil works and specification for Public Health Engg. works, specifications for Civil works shall take precedence.

1.1.01 APPROVAL The materials for P.H. Engineering works which are to be supplied by the contractor shall conform to the relevant IS specifications and on the latest approved list of Mumbai Municipal Corporation/Local bodies if any, and shall be approved by the Engineer-in-Charge prior to installation of fixture and the approved samples shall be maintained at site till the completion of work. The approved makes of main items are, however specified in the list of approved makes of materials herein before.

1.1.02 PRECAUTIONS While carrying out pipe line work in case the contractor encounter any interference with other services such as cables, conduits etc, he shall take sufficient precautions in order to prevent any damage to them. If any damage occurs, it shall be rectified to its original condition at his own cost to the satisfaction of the officers concerned with such services.

The contractor shall ensure that all inserts, pipe lines embedded in structural members or sleeves are placed in position in co-ordination with civil work.

All public health engineering services shall be handed over to Engineer-in-charge complete in all respects on completion of the work. Incomplete work will not be taken over. Any loss or damage to these services due to any reasons by anybody whatsoever before handing over will be at contractor's risk and cost. Any damage to any structural/finishing work done during the testing or rectification shall be made good by the contractor at his own cost and risk.

1.1.03 COST TO BE COVERED : The rates quoted by the tenderer under this contract shall cover the cost of all the following elements.

1.1.04 MISCELLANEOUS WORK : The contractor carrying out the construction work shall take effective measures to carefully open out all existing channels, culverts, bridges, pipelines, conduits, water courses, sewer, drains, electrical cables, transmission lines and their supports and all works buried or otherwise where such services have to be interfered with the purpose of the construction of the works. He shall provide and arrange all

necessary temporary supports and diversions if necessary across/under/even through along sides of the trenches and all other parts of construction works for all such channels, culverts, bridges, pipe lines, conduits.

1.1.05 CLEARANCE FOR ROADS AND FOOT PATHS : The contractor shall arrange to carry out all works with least interference practicable with public footpath and vehicular traffic and with existing waste water or storm water drainage arrangements and provide all necessary road barriers, fences, notices, lights, gangways, access crossings, diversions for traffic, temporary drains, dewatering channels, chutes pumping or water lifting arrangements and all other facilities for the proper execution of the works to the approval and satisfaction in all respects of the Engineer-in-Charge. Any work carried out by the contractor in this connection shall be deemed as temporary works incidental to the construction work.

1.1.06 LOCATION : The rates quoted by the tenderer under this contract shall be applicable for the work at all floor and locations.

1.1.07 DEWATERING : The rates quoted by the tenderer under this contract shall include bailing or pumping out all the water which may accumulate during the progress of the work either through seepage, springs, rain or any other cause.

1.1.08 : WATER SUPPLY MAIN : The cost includes for transport charges and testing charges prescribed by the municipal Corporation. After the pipeline is laid, contractor has to approach Municipal Authorities and has to get certified the pipe line so laid. Water mains thus laid shall be tested to a pressure as specified in the schedule and specifications. Contractor has to get the pipe line laid hydraulically tested by the Municipal Authorities. Contractor has to bear the Municipal hydraulic testing charges and ancillary charges and has to obtain the certificate to this effect , if necessary.

1.1.09 FORMALITIES WITH STATUTORY BODIES : The work shall be carried out in a manner complying in all respects with requirement of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

The contractor has to satisfy all the requirement of fire brigade, drainage and hydraulic engineering department of Municipal Corporation, obtaining approval for scheme testing for completion of work including certificate of permission issued by Municipal Corporation of Greater Mumbai/any other local governing authority. It will be the responsibility of the contractor to get completion certificates from Municipal Corporation for functioning and installation of the entire public health engineering works covered in this tender

The contractor has to obtain various permissions and approvals, from MUNICIPAL CORPORATION OF GREATER MUMBAI or any other local governing body for Mumbai and New Mumbai works in coordination with the Department and Engr-in-ch. prior to starting of the work & completion certificates after the completion of the work, for the following points.

1.1.10 APPROVAL FROM A.E. WATER WORKS :

1. Water supply for labourers at site.
2. Permission for Internal Water supply and sanitary fittings.

3 Completion Certificate for internal water supply and sanitary fittings.

1.1.11 APPROVAL FROM A.E. BUILDING PROPOSALS :

1. Approval for internal drainage.
2. Completion certificate for internal drainage.

1.1.12 APPROVAL FROM MALARIA DEPARTMENT : Certificate should be obtained for water tank from pest control officer of Malaria Department.

1.1.13 DEPARTMENTAL ASSISTANCE : The Department shall render only technical & administrative assistance if necessary to the contractor for obtaining the assessment clearance for all Public Health Engineering Works.

Note : Unless otherwise specifically provided in the schedule of quantities for obtaining BMC approval, the rate quoted by contractor shall include the cost of above approvals. In case a separate item is included in the schedule of quantities, contractor shall engage a licensed P.H. engineer / licensed plumber and obtain all the above certificates from Municipal Corporation. The Department shall authorise the contractor to deal with BMC on behalf of the Department.

1.2 List of Indian standards

The following IS codes shall be referred in execution of PH Engineering works.

Indian Standard	Subject
27	Specifications for Pig Lead
269	Specifications for Ordinary Portland Cement
407	Brass tubes for General purposes
456	Code of practice for Plain & Reinforced concrete.
458	Specifications for Concrete Pipes.
554	Dimensions for pipe thread where pressure tight joints are required.
638	Sheet rubber jointing & rubber insertion jointing
651	Specifications for Salt glazed stoneware pipes & fittings.
774	Flushing cistern for water closet and urinals.
778	Specifications for copper alloy gate & Globe check valves for water works
779	Water meters (domestic type)
781	Specifications for cast copper alloy screw down bib taps & stop cocks for water services
1172	Code of basic requirements for water supply, drainage and sanitation
1200 Part 16	Method of measurements for Laying of water and sewer lines including appurtenant items.
1200 Part 19	Method of measurements for Water supply, plumbing and drains.
1239 Part 1	Specifications for Mild steel tubes
1239 Part 2	Specifications for Mild steel Tubular & other wrought steel pipe fittings
1300	Phenolic moulding material specification
1536	Specifications for Centrifugally cast iron (spun) pressure pipes for water, gas and sewage
1537	Specifications for Vertically cast iron pressure pipes for water, gas and sewage
1538	Cast iron fittings for pressure pipes for water, gas and sewage
1701	Combination valve , mixing valves
1703	Float valve (horizontal plunger type) for water supply.
1711	Self closing taps.
1726	Cast iron manhole covers and Frames.
1729	Cast iron/ductile iron drainage pipes and fittings for over ground NP pipeline S/S series.
1742	Code of practice for building drainage
1795	Pillar taps for water supply purposes
2065	Code of practice for water supply in buildings.
2373	Specification for Water Meter (Bulk type)
2379	Colour code for identification of pipe lines.
2470 Part 1 to 2	**Code of practice for installation of septic tanks**
2470 Part 1	Design criteria & construction

Indian Standard	Subject
2470 Part 2	Secondary Treatment & disposal of septic tank effluent
2527	Code of practice for fixing rain water gutters and down pipes for roof drainage.
2548 Part 1	Plastic water closet seats and covers.
2548 Part 2	Plastic water closet seats and covers.
2556 Part 1 to 15	**Specification for Vitreous (Vitreous China) sanitary appliances.**
2556 Part1	General requirements
2556 Part2	Specific requirements of wash down water-closets
2556 Part3	Specific requirements of squatting pans
2556 Part 4	Specific requirements of wash basins
2556Part 5	Specific requirements of laboratory sinks
2556 Part 6	Specific requirements of urinals & partition plate
2556 Part 7	Specific requirements of accessories for sanitary appliances
2556 Part 8	Specific requirements of pedestal close coupled & wash down and siphonic water closets
2556 Part9	Specific requirements of pedestal type bidets
2556 Part 14	Specific requirements of integrated squatting pans
2556 Part 15	Specific Requirements of Universal Water Closets
2556 Part 16	Specific Requirements of Wash Down Wall Mounted Water Closets
2556 Part 17	Specific Requirements of Wall Mounted Bidets
2643	Type Threads where pressure tight joints are not mase on the threads – dimension, tolerances and designation
2685	Code of practice for selection, installation and maintenance of sluice valves
2692	Specification for Ferrules for water services.
2951 Part 1 to 2	**Recommendation for estimate of flow of liquids in closed conduits.**
2951 Part 1	Head loss in straight pipes due to frictional resistance
2951 Part 2	Head loss in valves & fittings.
2963	Copper Alloy Waste Fittings and Waste Plug for Wash Basin and Sinks
3006	Specification for Chemically resistant glazed S.W. pipes and Fitting
3114	Code of practice for laying of Cast Iron pipes.
3328	Quality tolerances for water for swimming pools
3389	Urea formaldehyde moulding materials
3589	Specifications for steel pipes for water & sewage (168.3 to 2540 mm outside dia.)
3597	Method of test for concrete pipes.
3950	Specification for Surface boxes for sluice valve.
3989	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings & accessories.
4038	Foot valves for water works purposes.
4111 Part 1to 5	**Code of practice for ancillary structures in sewage system.**

Indian Standard	Subject
4111 Part 1	Manholes
4111 Part 2	Flushing tanks
4111 Part 3	Inverted syphon
4111 Part 4	Pumping stations & pumping mains (rising mains)
4111 Part 5	Tidal out-falls
4120	Tubs and baths.
4127	Code of practice of laying of glazed stone ware pipes.
4350	Specification for concrete porous pipes for under drainage.
4736	Specification for hot –dip zinc coating on mild steel tubes.
4854 Part 1to 3	**Glossary terms for valves and their parts**
4854 Part 1	Screw down stop, check & gate valves & their parts
4854 Part 2	Plug valves & cocks & their parts
4854 Part 3	Butterfly valves
4885	Sewer Bricks - Specification
4984	Specifications for HDPE pipes for water supply
4985	Specifications for unplasticised PVC pipes for potable water supplies
5312 Part 1	**Swing check type reflux (non return) valves**
5312 Part 1	Reflux (non return) valves – single door pattern
5312 Part 2	Reflux (non return) valves – Multi-Door Pattern
5329	Code of Practice for sanitary pipe work above ground for building
5330	Criteria for design for anchor blocks for pen-stocks with expansions joints.
5382	Specifications for rubber sealing rings for water, gas & sewer mains
5455	Cast iron steps for manholes
5600	Specifications for Sewage and drainage pumps
5611	Code of Practice for waste stabilization ponds (Facultative type)
5822	Code of Practice for laying of welded steel pipes for water supply
5961	Specifications for Cast Iron grating for drainage purposes
6279	Equipment for grit removal
6280	Sewage screens
6295	Code of practice for water supply & drainage in high altitude & / or sub-zero region
6392	Steel pipe flanges
6411	Specifications for gel coated glass fiber reinforced polyester resin bath tubs
6418	Cast Iron & malleable flanges for general engg. Purpose
6494	Code of Practice for water proofing of under ground water tanks & swimming pools
6587	Specifications for Spun hemp yarn
7181	Horizontally Cast Iron Double Flanged pipe for water, gas & sewage.
7231	Specifications for Plastic Flushing Cisterns for w.c. & urinals

Indian Standard	Subject
7558	Code of Practice for domestic hot water installations
7634 Part 1 to 3	**Code of Practice for Plastic pipe work for potable water supplies**
7634 Part 1	Choice of materials & general recommendations
7634 Part 2	Laying & jointing polyethylene (PE) pipes
7634 Part 3	Laying & jointing unplasticised PVC pipes
7740	Code of Practice for road gullies
7834 Part 1 to 8	**Injection moulded PVC socket fittings with solvent cement joints for water supplies**
7834 Part 1	General requirements
7834 Part 2	Specific requirements for 45 ^{0} elbows
7834 Part 3	Specific requirements for 90 ^{0} elbows
7834 Part 4	Specific requirements for 90 ^{0} tees
7834 Part 5	Specific requirements for 45 ^{0} tees
7834 Part 6	Specific requirements for sockets
7834 Part 7	Specific requirements for unions
7834 Part 8	Specific requirements for caps
8008 Part 1 to 7	**Injection moulded HDPE fittings for potable water supply-Specification**
8008 Part 1	General requirements for fittings
8008 Part 2	Specific requirements for 90 ^{0} bends
8008 Part 3	Specific requirements for 90 ^{0} tees
8008 Part 4	Specific requirements for reducers
8008 Part 5	Specific requirements for ferrule reducers
8008 Part 6	Specific requirements for pipe ends
8008 Part 7	Specific requirements for sandwich flanges
8008 : Part 8	Specific Requirements for Reducing Tees
8008 : Part 9	Specific Requirements for Ends Caps
8329	Centrifugally cast (spun) ductile iron pressure pipes and fittings for water, gas & sewage
8413 Part 1	**Requirements for biological treatment equipment**
8413 Part 1	Trickling Filter
8413 Part 2	Activated sludge process and its modifications
8835	Guideline for planning and design of surface drains.
8931	Specifications for copper alloys Fancy single taps, combination tap assembly & stop valves for water services
9140	Method of sampling of vitreous & fire clay sanitary appliances
9293	Specifications for flax canvas
9338	Specifications for Cast Iron screw down stop valves and stop & check valves for water works purposes
9739	Specifications for Pressure reducing valves for Domestic water supply system.
9758	Flush valves and Fittings for water closets and urinals

Indian Standard	Subject
9762	Specifications for polyethylene floats for float valves
9763	Specifications for Plastic Bib taps, pillar taps, angle valves and stop valves for hot & cold water service.
10221	Code of practice for coating and wrapping of underground M.S. steel pipeline,
10500	Specification for Drinking water
11189	Methods of Tubewell Development
11606	Method for sampling of cast iron pipes and fittings.
11632	Rehabilitation of Tubewells
12183 Part 1	**Code of practice for Plumbing in multi-storied buildings (for water supply)**
12231	UPVC pipes for section & delivery lines of agricultural pumps– Specification.
12235	Method of test for UPVC pipe for potable water supply
12288	Code of practice for use and laying of Ductile Iron pipes.
12592	Precast concrete frame & cover (SFRC frame & cover)
12701	Specifications for rotational moulded polyethylene water storage tanks
12709	Glassfiber reinforce plastic(GRP) pipes, joints & fittings for use for potable water supply – Specification.
12818	Spn. for UPVC ribbed screen casing & plain casing pipes for bore / tube well
12820	Dimensional Requirements of Rubber Gaskets for Mechanical Joints & push in joints for use with Cast Iron Pipes & fittings for carrying water, Gas & sewarge.
13095	Butterfly valves for general purposes
13114	Spn. for forged brass gate, globe and check valves for water works purposes
13382	Cast Iron specials for mechanical & push-on flexible joints for pressure pipelines for water, gas & sewage
13592	Specifications for PVC soil, waste & rain water (SWR) including ventilation pipes
13593	UPVC pipes fittings for use with section and delivery lines for Agricultural pumps – Specification.
13916	Code of practice for installation of GRP piping system.
13983	Specifications for stainless steel kitchen sinks & drain boards for domestic purpose
14333	Specification for HDPE pipes for sewerage system.
14402	GRP pipes, joints & fittings – Specification.
14735	UPVC injection moulded fittings for UPVC – SWR pipes – Specifications.
14845	Resilient seated cast iron air relief valves for water works purposes – Spn
14846	Specifications for sluice valve for water works purposes (50 to 1200 mm size)
15265	Specifications for flexible PVC pipes or polymer reinforcement thermo plastic hoses for suction and delivery lines for Agricultural pumps.

Indian Standard	Subject
15328	UPVC non pressure pipes for use in underground drainage and sewerage system – Specifications.
15450	Polyethylene/Aluminium/Polyethylene composite pressure pipes for hot and cold water supplies – Specifications.
15778	Chlorinated polyvinyl chloride (CPVC) pipes for potabvle hot and cold water distribution supplies – Specifications
15801	Polypropylene-random copolymer pipes for hot and cold water supplies – Specifications
15905	Hubless Centrifugally Cast (spun) Iron Pipes, Fittings And Accessories - Spigot Series
16098 Part 1 to 2	**Structured-Wall Plastics Piping Systems for Non-Pressure Drainage and Sewerage - Specification**
16098 Part 1	Pipes and Fittings With Smooth External Surface, Type A
16098 Part 2	Pipes and Fittings With Non-Smooth External Surface, Type B

1.3 MANDATORY TESTS / OPTIONAL TESTS :-

1. The following mandatory tests shall be carried out when the qty. of materials to be incorporated in the work exceeds the minimum qty. specified in col.5 of the table below irrespective of whether the materials are with I.S. mark, or otherwise.
2. Optional tests specified or any other tests shall be carried out in case of specialized work/ important structure at Department's discretion.
3. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for all mandatory tests.
4. Testing charges for optional tests shall be paid by the Dept. However, the incidental charges and cost of sample for testing shall be borne by the contractor.
5. In case of non-I.S. materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant I.S. specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for such tests.

1.4.1 Mandatory tests for P.H.E. works :

Material	Test	Field/lab test	Test Procedure	Minimum quantity of material / work for carrying out the test 5	Frequency of sampling	Remarks
1	2	3	4	5	6	7
G.I. pipes	**Physical** Dimensional Nominal unit wt. Tensile, Elongation **Chemical** Mass of zinc coating Sulpher, Phosphorus	 Field/lab Field/lab Lab Lab Lab Lab	 IS 4736 IS 228 IS 228	 >20tubes >20tubes >1000/ 500 up to 25 mm bore >25 mm bore respectively. Up to bore 25mm 1 tube / 1000 or part thereof >25mm bore 1 tube/ 500 tube	 Sampling & criteria for conformity as per 4711	
C.I. pipes Water Quality "LA/A/B"	Dimensional Unit weight Hammer test	Field/lab Field/lab Field/lab		> 20 pipes > 20 pipes --------	Sampling & Conformity as per IS	Hardness & grade shall be

Class	Hydrostatic test Hardness & grade	Field/lab -------			1536 & IS 11606 IS1500	optional
D.I. pressure pipes	Dimensional Unit weight Hydrostatic test Hardness & grade	Field/lab Field/lab Field/lab Lab	IS 4985	> 20 pipes > 20 pipes	Sampling & Conformity as per IS 8329 & IS 11606	
uPVC pipes	Dimensional Reversion Test Vicat Softening Test Density Suiphated Ash Content Test Resistance to External Blows at 0°C Internal Hydrostatic Pressure Test Type Test & Eflect on Water (Manufacturer has to submit Test certificate)	Field/lab Lab Lab Lab Lab Lab Lab	IS 4985	>20 tubes >20 tubes	Sampling & Conformity as per IS 4985	
CPVC pipes	Dimensional Reversion Test Vicat Softening Test Density Resistance to External Blows at 0°C Internal Hydrostatic Pressure Test Type Test & Eflect on Water (Manufacturer has to submit Test certificate)	Field/lab Lab Lab Lab Lab Lab	IS 15778	>20 tubes >20 tubes	Sampling & Conformity as per IS 15778	
C.I. pipe Soil quality	Dimensional Unit weight Hammer test Hydrostatic test Hardness & grade	Field/lab Field/lab Field/lab Field/lab -------		> 20 pipes > 20 pipes ---------	Sampling & Conformity as per IS 3981, IS1729 IS 1500	Hardness & grade shall be optional
Pig lead	Chemical Analysis	Lab	IS 1817	Lot > 1000 kg, if less Mfr. test report to be furnished	Each lot > 1000 kg.	
Stone ware pipes	Hydraulic Test, Absorption Test, Test for Acid Resistance ,	Lab	IS 651	3no for lot of 150 5 no. for 151 to 1200		

	Test for Alkali Resistance, Crushing strength Test			8 no. for 1201 to 10000		
Cement, Bricks	**As per Civil specification**					
Pre Cast Concrete man hole frame & covers/ Gratings	Dimension Load test	Lab	IS 12592 (Part I)	> 20 frame & covers/ gratings	Sampling as per IS 12592(partI)	
CI man hole frame & covers	Dimension Load test	Lab	IS 1726	>50 frame & covers/ gratings	Sampling as per IS 1726	
Hume pipe NP class	Dimension Hydrostatic test Three-edge bearing Absorption test	Lab/field Lab Lab Lab	IS 458 IS 3597 IS 3597 IS 3597	>50 pipes	As per IS 458	
Sanitary fittings	Manufacturer's Test certificate To be produced IS mark materials.					
CP brass fittings Bib taps/ stop cocks	Manufacturer's Test certificate To be produced IS mark materials.					

1.4.2 Testing, tolerances, Acceptance and mode of payment

a) The materials should pass all tests and tolerance in dimensional, chemical, physical properties should be within the limit as stipulated in relevant I.S. for acceptance. Such materials will be accepted as standard.

b) Payments shall be restricted to standard unit mass, or as specified in the schedule, without making any cost adjustment towards mass or any other properties provided the material pass all the tests and tolerance are within the specified limit.

c) In case of non-standard materials, materials not covered under any I.S specification, such as aluminium sections, the payment shall be made based on the actual unit weight as determined by testing at random sampling.

Post construction Inspection and testing : After completion of work and during the maintenance liability period of contract, the work shall be subjected to "Post construction and testing". In case, if the materials incorporated in the work are found to be inferior, though the sample collected from the materials might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same without any cost to the department failing which the department may rectify the same at the risk and cost of the contractor or the department may accept the same as sub standard, and cost be adjusted from the outstanding security deposit as per the terms and condition of the contract for the work.

2.0 GENERAL SPECIFICATIONS :

2.1 EARTH WORK AND BACKFILL

2.1.1 SCOPE OF WORK :

The scope of work covered under this specifications pertains to excavation of foundations, trenches, pits and over areas, in all sorts of soils, soft and hard rock, correct to dimensions given in the drawing including shoring, protections of existing underground utilities if any, such as water lines, electric cables etc., dewatering and shoring if necessary, stacking the useful materials as directed within the lead specified, refilling around the foundation and into the plinth with selected useful excavated earth and disposing off the surplus earth/materials within specified lead and finishing the surface to proper levels, slopes and camber etc. all complete.

2.1.2 SITE CLEARANCE :

Before the earth work is started the area coming under cutting and filling shall be cleared of all obstructions, loose stones, shrubs, rank vegetation, grass, brush-wood, trees and saplings of girth upto 30 cm. measured at a height of one metre above ground and rubbish removed upto a distance of 150 metres outside the periphery of the area under clearance. The roots of trees shall be removed to a minimum depth of 60 cm. below ground level, or a minimum of 30 cm. below formation level whichever is lower, and the hollows filled up with earth, levelled and rammed. This work is deemed to be included in the earth work items and no separate payment will be admissible for the work.

The trees of girth above 30 cm. measured at a height of one meter above ground, shall only be cut after permission of the Engineer-in-charge is obtained in writing. The roots shall also be removed as described in the preceding sub-para. Payment for cutting and removing roots of such trees shall be made separately. Any material obtained from the site will be the property of the Department and the useful materials as decided by the Engineer-in-charge will be conveyed and properly stacked as directed within the lead specified.

2.1.3 SETTING OUT AND MAKING PROFILES :

Masonry or concrete pillars will be erected at suitable points in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with G. T. S. or any other permanent bench mark approved by the Engineer-in-charge. Necessary profiles with pegs, bamboos and strings or Burjis shall be made to show the correct formation levels before the work is started. The contractor shall supply labour and materials for setting out and making profiles and Burjis for the work at his own cost and the same shall be maintained during the excavation work. The Department will show grid Co-ordinate or other reference points. It shall be the responsibility of the contractor to set out centre lines correctly with reference to the drawings and install substantial reference marks. Checking of such alignment by the Department will not absolve the contractor from his responsibility to execute the work strictly in accordance with the drawings.

2.1.4 EARTHWORK :

The contractor shall notify the Engineer-in-charge before starting excavation and before the ground is disturbed, to enable him to take existing levels for the purpose of measurements. The ground levels shall be taken at 5 to 15 metres intervals in uniformly sloping ground and at closer distance where local mounts, pits or undulations are met with, as directed by the Engineer-in-charge. The ground levels shall be recorded in field books and plotted on plans, which shall be signed by the Contractor and the Engineer-in-charge, before the earth work is actually started. The labour required for taking levels, shall be supplied by the Contractor at his own cost. The Contractor shall perform excavation in all types of soils, murrum, soft and hard rock, boulders etc. in foundation, over areas and in trenches to widths, lines, levels, grades and curves as shown in the drawing or lesser widths, lines and levels as directed by the Engineer-in-charge and as per items in the schedule of quantities.

2.1.4.1 The item in the schedule of quantities shall specify the excavation in trenches

For this purpose, the excavation in trenches for foundations and for pipes, cables etc. not exceeding 1.5 m. in width and for chambers, manhole, shafts, wells, cesspits and the like not exceeding 10 sqm. on plan and to any depth shall be described as Excavation in trenches for foundation, drains, pipes and cables and returning the excavated material to fill the trenches after pipes, cables etc, are laid and their joints tested and passed and disposal of surplus excavated material upto 50 m lead.

2.1.4.2 Excavation exceeding 1.5 m. in width as well as 10 sqm. on plan (excluding trenches for pipes, cables etc.) and exceeding 30 cm in depth shall be described as Excavation over areas.

2.1.5 CLASSIFICATION OF EARTH WORK:

The earth work shall be classified under the following main categories and measured separately for each category.

a) All types of soils, murrum, boulders.

b) Soft rock.

c) Hard rock.

2.1.5.1 a) ALL TYPES OF SOILS, MURRUM, BOULD : This includes earth, murrum, top deposits of agricultural soil, reclaimed soil, clay, sand or any combination thereof and soft and hard murrum, shingle etc. which is loose enough to be removed with spades, shovel and pick axes. Boulders not more than 0.03 cum. in volume found during the course of excavation shall also fall under this classification.

b) EXCAVATION IN SOFT ROCK : This shall include all materials which are rock or hard conglomerate, all decomposed weathered rock, highly fissured rock, old masonry, boulders bigger than 0.03 cum. in volume but not bigger than 0.5 cum. and other varieties of soft rock which can be removed only with pick axes, crow bars, wedges and hammers with some difficulty. The mere fact that the contractor resorts to blasting and/or wedging and chiselling for reasons of his own, shall not mean the rock is classificable as hard rock.

c) EXCAVATION IN HARD ROCK : This includes all rock other than soft rock mentioned in 2.1.5.1 b viz. soft rock, occurring in masses, boulders having approximate volume more than 0.5 cum. plain or reinforced cement concrete, which can best be removed by blasting or chiselling and wedging where blasting cannot be permitted owing to any restriction at site.

i) EXCAVATION IN HARD ROCK BY BLASTING : Where blasting is permitted the excavation in rock shall be done by means of blasting. No heavy blasting will be permitted and only controlled/muffled blasting will be permitted at the discretion of the Engineer-in-Charge. The Contractor shall be governed by the relevant statutory laws, rules and regulations on explosives, pertaining to the acquisition, transport, storage, handling and use of explosive which shall be rigidly followed and shall obtain himself all necessary materials and equipment for blasting. Blasting shall be executed through a licensed blaster with prior permission from police authorities. Prior to blasting sufficient notice shall be given to concerned parties to avoid danger to people, materials and nearby structures. All the damages caused by careless blasting if any shall be made good by the contractor at his own expenses.

ii) EXCAVATION IN HARD ROCK BY CHISELLING AND WEDGING : Where blasting is not permitted and if the Engineer-in-Charge so desires, the excavation shall be done by chiselling and wedging or any other agreed method.

NOTE : All the excavated hard rock obtained shall be stacked properly and neatly within the specified lead by the contractor as directed by the Engineer-in-Charge.

2.1.6 EXCAVATION : The excavation under all classifications in areas in trenches or in pits shall be carried out systematically. Cutting shall be done from top to bottom and no under-pining or undercutting will be allowed. The bottom and sides of excavation shall be dressed to proper level, slopes, steps, camber etc. by removing high spots, and ramming thoroughly as directed by the Engineer-in-charge.

All the excavation shall be carried out strictly to the dimensions given in the drawing. The width shall generally be of the width of mudmat concrete and depth as shown in drawing or as directed by the Engineer-in-Charge, according to availability of the desired bearing capacity of soil below. Any excavation if taken below the specified depths and levels, the contractor shall at his own cost fill up such overcut to the specified level with cement concrete 1:4:8 in case of excavation in all types of soils and with cement concrete 1:2:4 in case of excavation in soft and hard rock.

After the excavation is completed, the contractor shall notify the Engineer-in-Charge to that effect and no further work shall be taken up until the Engineer-in-Charge has approved the depth and dimensions and also the nature of foundation materials. Levels and measurements shall also be recorded prior to taking up any further work.

2.1.6.1 SIZES OF TRENCH FOR EXCAVATION FOR PIPE LINE :

Where the width of trench is not specified the following shall apply.

a) Upto 1.0 metre deep shall be arrived at by adding 25 cm to the external diameter of pipe (not socket/collar) cable, conduit etc where a pipe is laid on concrete bed/cushioning layer, the authorised width shall be the external diameter of the pipe (not socket/collar) plus 25 cm or the width of concrete bed/cushioning layer whichever is more.

b) For depths exceeding one metre, an allowance of 5 cm per metre of depth for each side of the trench shall be added to the authorised width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils upto a depth of 2 metres from the bottom. For depths greater than 2 metres, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two metres from bottom.

c) Where more than one pipe, cable, conduit etc. are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.

d) Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored-up as directed by the Engineer-In-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-In-charge regarding increase in the width of trench, sloping or shoring to be done for excavation in soft, loose or slushy soils.

2.1.6.2 SIZES OF TRENCH FOR EXCAVATION FOR CHAMBERS, MANHOLES, SHAFTS, WELLS, CESSPITS:

Authorised working space shall be special in each case. Where authorised working space is not so specified the following shall apply :

600 mm measured from the external face of substructure/walls (including protective measures like water proof plaster, tile cladding etc. if any) at lowest level, where extra working space is required.

2.1.7 SHORING :

Unless separately provided for in the schedule of quantities, the quoted rate for excavation shall include excavation of slopes to prevent falling in soil by providing and/or fixing, maintaining and removing of shoring, bracing etc. The contractor would be responsible for the design of shoring for proper retaining of sides of trenches, pits etc. with due consideration to the traffic, superimposed loads etc. Shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. It shall be removed as directed after items for which it is required are completed. Should the slips occur, the slipped material shall be removed and slope dressed to a modified stable slope. Removal of the slipped earth will not be measured for payment.

2.1.8 DEWATERING :

Unless specifically provided for as a separate item in the schedule of quantities, rate shall also include bailing or pumping out all water which may accumulate in the excavation during the progress of further works such as mud mat concrete, R.C. footings, shuttering etc. either due to seepage, springs, rain or any other cause and diverting surface flow by bunds or other means. Care shall be taken to ensure that the water discharged sufficiently away from the foundations to keep it free from nuisance to other works in the neighbourhood.

2.1.9 DISPOSAL OF EXCAVATED MATERIALS :

a) ANTIQUITES : Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-Charge and shall be the property of the Government.

b) USEFUL MATERIALS : Any material obtained from the excavation which in the opinion of the Engineer-in-Charge is useful, shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

No material excavated from foundation trenches of whatever kind they may be are to be placed even temporarily nearer than about 3 m. from the outer edge of excavation. Discretion of the Engineer-in-Charge in such cases is final. All materials excavated will remain the property of the Department. Rate for excavation includes sorting out of the useful materials and stacking them separately as directed within the specific lead.

Materials suitable and useful for refilling or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or other elevation shown on the plan or as directed by the Engineer-in-Charge. Materials not useful in anyway shall be disposed off, leveled and compacted as directed by the Engineer-in-charge within a specified lead. The site shall be left clean of all debris and leveled on completion.

2.1.10 REFILLING IN SIDES OF CHAMBERS, DRAINS ETC. :

The back filling shall be done after the concrete or masonry has fully set and shall be done in such a way as not to cause under-thrust on any part of the structure. Where suitable excavated material is to be used for back filling, it shall be brought from the place where it was temporarily deposited and shall be used in refilling. The scope of work for back filling/filling in sides of chambers and other areas shall include filling for all the excavation covered under the contract. Surplus earth available from the excavation, if required, shall be used for refilling/filling for filling the trenches for pipes cables buildings also within the specified lead mentioned in the item.

All timber shoring and form work left in the trenches, pits, floors etc. shall be removed after their necessity ceases and trash of any sort shall be cleared out from the excavation. All the space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface with approved materials in layers not exceeding 200 mm. in thickness, watered and well consolidated by means of rammers to atleast 90% of the consolidation obtainable at optimum moisture content (Proctor density). Flooding with water for consolidation will not be allowed. Areas inaccessible to mechanical equipment such as areas adjacent to walls and columns etc. shall be tamped by hand rammer or by hand held power rammers to the required density. The backfill shall be uniform in character and free from large lumps, stones, shingle or boulder not larger than 80 mm. in any direction, salt, clods, organic or other foreign materials which might rot. The refilling in plinth and under floors shall be done in similar way in layers not exceeding 200 mm. thick and shall be well consolidated by means of mechanical or hand operated rammers as specified to achieve the required density.

Test to establish proper consolidation as required will be carried out by the Department at rates specified. Two tests per 50 sqm. will be taken to ascertain the proper consolidation. The cost of tests carried out will be recovered from the contractors bill.

2.1.11 REFILLING IN TRENCHES FOR PIPES, CABLES ETC.

Filling in trenches shall be commenced soon after the joints of pipes, cables, conduits etc. have been tested and passed. The space alround the pipes, cables, conduits etc. shall be cleared of all debris, brick bats etc. Where the trenches are excavated in hard/soft soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8 cm in any direction shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the excavated earth is used for filling. In case of excavation of trenches in ordinary/hard rock, the filling upto a depth of 30 cm above the

crown of pipe, cable, conduits etc. shall be done with fine material like earth, murrum or pulverised/decomposed rock according to the availability at site. The remaining filling shall be done with boulders of size not exceeding 15 cm mixed with fine material like decomposed rock, murrum or earth as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30 cm. Excavated material containing deleterious material, salt peter earth etc. shall not be used for filling. Ramming shall be done with iron rammers where feasible and with blunt ends of crow bars where rammers cannot be used, Special care shall be taken to ensure that no damage is caused to the pipes, cables, conduits etc. laid in the trenches.

2.1.12 LEAD & LIFT

LEAD : The lead for disposal/deposition of excavated materials shall be as specified in the respective item of work. For the purpose of measurements of lead, the area to be excavated or filled or area on which excavated material is to be deposited/ disposed off shall be divided in suitable blocks and for each of the block, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route adopted.

LIFT : Lift shall be measured from ground level. Excavation up to 1.5 m depth below ground level and depositing excavated material on the ground shall be included in the item of earthwork for various kinds of soil. Extra lift shall be measured in unit of 1.5 m or part thereof. Obvious lift shall only be measured; that is lifts inherent in the lead due to ground slope shall not be measured except for lead upto 250 m. All excavation shall be measured in successive stages of 1.5 m stating the commencing level. This shall not apply to cases where no lift is involved as in hill side cutting.

2.1.13 MODE OF MEASUREMENTS:

2.1.13.1 All excavation in areas having depth more than 30 cm. pits, trenches etc. shall be measured net. The dimensions for the purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, rafts or other foundations, multiplied by the mean depth from the surface of ground determined by levels. Excavation for side slopes will not be paid for. Excavation in areas having depths less than 30 cms. shall be measured as surface excavation on square metre basis, mentioning the average depth of excavation.

Reasonable working space beyond concrete dimension required for waterproofing and shuttering where considered necessary in the opinion of Engineer-in Charge will be allowed in execution and considered for payment for underground water tank, sump, septic tank etc.

2.1.13.2 Wherever direct measurements of rock excavation are not possible, volume of rock be calculated on the basis of length, breadth and depth of stacks made at site. The net volume shall be worked out by reducing it by 50%, taking the voids into consideration as 50%. Similarly to arrive at net quantity to be paid in the case of soil, reduction @ 20% of corresponding stack/truck measurements shall be made.

2.1.13.3 The rate for excavation shall include carting and disposing and levelling the excavated materials within the specified lead. The rate shall also be inclusive of cost of all tools, plants, explosives, shoring, dewatering at various stages, labour, materials etc. to complete all the operations specified.

2.1.13.4 The backfilling and consolidation in sides of foundation and in plinth with excavated material will not be paid for separately. The rate quoted for excavation shall be deemed to have been included the cost of stacking of excavated materials, conveying within the specified lead, picking of selected stacked materials, conveying it to the place of final backfill, compaction to the required proctor density etc.

2.1.13.5 Payment for filling and consolidation inside the trenches, sides of foundations, plinth etc. with selected materials brought by the contractor other than the excavated material, shall be paid for separately as per the rates in schedule of quantities which includes cost of such materials/excavation, royalty, its conveyance within the specified lead, watering, consolidating, dressing etc. Actual quantity of consolidated filling shall be measured and paid in cubic metres upto two places of decimal.

2.1.13.6 The rate quoted in cum. for items of excavation is deemed to include the necessary additional quantity of excavation involved beyond the plan dimensions of the work which may be necessary to be carried out for carrying out the work in an engineering manner, decided upon by the contractor. Therefore no extra payment will be made for any excavation done other than the required quantity as per the plan dimension indicated in the drawings.

2.1.13.7 Measurements for excavation over areas shall be determined by levels or by “Dead men” or both at the discretion of the Engineer-in-Charge. If however the Engineer-in-Charge decides on measurement by levels, levels of site shall be jointly taken and recorded by the Engineer-in-Charge or his representatives and the contractor, before commencement of the work and after completion of the work and the quantity of work done shall be computed based on these levels. The volume of earth work shall be computed based on “Simpson’s formula” or any other approved method at the discretion of the Engineer-in-Charge.

2.2 PLAIN CEMENT CONCRETE :

2.2.1 GENERAL : The specification covers the requirement of ordinary Cement Concrete of the specified proportion to be used for various concrete items.

2.2.2 MATERIAL : The material requirement for particular item shall be as per IS 456

2.2.3 CEMENT : Cement shall be OPC/PPC cement conforming to IS 269 & IS 1489 respectively. Cement shall

be stored in dry godowns or sheds use of PPC slag cement as approved by the Engineer In-charge, out of construction with damp ground on a 0.6M height platform. Cement shall not be stored in the open. All cement shall be kept well stacked and no cement other than intended to use in the work, shall be used. The cement shall be stored as received and shall be consumed in the order in which consignments are received and shall not be stored for long periods. No clogged cement caused by dampness shall be used. Blended cement for finishing work shall be used with the prior approval of the Engineer In-charge.

2.2.4 FINE AGGREGATE : The sand shall be clean, well graded, hard, strong, durable and gritty particles of size 0.15 mm to 5 mm fee from mica, dust, clay, kankar, soft or flaky particles and other deleterious materials. If the fine aggregate contain more than 4 percent of clay, dust or silt it shall be washed. Sea sand should not be used. The fineness modulus may range between 2.6 to 3.6.

2.2.5 COARSE AGGREGATE : All stone aggregate to be used for cement concrete shall be from approved sources. The aggregate shall be clean hard, strong and durable. It shall not contain soft, flaky thin or elongated pieces, alkali organic matter or other notorious matter. The specific gravity of the aggregate shall be between 2.5 to 2.7.

2.2.6 STORAGE, SCREENING AND WASHING : It shall be stored at the work site in such a manner as to prevent contamination. All aggregate shall be stored to convenient height on hard and dry platform. The contractor shall install screens, one for coarse aggregate and one for sand and shall thoroughly wash all aggregate if directed by Engineer-in-charge.

2.2.7 WATER : The water shall be confirming to IS 3025. The water shall be clean and free from deleterious matters such as acids, oils, alkalies, sugar and vegetable matter. Every attempt shall be made to use water that is fit for drinking and whenever possible, water shall be used direct from the supply mains. PH value of water shall not be less than 6.

2.2.8 PROPORTIONING OF MIX : In ordinary concrete although proportion of cement to fine and course aggregate is specified by volume, the quantity of cement shall be determined by weight assuming one bag of cement weighing 50 kg. net to be equivalent to 35 Ltrs. fine and course aggregate shall be measured by dry volume in suitable measuring boxes. The allowance shall be made for bulking in the fine aggregate due to moisture if any at the time of mixing. Water cement ratio will be such as will give concrete just sufficient workable to place and compact with out difficulty.

2.2.9 MIXING : In all the cases concrete shall be mixed in a mechanical mixer at the site of work, mixer and other accessories should be in first class condition and well maintained through out the construction. Mixing shall be continued till the homogeneous mixture is obtained but in no case mixing shall be done for less than 1.5. minutes.

When hand mixing is permitted by Engineer-in-charge in any special condition, it shall be done on a smooth, hard and water tight, platform large enough to allow sufficient turning over of the ingredients of concrete after adding the water. The material shall be mixed in dry state and turned over until they are thoroughly and fully mixed homogeneously. In hand mixing, the quantity of cement shall be increased by 10 percent with out any extra cost. Retampering or remixing of partially hardened concrete shall not be permitted.

2.2.10 PLACING : The concrete shall be transported in such a manner that there shall be no tendency for the segregation of the different ingredients and it shall not be dropped into position from the height greater than 1.00 meter and shall be placed within 30 minutes after mixing. It shall not be interfered when once it has become to set. When new concrete is to be placed on the already set concrete, the surface of the old concrete shall be thoroughly roughened & wetted before the new concrete is laid. Cement sand slurry (1:2) being laid over the surface of the old concrete which is roughened, washed and wetted. The stripped surface of concrete shall be smooth & sharp. Any honey combing, air holes,board marks etc, shall be finished smooth.

2.2.11 COMPACTION : The concrete shall be thoroughly compacted during depositing to get dense concrete. The concrete shall not be disturbed once it is set. For important works, the use of mechanical vibrator is essential. The vibrator shall not be less than 4000 to 5000 impulse per minute and shall be worked at an interval about 600 mm. Over vibration shall be avoided.

2.2.12 DEWATERING : The item rate shall include bailing or pumping out all water if accumulated during the progress of the work either from seepage, springs, rain or any other cause.

2.2.13 FORM WORK : The forms shall generally comply with IS 456 & IS 14687. The shuttering shall be of wood or metal. Before placing the concrete the inside of the forms which comes into contact with concrete shall be coated with mineral oil. The forms shall be erected in position firmly so that it should not be dislocated during concreting. The forms shall be removed without damaging the concrete structure after development of sufficient strength and taking consent of the Engineer-In-Charge.

2.2.14 DEFECTIVE CONCRETE : The defective concrete surface shall be made good as per the direction of Engineer-In-Charge at the contractor's own cost and charges.

2.2.15 WATERING AND CURING : All the concrete work shall be kept wet continuously for a period of a least 14 days to prevent excessive evaporation. In hot and dry weather matting or gunny bags may be hung on out side of the concrete surface to keep moist.

2.2.16 THE RATE INCLUDES FOR :

1. Installation and removal of scaffolding and shuttering.

2. Cost includes transporting, placing, compacting, curing and finishing cement concrete,
3. Necessary sampling and tests for materials and concrete.
4. Dewatering the pit or trench if found necessary till completion of work.
5. All labour, materials, use of equipment, tools and plants.

2.2.17 MODE OF MEASUREMENT : The measurement shall be for unit cubic meter of concrete or as specified in schedule of work. The concrete shall be measure for its length, breadth and depth. Deduction for pipe shall be made as per the actual outer dimension of the pipe.

2.3 BRICK MASONARY :

2.3.1 GENERAL : This specification covers requirement of the Brick Work in specified proportion of cement mortar.

2.3.2 MATERIAL : Bricks used in the masonry shall be of the following type

2.3.2.1 THE COMMON BURNT CLAY BRICK : Brick shall generally confirmed to IS 1077. All the bricks to be used in the work shall be well bunt clay brick of class 35, red colour, homogeneous in texture, free from flaws, cracks and crevices. They shall have a frog of 10 mm. depth on one side of their flat faces. No brick after twenty four hours immersion in water shall absorb more than 25% of its own weight and strength should not be less than 3.5 MPa (35 kg/Sq.cm). The test report of the bricks shall be submitted to the Engineer-in-charge at the contractor's own cost, if required Brick shall be uniformly burnt throughout but not over burnt, shall give the clear metallic ringing sound when struck.

2.3.2.2 FLY ASH LIME BRICKS (FALG BRICKS) : The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. The bricks shall be solid and with or without frog on one of its flat side. Fly ash shall conform to IS 3812. Bottom ash used as replacement of sand shall not have more than 12% loss on ignition when tested. Deleterious materials, such as clay and silt in the sand shall preferably be less than 5%. Lime shall conform to class „C" hydrated lime of IS 712. Any suitable additive considered not detrimental to the durability of bricks may be used.

2.3.2.3 MECHANIZED AUTOCLAVE FLY ASH LIME BRICK: These bricks shall be machine moulded and prepared in plant by appropriate proportion of fly ash and lime. The autoclave fly ash bricks shall conform to IS 12894. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with frog, and of 100/80 mm in length, 40 mm width and 10 to 20 mm deep on one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour. Fly ash shall conform to IS 3812 and lime shall conform to class „C" hydrated lime of IS 712.

2.3.2.4 CLAY FLY ASH BRICKS: The clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

2.3.3 BRICK WORK : All bricks shall be thoroughly soaked in water before use till the bubbles ceases to come up. No half or quarter brick shall be used except as closures. The course shall be horizontal and the wall shall be raised to plumb. Joints in brick wall shall not exceed to 10mm thick. All joints shall be thoroughly flushed with mortar of mix as specified in the schedule of quantities, at every courses. Care shall be taken to see that the bricks are bedded effectively and all joints completely filled to the full depth. Ready mix cement mortar can be used as per requirement and as directed by EIC. Brick work shall be uniformly raised around to heights as per drawings. All joints shall thoroughly flushed with mortar at every courses. Care shall be taken to see that the bricks are properly bedded and joint completely filled to full depth. No bat or cut bricks shall be used in the work unless absolutely required to give proper shape. Brick work shall be built in cement and sand mortar as specified in the schedule or as per drawing. The joints shall be raked for a depth of 10 mm to receive cement plaster.

2.3.4 DEWATERING : The item rate shall include bailing or pumping out all water which may accumulate during the progress of the work either from seepage, springs, rain or any other cause.

2.3.5 WATERING AND CURING : All the brick work shall be kept damp continuously for a period of 14 days to prevent excessive evaporation In hot and dry weather matting or gunny bags may hung on the out side of brick work & kept moist.

2.3.6 THE RATE INCLUDES FOR :

1. Erecting, dismantling and removing the scaffolding. and curing brick work for at least 14 days.
2. Dewatering the pit or trench if found necessary till completion of work.
3. Labour, materials, tools, paint etc. used in the work.

2.3.7 MODE OF MEASUREMENT : The measurement shall be for unit cubic meter of brick work or as specified in the schedule of work. The brick wall shall be measured for it's length, breadth and depth.

2.4 CEMENT PLASTER :

2.4.1 GENERAL : This specification covers the requirement of the Cement plaster in the specified proportions.

2.4.2 CEMENT MORTAR : Cement and sand shall be mixed to the proportions as described in the schedule. Cement and sand shall be first mixed dry on the dry platform after which sufficient clean water shall be added to bring the whole mix into a plastic condition. No mortar which has started to set shall be used nor such mortar remixed with new one. It shall be removed from the work site at once. Ready mix cement plaster mortar can be used as per requirement and as directed by EIC.

2.4.3 PLASTERING : In all plaster work, mortar shall be firmly applied and well pressed into the joints on the surface and drubbed and leveled with a flat wooden rule to give required thickness. Long straight edge shall be freely used to ensure a perfectly plane and even surface. All corner must be finished to their true angle or rounded as directed. Cement plaster should be done in square or strips and shall be done from top to downward.

2.4.4 FLOATING COAT : The floating coat over the plaster shall be so done whenever specified in the item with neat cement to finish the surface so that cracks, crevices etc. are not developed in the plaster.

2.4.5 DEWATERING : The item rate shall include bailing or pumping out all water if accumulated during the progress of the work either from seepage, springs, rain or any other cause.

2.4.6 WATERING AND CURING : All the plaster work shall be kept damp continuously for a period of 14 days to prevent excessive evaporation. In hot and dry weather matting or gunny bag may be hung on the the out side of the plaster in the beginning and kept moist.

2.4.7 THE RATE INCLUDES FOR :

1. Erecting, dismantling and removing the scaffolding.
2. Preparation of the surface to receive the plaster of specified thickness and number of coats, curing etc.
3. Labour, materials, tools and plants used to complete the work.

2.4.8 MODE OF MEASUREMENT : The measurement shall be for unit square meter of cement plaster. The plaster shall be measured for it length, breadth / depth.

2.5 CUTTING OF ASPHALT ROAD AND PAVED YARD :

2.5.01 GENERAL : This specification covers the scope of cutting and breaking the asphalt, concrete roads, paths etc. and making good to its original condition.

2.5.02 MATERIAL : Wherever cutting is done across public paths, roads etc. the orders of materials excavated shall be preserved in well manner and reinstatement shall be done in the same order and road brought to the original condition. The contractor shall made up for any deficiency in/material at his own cost.

2.5.03 WORKMANSHIP : The cutting of road and paved yard shall be done as directed by the E-I-C, Ramming the sub-grade for piping work. The soling stones, spreading the metals to required thickness and making water bound with stone dust/ murrum as per requirement shall be reinstated to the original condition at his own cost.

2.5.04 THE RATE INCLUDES FOR :

1. Cutting asphalt road, water bound macadam and soling and stacking usable material at site.
2. Ramming sub-grade for laying pipe line and making asphalt road in original condition after completion of work.
3. Labour, materials, tools and plants used to complete the work.

2.5.05 MODE OF MEASUREMENT : The measurement shall be for unit square meter. The cutting portion shall be measured for its length and breadth.

2.6 REMOVAL OF FOOT PATH TILES :

2.6.01 GENERAL : This specification covers the scope of removing stone tiles from foot paths and refixing the tiles as good to its original condition.

2.6.02 MATERIAL : Wherever cutting is done across pubic foot paths and roads, the orders of materials removed from foot paths shall be preserved in well manner and reinstatement shall be done in the same order and foot path brought to the original condition. The contractor shall make up for any deficiency in material at his own cost.

2.6.03 WORKMANSHIP : The foot path tiles shall be removed in required area required or as directed by the E-I-C. Ramming the sub-grade for laying and fixing the tiles after completion of work to the original condition with 1:3 cement mortar.

2.6.04 THE RATE INCLUDES FOR :

1. Removing the stone tiles from foot paths and stacking at site.
2. Ramming sub-grade for refixing the tiles including cement, sand, tiles etc.
3. Labour, materials, tools and plants used to complete the work.

2.6.05 MODE OF MEASUREMENT : The contract rate shall be for unit square meter and it shall be measured for it length and breadth.

2.7 REMOVAL OF KERB STONE :

2.7.01 GENERAL : This specification covers the scope of removing road side kerb stone and refixing the kerb stone as good to its original condition.

2.7.02 MATERIAL : Wherever cutting is done across public paths and roads, the order of materials shall be preserved in well manner and reinstatement shall be done in the same order and it shall be brought to the original condition. The contractor shall make up for any deficiency in material at his own cost.

2.7.03 WORKMANSHIP : The road side kerb stone shall be removed to the required length or as directed by the E-I-C. Ramming the sub-grade for fixing the kerb stone after completion of work in the original condition with 1:3 cement mortar.

2.7.04 THE RATE INCLUDES FOR :

1. Removing the kerb stone and stacking at site.
2. Ramming sub-grade for refixing the kerb stone including cement, sand, kerb stone etc.
3. Labour, materials, tools and plants used to complete the work.

2.7.05 MODE OF MEASUREMENT : The measurement shall be for unit running meter and it shall be measured for its length.

2.8 STRUCTURAL STEEL WORK :

2.8.01 GENERAL : This specification covers the requirement of providing, fabrication and erection of Structural steel work including painting.

2.8.02 MATERIAL : All the Structural steel shall conform to IS 226 and IS 800. They shall be free from defects and shall have uniform section with smooth finish.

2.8.03 FABRICATION AND ERECTION : Cutting, holding, assembly, riveting, bolting, welding, machining, painting, marking and erection shall be carried out in accordance with approved plans and as directed by Engineer-in-charge and shall comply with IS 800.

2.8.04 DAMAGED MEMBER : Any material found, damaged or defective shall not be used and contractor has to replace the same at his own cost and charges.

2.8.05 PAINTING : Painting shall be conforming to IS 800. One priming coat of Zinc chromate shall be applied immediately after fabrication and two coats of oil paint of approved shade be applied after completion of erection.

2.8.06 INSPECTION AND TESTING : These shall be carried out in conformity with IS 800.

2.8.07 THE RATE INCLUDES FOR :

1. Supplying, fabrication, erecting in position at site the structural steel sections.
2. All labour, materials and use of tools and equipment and painting.

2.8.08 MODE OF MEASUREMENT : The measurement shall be for unit weight.

3.0 SANITARY INSTALLATIONS

3.1 INDIAN WATER CLOSET

3.1.01 GENERAL : The item pertains for providing white or colour glazed vitreous chinaware Indian water closet of size and colour as specified in the schedule including fixing.

3.1.02 MATERIAL : Squatting Pan (Orissa Pattern) is of white or colour glazed vitreous China conforming IS 2556 Part III. Pan shall have flushing rim and are inlet of self draining type. It shall have weep hole at the following inlet to the Pan. The flushing inlet shall be in front unless otherwise specified. The inside of the bottom of the pan shall have sufficient slope from the front to the outlet and surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have groove at right angle to the axis of the outlet. In all the cases pan shall have be provided with 100 mm Glazed Vitreous China `P` or `S` trap with 50 mm water seal and 40 mm size vent

3.1.03 FIXING : The water closet pan shall be placed in position as shown in the drawing. The IWC shall be supported on brick masonry in CM 1:4 or as directed by the Engineer-in-charge. The pan shall be fixed slightly lower than the floor level. If the pan or trap is damaged during handling of fixing, it shall be replaced by the contractor at his own cost. The pan, trap and

pipe shall be jointed in 1:1 Cement Mortar with hemp yarn caulked. The gap between W.C. and floor shall be finished with white/matching cement as directed.

3.1.04 PROTECTION AND FINAL CLEANING : The IWC shall be covered with husk and sand till all the civil and electrical works are completed and shall be removed and cleaned on completion of civil and electrical works prior to testing and handing over. However the contractor should ensure that the out let is plugged with gunny bags or similar materials to avoid the pipe getting blocked.

3.1.05 THE RATE INCLUDES FOR :

3.1.05.1 Water Closet pan with SCI trap `P` or `S` type and jointing in 1:1 cement mortar with hemp yarn caulked.

3.1.05.2 Cutting wall / slab / beam etc. and making all the damage goods to original condition after completion of work.

3.1.05.3 Testing the entire system and rectification of defects, if any.

3.1.05.4 All necessary labour, material and use of tools.

3.1.06 MODE OF MEASUREMENT : The measurement shall be for each unit of W.C. Pan fixed.

3.2 EUROPEAN/ ANGLO INDIA WATER CLOSET :

3.2.01 GENERAL : The item pertains for providing white or colour glazed vitreous chinaware European or Anglo Indian water closet with seat and cover of size and colour as specified in the schedule including fixing.

3.2.02 MATERIAL : European type water closet shall be wash down pattern unless otherwise specified. Water closet shall be vitreous china conforming to IS 2556 (Part-I & II). The closet shall be of one piece construction and shall have minimum two hole of 6.5 mm diameter for fixing closet to floor. Closet shall have an integral flushing rims of self draining type. Each water closet shall have an integral trap with either `S` or `P` outlet with and trap shall be uniform and smooth in order to enable an efficient flush. Plastic seat and cover shall be of black colour or as specified, they shall have conformity to IS2548 Part I & II.

3.2.03 FIXING : The water closet pan shall be placed in position as shown in the drawing. If the pan trap is damaged during handling or fixing, it shall be replaced by the contractor at his own cost. The pan, soil pipe shall be jointed in 1:1 Cement Mortar with hemp yarn caulked. The gap between W.C. and floor shall be finished with white/matching cement and sand as directed. Seat and cover shall be fixed to the Pan by two corrosion resistance hinge with 65 mm shank and threaded to within 25 mm from of flange. Seat shall be fixed in level by providing the washers of rubber with non ferrous or stainless steel washer to bolt.

3.2.04 THE RATE INCLUDES FOR :

3.2.04.1 European type water closet with an integral `P` or `S` trap, plastic seat cover, etc. jointing in 1:1 cement mortar with hemp yarn caulked.

3.2.04.2 Cutting hole in wall / slab / beam etc. wherever required. and making all damages good to original condition after completion of work

3.2.04.3 Testing the entire system and rectification of defect if any.

3.2.04.4 All necessary labour, material and use of tools.

3.2.05 MODE OF MEASUREMENT : The measurement shall be for each unit of W.C. fixed.

3.3 WALL HUNG/ MOUNTING WATER CLOSET :

3.3.01 GENERAL : The item pertains for providing white or colour glazed vitreous chinaware Wall Hung/ Mounting water closet with seat and cover of size and colour as specified in the schedule including fixing.

3.3.02: MATERIAL : Water closet shall be wash down pattern unless otherwise specified. The WC shall be provided with not less than two fixing holes to enable the WC to be securely installed to the wall using metallic corrosion resistant bolts and nuts and an independent concealed support frame. The support frame (metal hanger or carrier), depending on the design shall be securely attached to the building structural members so that no strain is transmitted to WC connector or any part of the plumbing system. Each wall mounted water closet shall have an integral trap and P type outlet confirming to IS 2556 (Part 16): 2002. Inside surface of water closet and trap shall be uniform and smooth in order to ensure an efficient flushing. The outlet if without serration, shall be glazed and if same is with serration, may not be glazed. For jointing rubber gasket as recommended by Manufacturer shall be provided.

Plastic seat and cover shall be of ~~black~~ white or colour or as specified, they shall have conformity to IS2548 Part I & II.

3.3.03 : FIXING : The water closet pan shall be placed in position as shown in the drawing. If the pan trap is damaged during handling or fixing, it shall be replaced by the contractor at his own cost. Each wall mounted water closet shall be provided with fixing arrangement and shall have an integral flushing rim of suitable type. It shall have an inlet for connecting the flushing pipe of dimension confirming to IS 2556. Seat shall be fixed in level by providing the washers of rubber with non ferrous or stainless steel washer to bolt.

3.3.04: THE RATE INCLUDES FOR :

3.3.04.1: Wall Hung/ Mounting water closet with an integral `P` trap, plastic seat cover, etc. jointing with gasket as recommended by Manufacturer, including metallic corrosion resistant bolts and nuts and an independent concealed support frame.

3.3.04.2: Cutting hole in wall / slab / beam etc. wherever required and making all damages good to original condition after completion of work.

3.3.04.3: Testing the entire system and rectification of defect if any.

3.3.04.4: All necessary labour, material and use of tools.

3.3.05: MODE OF MEASUREMENT : The measurement shall be for each unit of W.C. fixed.

3.4 WASH BASIN :

3.4.01 : GENERAL : The item pertains for providing colour or white glazed vitreous chinaware wash basin with or without pedestal of size and colour as specified in the schedule including fixing.

3.4.02 : MATERIAL : Wash basins shall be of vitreous china conforming to IS : 2556(Part-IV) of flat back or angle back as specified shall be of one piece construction including combined over flow, basin shall be provided with single or double tap holes of size 28 mm square or 30 mm rounded. Each basin shall have circular waste hole, or 5 sq.cm slot type over flow. Pedestals for wash basin shall be exactly same glazing that of basin. Pedestal shall be capable of supporting the basin and completely recessed at the back to accommodate supply and waste pipes and fittings. The basin shall be supported on pan of C.I cantilever brackets conforming to IS 775. Use of MS angle or Tee Section as bracket is not permitted.

3.4.03 : FIXING: The wash basin shall be fixed in position as indicated in the drawing. Basin shall be supported on a pair of C.I brackets which is embedded in cement concrete (1:2:4) block 100 x 75 x 150 mm.

Oval shape or round shape wash basins are required to be fixed in RCC platform with stone tapping either fully sunk in stone top or flush with stone topping.

The wall plaster on seat shall be cut to rest over the top edge of the basin so as not to leave any gap for water seepage through between wall plaster & skirting of basin. The gap between basin and wall shall be finished with white matching cement.

3.4.04 THE RATE INCLUDES FOR :

3.4.04.1 Wash Basin with pair of C.I bracket as required.

3.4.04.2 Cutting hole in wall / slab / beam etc. wherever required. and making all damages good to original condition after completion of work.

3.4.04.3 All necessary material, labour and use of tools.

3.4.05 MODE OF MEASUREMENT : The measurement shall be for each unit of wash basing fixed.

3.5 URINAL :

3.5.01 GENERAL : The item pertains for providing colour or white glazed vitreous chinaware urinal in single or range (1,2 & 3) and size as specified in the schedule with necessary fittings and appliances

including fixing.

3.5.02 MATERIAL :

3.5.02.1 BOWL TYPE (WITH FLUSHING RIM) : Urinal basin shall be flat back or corner wall type lipped in front. The vitreous china conforming to IS 2556 (Part VI). Urinal shall have and integral flushing rim and inlet or supply horn for connecting flush pipe. Flushing rim and inlet shall be of the self draining type. At bottom of basin and outlet horn for connecting outlet shall be provided. The inside surface of the urinal shall be uniform and smooth throughout to ensure efficient flushing.

3.5.02.2 BOWL TYPE FLAT BACK WITHOUT FLUSHING RIM : They shall be of vitreous china conforming to IS:2556 (Part-VI) constructed in one piece with providing slot or alternative fixing arrangement at flat back and where the integral flushing rim is not provided, they shall be provided with ridges in side the bowl to divert towards the front line of the urinal.

3.5.02.3 STALL URINALS : The stall urinal and its screen shall be glazed fire clay conforming IS :771 (Part-III, Sec-2). The inside surface of stall and screen shall be regular and smooth throughout to ensure efficient flushing.

3.5.02.4 CP BRASS FLUSH PIPE : The flushing arrangement to urinals shall be with CP brass spreader of 15 mm dia conforming to IS : 407. Each urinal shall be provided with flush valve.

3.5.03: FIXING :

3.5.03.1: BOAL TYPE FLAT BACK URINAL WITHOUT FLUSHING RIM (Single or Range): Urinal shall be fixed in position by using rawl plug, wooden plug, C.P screws etc. It shall be fixed at height of 65 cm from the standing level to the top of the lip of urinal or as directed by the Engineer-in-charge. Each urinal shall be connected with 32 mm size waste pipe which shall discharge into channel or a floor trap.

3.5.03.2: STALL URINALS : The lip of the stall urinal shall be flush with the finished floor level. The stall urinal shall be laid over a fine sand cushion on average 25 mm thickness. The gap between wall surface, finished floor level and urinals shall not be more than 3mm and filled with water proofing plastic compound.

3.5.03.3: CP BRASS FLUSHING ARRANGEMENT : The flushing arrangement to urinal shall be of with CP brass spreader of 15 mm confirming to IS; 407

3.3.04 THE RATE INCLUDES FOR :

3.3.04.1 Glazed Urinals and CP brass spreader of 15 mm including the cost of jointing material.

3.3.04.2 Cutting hole wherever required and making all damage good to original condition after completion of work.

3.3.04.3 Testing the entire system and rectification of defects if any.

3.3.04.4 All necessary materials, labour and use of tools.

3.5.03 MODE OF MEASUREMENT : The measurement shall be for each unit of urinal set (single or range) fixed.

3.6 URINAL SQUATTING PLATE :

3.6.01 Material : The squatting plates shall be of white vitreous china conforming to IS : 2556 (Part-I), IS : 2556 (Part-VI) with internal flushing rim with front or side inlet. Each squatting plat shall have integral longitudinal flush pipe. There shall be of 100 mm dia white glaze vitreous china channel with slope and outlet piece in front.

3.6.02 FIXING : The plate shall be fixed in position. The top edge of squatting plate shall be flush with the finished floor level adjacent to it. It shall be embedded on a layer of 25 mm thick cement mortar 1:6 laid over a bed of cement concrete 1:3:6. Gap between wall, floor etc. shall be finished with white/matching cement.

3.6.03 THE RATE INCLUDES FOR :

3.6.03.1 Urinals(single or in range) squatting plate.

3.6.03.2 Cutting hole wherever required and making all damage good to original condition after completion of work.

3.6.03.3 Testing the entire system and rectification of defects if any.

3.6.03.4 All necessary materials, labour and use of tools.

3.6.04 MODE OF MEASUREMENT : The measurement shall be for each unit of squatting plate (single or range) fixed.

3.7 MARBLE/ GRANITE PARTITION :

3.7.01 GENERAL : The item pertains for providing marble /granite (both side polished) partition of size and colour as specified in the schedule including fixing.

3.7.02 MATERIAL : The partition shall be of 20 mm thick marble / granite slab of size as specified in the schedule. it shall be polished on both sides with exposed to proper shape the exposed edges of Marble/ granite shall be made smooth corners rounded. Cracked or damaged marble slab shall not be used in the work and shall be replaced if any by the contractor at his own cost and charges +/- 3mm tolerance shall be permissible for thickness of slab.

3.7.03 FIXING : Partition shall be fixed vertically in position as indicated in the drawing at proper height. 100 mm wide chases shall be cut in the wall and the partition shall embedded at least 50 mm in the wall using 1:2:4 cement concrete. After fixing the partition slab, the chases cut in the wall shall be made good to original condition.

3.7.04 THE RATE INCLUDES FOR :

3.7.04.1 Marble /granite (both side polished) partition slab including cost of cement concrete, cement mortar etc.

3.7.04.2 All necessary labour, material and use of tools.

3.7.05 MODE OF MEASUREMENT : The measurement shall be for each unit of marble partition fixed.

3.8 DIVISION PLATE / PARTITION PLATE :

3.8.01 GENERAL : The item pertains for providing white or colour glazed vitreous chinaware division plate of size and colour as specified in the schedule including fixing.

3.8.02 MATERIAL : Division plate shall be white or colour glazed of size as specified in the schedule, and shall conform to IS .2556 PART VI.

3.8.03 FIXING : Division plate shall be fixed vertically in position at proper height with expandable anchor fasteners, CP brass screws, wooden plugs etc.

3.8.04 THE RATE INCLUDES FOR :

3.8.04.1 Glazed division plate including the cost of CP brass screws, wooden plugs, expandable anchor fasteners etc.

3.8.04.2 All necessary labour, material and use of tools.

3.8.05 MODE OF MEASUREMENT : The measurement shall be for each unit of division plate fixed.

3.9 HALF ROUND CHANNEL :

3.9.01 GENERAL : The item pertains for providing colour or white glazed vitreous chinaware half round channel of size and colour as specified in the schedule including laying and fixing.

3.9.02 MATERIAL: The half round channel shall be of white or colour glazed vitreous chinaware of size as mentioned in the schedule with or without dead end and shall conform to IS 2556 part VII.

3.9.03 FIXING : The channel shall be laid to the correct alignment to required slope. It shall be fixed on 80 mm thick bed of 1:2:4 cement concrete. The channel shall be used in standard length. Pieces are not allow except where it is necessary to make up exact length. The joint and gap shall be finished with white / matching colour cement.

3.9.04 THE RATE INCLUDES FOR :

3.9.04.1 Cement concrete, cutting the channel and wastage etc.

3.9.04.2 Supplying & fixing vitreous china half round channel

3.9.04.3 All necessary labour, material and used of tools.

3.9.05 MODE OF MEASUREMENT : The measurement shall be for unit running meter length of half round channel of specified diameter fixed.

3.10 GLAZED FLOOR TRAP WITH DOME SHAPED GRATING :

3.10.01 GENERAL : The item pertains for providing white glazed vitreous chinaware floor trap with dome shaped C.P. Brass grating of size as specified in the schedule including fixing.

3.10.02 MATERIAL : The trap shape be of white vitreous chinaware of 100 mm dia. or as specified in the schedule with hinged type dome shaped grating of chromium plated brass or stainless steel as specified.

3.10.03 FIXING : The trap shall be laid to the correct alignment and to required slope. The trap shall be fixed on 80 mm thick bed or 1:2:4 cement concrete. The caulking shall be done using 1:1 cement concrete. The caulking shall be done using 1:1 cement mortar and hemp yarn.

3.10.04 THE RATE INCLUDES FOR :

3.10.04.1 Floor trap, dome shaped grating, concrete, cement mortar etc.

3.10.04.2 Caulking with 1:1 cement mortar with hemp yarn.

3.10.04.3 All necessary labour, material and use of tools.

3.10.05 MODE OF MEASUREMENT : The measurement shall be for each unit of floor trap fixed.

3.11 TOILET PAPER ROLL HOLDER :

3.11.01 GENERAL : The item includes providing white or colour glazed vitreous chinaware toilet roll holder of size as mentioned in the schedule including fixing.

3.11.02 MATERIAL : The toilet paper roll holder shall be of CP brass or vitreous china on specified and of size and design as approved by the Engineer-in-charge. Toilet paper roll holder shall conform as per IS standard and should have ISI mark.

3.11.03 FIXING : Toilet paper roll holder shall be fixed in position by means of C.P brass covers and rawl plug embedded in the wall. Vitreous china toilet paper roll holder shall fixed into the wall with 1:2 cement mortar. The pocket shall be cut in wall for toilet paper roll holder if not left finishing the gap with white/matching cement.

3.11.04THE RATE INCLUDES FOR :

3.11.04.1 Toilet paper roll holder, cement, sand, curing etc.

3.11.04.2 Cutting the pocket if they are not left.

3.11.04.3 All necessary labour, material and use of tools.

3.11.05MODE OF MEASUREMENT : The measurement shall be for each unit of toilet paper roll holder fixed.

3.12 PVC / BRAIDED HOSE WATER INLET CONNECTION :

3.12.01 GENERAL : The item pertains to providing colour or white PVC/ braided hose water inlet connection for cistern and wash basins, pillar tap, urinal /spreader, geyser,etc.

3.12.02 MATERIAL : PVC / braided hose water inlet connection shall conform to IS specifications and shall be of standard pattern with nylon insulation of minimum 450 mm long with CP brass check nut at both the end and shall be able to withstand the testing pressure of 1 MPa (10 kg/sq.cm.). For geyser connection PVC / braided hose inlet pipe shall be capable to be used for hot water.

3.12.03 FIXING : The PVC water inlet connection shall be fixed in position as indicated in the drawing or as directed by the Engineer-in-charge for flushing cistern and wash basins.

3.12.04 THE RATE INCLUDES FOR :

3.12.04.1 Supplying and fixing of PVC / braided hose water inlet connection.

3.12.04.2 All necessary labour, material and use of tools.

3.12.05 MODE OF MEASUREMENT : The measurement shall be for each unit of water inlet connection fixed.

3.13 GLAZED FIRE-CLAY/ VITREOUS CHINA SINK:

3.13.01 GENERAL : Item includes providing white or colour glazed -fire clay sink for kitchen or vitreous china sink for lab as specified in the schedule of quantities including fixing.

3.13.02 MATERIAL : Laboratory sink shall be of vitreous china confirming to IS 2556 (PART-V) and kitchen sink shall be of glazed fire-clay conforming to IS 771 (Part-II) and shall have combined over flow of the weir type and invert shall be 30 mm below the top edge. These shall be of one piece construction and floor of sink shall gently slope towards the outlet. The outlet of sink should be suitable for waste fitting having flanges 88 mm diameter and waste hole of 65 mm diameter. the waster hole shall be either rebated or beveled having the depth of 10 mm. C.I brackets for supporting sink shall confirm to IS: 775.

3.13.03 FIXING : The sink shall be supported on C.I cantilever brackets, embedded in cement concrete 1:2:4 block of size 100 x 75 x 150 mm. Bracket shall be fixed in the position before dado work is done. The height of front edge of sink from floor level shall be 80 cm or as directed by the Engineer-in-charge. The gap between floor/wall and sink shall finish with white cement.

3.13.04THE RATE INCLUDES FOR :

3.13.04.1 Sink & C.I brackets (Pair) cement, sand etc.

3.13.04.2 All necessary labour, material and use of tools.

3.13.05MODE OF MEASUREMENT : The measurement shall be for each unit of sink fixed.

3.14 STAINLESS STEEL SINK :

3.14.01 GENERAL : Item includes providing the stainless steel sink with or without drain board of size as specified in the schedule including fixing.

3.14.02 MATERIAL The sink shall be manufactured from stainless steel of Salem or equivalent steel conforming to IS: 13983. Stainless steel sink shall be of one piece construction moulded out of 19 SWG (1mm) stainless steel sheet of grade AISI 304 (18/8) with stainless steel choke – stop strainer (waste

coupling) checknuts conforming to IS 13983.

3.14.03 FIXING : The sink shall be fixed in position as indicated in the drawing. The sink shall be placed over the brackets or on the platform. Gap between sink and platform / wall shall be finished with white / matching cement.

3.14.04 THE RATE INCLUDES FOR :

3.14.04.1 S.S. sink with waste coupling cement sand etc.

3.14.04.2 All necessary labour, material and use of tools.

3.14.05 MODE OF MEASUREMENT : The measurement shall be for each unit of s.s. sink fixed.

3.15 SINK DRAIN BOARD :

3.15.01 GENERAL : The item includes providing white or colour glazed / fire clay drain board of size mentioned in the schedule fixing.

3.15.02 MATERIAL : The drain board shall be manufactured from stainless steel of Salem or equivalent steel conforming to IS: 13983. Stainless steel sink shall be of one piece construction and its thickness not less than 1 mm.

3.15.03 FIXING : The drain board shall be fixed in the position as indicated in the drawing. It shall be place over the brackets or on the platform. Gap between board and platform / wall shall be finished with white /matching cement.

3.15.04 THE RATE INCLUDES FOR :

3.15.04.1 Drain board, cement, sand etc.

3.15.04.2 All necessary labour, material and use of tools.

3.15.05 MODE OF MEASUREMENT: The measurement shall be for each unit of drain board fixed.

3.16 SOAP DISH :

3.16.01 GENERAL : The item includes providing white or colour glazed chinaware type soap dish of size as mentioned in the schedule including fixing.

3.16.02 MATERIAL :. Soap Dish shall be of CP brass or vitreous China on specified and of size, design an approved by the Engineer-in-charge. Soap Dish shall conform to relevant IS standard and should have ISI certification mark.

3.16.03 FIXING : Soap Dish shall be fixed in position by means of C.P brass covers and rawl plug embedded in the wall. Vitreous china Soap Dish shall fixed into the wall with 1:2 cement mortar. The pocket shall be cut in wall, if not left, finishing the gap with white/matching cement.

3.16.04 THE RATE INCLUDES FOR :

3.16.04.1 Soap dish, cement, sand, curing etc.

3.16.04.2 Cutting the pocket if they are not left.

3.16.04.3 All necessary labour, material and the use of tools.

3.16.05 MODE OF MEASUREMENT : The measurement shall be for each unit of soap dish fixed.

3.17 GLASS MIRROR :

3.17.01 GENERAL : The item providing beveled or plain edges mirror with or without frame of size as mentioned in the schedule including fixing.

3.17.02 MATERIAL : The mirror shall be of superior sheet glass with edges rounded off or beveled, size 600 x 450 mm unless specified in the schedule. It shall be free from flaws, specks or bubbles and thickness plated and should not be less than 5.0 mm. The back of mirror shall be uniformly silver plated and should be free from silvering defects. Silvering shall now have a protective uniform covering of red lid paint, where beveled edge mirror are not available. Fancy looking mirrors with PVC beading/border or aluminum beading on stainless steel beading/border based on manufacturer's specification, provided nothing extra shall be paid on this account. The backing of mirror shall be provided with 6mm thick marine plywood or environmentally friendly material other than asbestos cement sheet.

3.17.03 FIXING : Mirror shall be fixed in position with 6mm thick marine ply wood backing. It shall be fixed by means of 4 nos. of CP brass screws & caps over rubber washers and rawl plug or as per the manufacturer's specification unless specified otherwise the longer side shall be fixed horizontally.

3.17.04 THE RATE INCLUDES FOR :

3.17.04.1 Glass mirror with plywood backing CP screws and CP caps etc.

3.17.04.2 All necessary labour material and the use of tools.

3.17.05 MODE OF MEASUREMENT : The measurement shall be for unit square meter or each unit to glass mirror of size as specified in the schedule.

3.18 GLASS SHELF :

3.18.01 GENERAL : The item includes providing glass shelf of size as mentioned in the schedule including fixing.

3.18.02 MATERIAL : Glass shelf shall consist of an assembly of glass shelf frame of size 600 x 125 mm or as specified in the schedule. It shall be with a pair of CP Brass brackets fixed to the wall with CP screws and CP brass rails alround with guard bar of 6 mm diameter fixed to the glass shelf frame with five numbers CP brass brackets. . The glass shall not be less than 5 mm thick. PVC stainless steel shelf or as per manufacturer`s specification and size as specified in the schedule of work shall be provided.

3.18.03 FIXING : The complete accessories shall be fixed to proper line and level as indicated in drawing with 40 mm long CP brass screws, wooden rawl plug, drilling hole and making good the wall to original condition after fixing the glass shelf.

3.18.04 THE RATE INCLUDES FOR :

3.18.04.1 Glass shelf with glass, CP bracket, guard bars, CP screws etc.

3.18.04.2 All necessary labour material and the use of tools.

3.18.05 MODE OF MEASUREMENT : The measurement shall be for each unit of glass shelf fixed.

3.19 LIQUID SOAP DISPENSER :

3.19.01 GENERAL: The item includes providing CP liquid soap dispenser of shape as mentioned in the schedule including fixing.

3.19.02 MATERIAL : Liquid Soap Dispenser shall be of C.P brass of heavy quality or of material specified in schedule and from list of approved make.

3.19.03 FIXING : The liquid soap dispenser shall be fixed to proper height and level as indicated in drawing with 40 mm long CP brass screws, wooden rawl plug, drilling hole etc. and making good the wall to original condition after fixing.

3.19.04 THE RATE INCLUDES FOR :

3.19.04.1 Liquid soap dispenser with CP brackets CP screws etc.

3.19.04.2 All necessary labour, material and the use of tools.

3.19.05 MODE OF MEASUREMENT : The measurement shall be for each unit of liquid soap dispenser fixed.

3.20 TOWEL ROD/TOWEL RING :

3.20.01 GENERAL :The item includes providing Towel rod / towel ring of size as mentioned in the schedule including fixing.

3.20.02 MATERIAL : Towel rail shall be of C.P brass with two CP brass bracket coated with chromium plating of thickness not less than grade No.2 of IS 4827. The size of rail shall be 600 mm x 20 mm dia unless otherwise specified in the schedule. Towel ring of CP brass with one CP brass bracket with thickness not less than Grade No.2 of IS 4827. The diameter of the ring shall be 175 mm unless otherwise specified in the schedule. The diameter of ring rod shall not be less than 8 mm.

3.20.03 FIXING : The towel rod/ ring shall be fixed to proper line and level as indicated in drawing with CP brass screws, wooden raw plug, drilling hole etc. and making good the wall to original condition after fixing the towel rod.

3.20.04 THE RATE INCLUDES FOR :

3.20.04.1 Towel rod rail/ring CP brackets & screws etc.

3.20.04.2 All necessary labour, material and the use tools.

3.20.05 MODE OF MEASUREMENT : The measurement shall be for each unit of towel rod fixed.

3.21 SHOWER ROSE :

3.21.01 GENERAL : The item pertains to provide chromium plated brass shower rose or of material specified in schedule of specified diameter with accessories including fixing.

3.21.02 MATERIAL : The shower rose shall be CP brass of approved and heavy quality or of material specified in schedule. It's accessories shall conform to IS 1239 Part II.

3.21.03 FIXING : Shower rose shall be fixed to be water supply pipe line with necessary G.I fittings etc. as required by the Engineer-in-charge. Jointing shall be done with the zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof at his risk & cost.

3.21.04 THE RATE INCLUDES FOR :

3.21.04.1 Shower rose, bend, socket, union/nuts, nipple etc.

3.21.04.2 All necessary labour, material and the use of tools.

3.21.05 MODE OF MEASUREMENT : The measurement shall be for each unit of shower rose fixed.

3.22 BIB TAP, STOP COCK , ANGLE STOP COCKS & PILLAR TAP :

3.22.01 GENERAL : The item pertains to provide fancy chromium plated brass bib tap and stop cock and angle stop cocks, free flanges (if joined to concealed pipe) including fixing.

3.22.02 MATERIAL : Bib cock (Bib tap) is drawn off tap with a horizontal inlet and free out let and a stop cock is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. These shall be of size 15 /20 mm size or as specified and shall be of screw down type or cartage type .The closing device shall be replaceable. The handle shall be crutch, butterfly or fancy design type securely fixed to the spindle. The tap shall open anti clock wise direction.

Taps & cocks shall be chromium plated-brass and shall conform to IS 8931.The nominal size of combination tap assembly shall be 15 mm nominal size or as specified. Casting of combination tap assembly shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to taps shall be axial, parallel and cylindrical with surfaces smoothly finished. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.

3.22.03 TESTING : Combination tap assembly shall withstand and internally applied hydraulic pressure of 1.6Mpa (16 kg/ sq.cm) for period of 1 minutes during which, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof.

3.22.04 FIXING : Bib tap stop cock shall be fixed to the pipe line with C.P. brass or pipe specials, if required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

3.22.05 THE RATE INCLUDES FOR :

3.22.05.1 Bib tap and stop cock with wall flanges, special etc.

3.22.05.2 All necessary labour, material and the use of tools.

3.22.06 MODE OF MEASUREMENT : The measurement shall be for each unit of bib tap and stop cock fixed.

3.23 COMBINATION TAP ASSEMBLY (WALL / PILLAR MOUNTED) :

3.23.01 GENERAL : The item pertains to provide chromium plated brass combination tap assembly, concealed or wall mounted hot & cold mixing for bath ,pillar mounted hot & cold mixing for sink ,basin, tub etc. including free flanges and fixing.

3.23.02 MATERIAL : The combination tap assembly shall be 15 mm nominal size or as specified in the schedule. It shall be of C.P. brass approved and heavy quality, and shall conform to I.S. 8931.

Combination tap assembly shall be chromium plated-brass and shall conform to IS 8931.The nominal size of combination tap assembly shall be 15 mm nominal size or as specified. Casting of combination tap assembly shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to pillar tap shall be axial, parallel and cylindrical with surfaces smoothly finished. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.

3.23.03 TESTING : Combination tap assembly shall withstand and internally applied hydraulic pressure of 1.6Mpa (16 kg/ sq.cm) for period of 1 minutes during which, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof.

3.23.04 FIXING : Combination tap assembly shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

3.23.05 THE RATE INCLUDES FOR :

3.23.05.1 Combination tap assembly (wall mounted / pillar mounted as specified in the schedule of work) including free flanges and fixing.

3.23.05.2 All necessary labour, material and the use of tools.

3.23.06 MODE OF MEASUREMENT : The measurement shall be for each unit of combination tap assembly fixed.

3.24 FLUSH VALVE FOR URINAL AND WC :

3.24.01 GENERAL : The items pertains to provide chromium plated brass flush valve or brass concealed type flush valve with necessary accessories including fixing. (Free flanges if joined to concealed pipes).

3.24.02 MATERIAL : The Flush valve shall be nominal diameter as specified in the schedule of quantities. It shall be of C.P. brass approved and heavy quality, and shall conform to I.S. 9758. The fresh valve shall have working pressure of 0.15 to 0.5 MPa. The valve shall be tested to a Hydraulic pressure of 2 MPa for 2 minutes.

3.24.03 FIXING : Flush value shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, sun yarn etc. A few turns of fine hemp yearn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof.

3.24.04 THE RATE INCLUDES FOR :

3.24.04.1 Flush valve, connecting pipe, socket, union, nipple, wall flanges if connected to concealed pipe.

3.24.04.2 All necessary labour, material and the use of tools.

3.24.05 MODE OF MEASUREMENT : The measurement shall be for each unit of flush valve fixed.

3.25 CHROME PLATED BRASS BATTERY BASED SENSOR OPERATED PILLAR TAP/ URINAL FLUSH VALVE:

3.25.02 GENERAL : The items pertains to provide sensor based chromium plated brass flush valve or brass concealed type flush valve with necessary battery & accessories including fixing. (Free flanges as required)

3.25.03 MATERIAL : The chrome plated brass battery based sensor operated tap/ valve shall be of chromium plated copper alloy and external and internal surface shall be clean, smooth and free from sand. The 15 mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the chrome plated brass battery based sensor operated tap/ valve are normally fitted.

Each chrome plated brass battery based sensor operated tap/ valve shall be legibly marked with the manufacture's name and trade mark. Chrome plated brass battery based sensor operated tap/ valve shall be enumerated. The tap/ valve shall be tested to the minimum test pressure of piping system. Sensor based operations shall be as specified or as per manufacturer's recommendation.

3.25.04 FIXING : Tap/ valve shall be fixed to the pipe line with necessary special as required as per manufacturer's recommendation or as directed by Engineer-in-charge. Jointing shall be done with white zinc, sun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof.

3.25.05 THE RATE INCLUDES FOR :

3.25.05.1 Tap/ valve, connecting pipe, socket, union, nipple, wall flanges if connected to concealed pipe.

3.25.05.2 All necessary labour, material and the use of tools.

3.25.06 MODE OF MEASUREMENT : The measurement shall be for each unit of tap/ valve fixed.

3.26 BATH TUB (Enamelled steel sheet) :

3.26.1 GENERAL : Item includes providing sheet steel bath tub of size and without side panel as specified in the schedule of quantities including fixing or placing.

3.26.2 MATERIAL : The bath tub shall conform to IS 3489. The bath tub shall be constructed of the fewest practicable number of sections which shall be such as to ensure a suitable finished surface for the reception of the enamel coating. Any welded surface shall be adequately cleaned off inside and outside the bath tub. The necessary surface shall be free from undulations, drawing line and other defects deleterious to the provision of a satisfactory enamel coating.

The interiors of the bath tub shall be adequately and evenly coated with vitreous enamel**.** The enamelling shall conform to IS : 772. Thickness of the enamel shall not be less than 0.2 mm and not more than 0.5 mm, External surface of the bath tub shall be given one ground or primer enamel coating. Gloss, colour & opacity shall be uniform and visually satisfactory. The finish shall be free from crazing, dimples, rundown sagging tilters not more than two in number on the interior surface, pinholes not more than two in number for coloured bath tubs and not more than four for white enamelled bath tubs, specks shall be less than one mm in size and max. five in number and there shall be no grouping of pinholes and specks. Warpage of edges set against wall or floor and edges of roll rims shall not exceed 5 mm/m.., warpage of all other edges shall not exceed 7.5 mm/m.

In forming the roll the outer edges shall be flanged or rolled back underneath sufficiently to prevent exposure of sharp edges. The vertical height of the flanged or rolled edges shall be not more than 30 mm. At the tap end of the roll, there shall be a level area within a radious of at least 25mm from the

centre of each tap hole.

3.26.3 FIXING : The bath tubs shall be as flat bottomed as practicable. The fall (slope) long the bottom head end to outlet shall be adequate for complete emptying. The waste hole shall be so formed as to be suitable for receiving 40 mm waste fitting. The bath tubs shall be provided at the tap end, with effective means of attaching an earth continuity conductor. With each bath tab, two spacing washers of suitable thickness to take up the difference between the thickness of the metal of the bath tub and the depth of the seating on pillar taps shall be supplied. In addition, two fibre or lead washers for each tap shall be supplied for fitting above and below the tap roll to prevent the enamel from erasing when the taps are tightened in position.

3.26.4 THE RATES INCLUDES FOR :

1. Enamelled sheet steel bath tub.
2. Placing/fixing the tub on C.I./MS supports.
3. Fixing the side panel if specified in schedule of quantities.
4. All necessary labour, material and use of tools.

3.26.5 MODE OF MEASUREMENT :- The measurement shall be for each unit of bath tub fixed or placed.

3.27 BATH TUB : (Gel coated G.R.P. resin)

3.27.1 GENERAL : Item includes providing gel coated glass fibre reinforced polyester resin bath tub of size and with or without panel as specified in the schedule of quantities including fixing or placing.

3.27.2 MATERIAL : The bath tub shall conform to IS 6411. The fibre glass used in the manufacture of bath tubs shall be non alkaline conforming to `E' type or `A' type Grade. The proportion of the glass fibre shall not be less than 25% of the glass fibre reinforced polyester layer including gel coated layer. Unsaturated polyester resin used in the manufacture of bath tubs shall be resistant to not water and weathering. When filler and colouring materials are used, their quality and proportion should be compatible to the polyester and the materials shall not have any harmful effect on the quality and performance of bath tubs. The bath tub shall posses a uniform gel-coat on the working surface. The resin used in the gel-coat shall be isopthalic grade of polyester or epoxy resin or any equally suitable chemical resistant grade of resin. The get-coat shall not be less than 0.25 mm thickness nor more than 1.00 mm thickness.

In forming the roll, the outer edges shall be flanged or rolled back underneath sufficiently to prevent exposure of sharp edges. The vertical height of the flanged or rolled edges shall be not more than 30 mm. At the tap end of the roll, there shall be a level area within a radious of at least 25mm from the centre of each tap hole.

3.27.3 FIXING : The bath tub shall be one piece unit with an opening for waste outlet with floor sloping towards the outlet. An overflow shall normally be provided on the side near the waste outlet. An apron (side panel) may be provided, integrally or separately with the bath tub as specified in schedule of quantities. The waste opening shall be suitable for the proper installation of waste fittings which are ordinarily used for the purpose. The bath tub shall be provided with a supporting structure integral to the unit in between the space between the bottom of the bath tub and the floor of the building on which the bath tub rests unless otherwise specified. The materials of the supporting structure shall be at least equal to the material of the bath tub in resistance to deterioration with age and shall meet the requirement of fungus and vermin.

3.27.4 THE RATES INCLUDES FOR :-

3.26.04.1 Gel-coated G.R.P.R. bath tub.

3.26.04.2 Placing/fixing the tub on supports.

3.26.04.3 Fixing the side panel if specified in schedule of quantities.

3.26.04.3 All necessary labour, material and use of tools.

3.27.5 MODE OF MEASUREMENT : The measurement shall be for each unit of bath tub fixed or placed.

3.28 WASTE COUPLING :

3.28.01 GENERAL : The item pertains to provide chromium plated brass waste coupling including fixing.

3.28.02 MATERIAL : Waste Coupling shall confirm to IS 3311.Waste fittings shall be of CP with thickness of CP coating not less than service Grade No.2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed. The waste fitting for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

3.28.03 FIXING : Waste coupling shall be fixed to wash basin, sink or urinal as ordered with necessary specials. Jointing shall be done with white zinc, yarn etc. A few turns of fine hemp yarn dipped in the linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint

shall be remade to make it leak proof.

3.28.04 THE RATE INCLUDES FOR :

3.28.04.1 Waster coupling with necessary specials.

3.28.04.2 All necessary labour, material and the use of tools.

3.28.05 MODE OF MEASUREMENT : The measurement shall be for each unit of waste coupling fixed.

3.29 BOTTLE TRAP :

3.29.01 GENERAL : The item pertains to provide chromium plated brass bottle trap including fixing.

3.29.02 MATERIAL : Bottle trap shall be of C.P with thickness of CP coating not less than service grade No. 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect of IS 2963 and shall be sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed and be truly machined so that nut smoothly moves on the body. The Bottle trap for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

3.29.03 FIXING : Bottle trap shall be fixed to wash basin, sink or urinal as indicated in the drawing with necessary specials or as ordered by the Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall remade to make it leak proof.

3.29.04 THE RATE INCLUDES FOR :

3.29.04.1 Bottle trap with necessary specials.

3.29.04.2 All necessary labour, material and the use of tools.

3.29.05 MODE OF MEASUREMENT : The measurement shall be for each unit of bottle trap fixed.

3.30 COAT AND HAT HOOK :

3.30.01 GENERAL : The item pertains to provide chromium plated brass coat and hat hook including fixing

3.30.02 MATERIAL : Coat & Hook shall be of three way type of approved and heavy quality. Coat & Hat Hook shall be CP brass and three way hook type or minimum six way patti type of 125 mm x 30 mm x 6mm size. CP coating shall not be less than service grade No.2 of IS 4827.

3.30.03 FIXING : The Coat and hat hook shall be fixed to proper line & level as indicated in drawing with CP brass screws.

3.30.04 THE RATE INCLUDES FOR :

3.30.04.1 Coat and hat hook with CP screws etc.

3.30.04.2 All necessary labour, material and the use of tools.

3.30.05 MODE OF MEASUREMENT : The measurement shall be for each unit of coat and hat book fixed.

3.31 FLUSHING CISTERN :

3.31.01 GENERAL : The item pertains to provide white or colour glazed chinaware / PVC flushing cistern with all inside syphonic fitting including fixing.

3.31.02 MATERIAL : The flushing cistern shall be automatic or manual of high level or low level as specified for water closets with dual or single flush arrangement.

Cisterns shall be of vitreous china, or Plastic as per relevant IS. Cistern shall be mosquito proof. All working parts shall be designed to operate smoothly and efficiently. The cistern shall have removable covers which shall fit closely on it and be screwed against top displacement where operating mechanism is attached to the cover. This may be made in two section, but the section supporting the mechanism shall be securely fitted or screwed to the body. The outlet fitting of the cistern shall be securely connected to the cistern. The nominal internal diameter of the cistern outlet shall not be less than 32 mm. Float valve shall be screwed type 15 mm in diameter and shall confirm of IS. The float shall be made of polyethylene as specified in IS 9762. Operation of cistern shall be through Push Button at the top for dual system and plastic handle for non-dual system.

The discharge rate of the cistern as per IS or as per water saving criteria in shedule. Flush pipe shall be of minimum 32 mm heavy duty. Over flow outlet shall be with mosquito proof jalli of 15 mm dia.

3.31.03 FIXING: The chinaware flushing cistern shall be placed over a pair of C.I. brackets. C.P. brass flush pipe shall be fixed to cistern and W.C. pan using check nut, spun yarn, cement mortar etc.

The PVC flushing cistern shall be placed or fixed as recommended by the manufacturer, PVC flush pipe of specified diameter shall be fixed to cistern and W.C. pan by using check nut, white zinc, spun yarn, cement mortar etc.

3.31.04 THE RATE INCLUDES FOR :

3.31.04.1 Supply and fixing flush tank, flush pipe and over flow pipe.

3.31.04.2 Painting all the metallic parts with two coats of flat oil paint over a coat of primer.

3.31.04.3 Cutting hole in wall / slab / beam etc. wherever required and making good the same to original condition after fixing.

3.31.04.4 Cost of jointing materials such as zinc, spun yarn, cement mortar 1:1 etc.

3.31.04.5 Testing the entire system and rectification of defects, if any.

3.31.04.6 All necessary materials, labour and use of tools.

3.31.05 MODE OF MEASUREMENT : The measurement shall be for each unit of flushing cistern fixed as a whole.

3.32 <u>BRACKET :</u>

3.32.1 GENERAL : The item pertains to provide a pair of bracket for wash basin, sink, flushing cistern etc. including fixing.

3.32.02 MATERIAL : The bracket shall be in pair of CI or as specified in schedule of required size and capable to take load of installation including all fixtures.

3.32.03 FIXING : Brackets shall be embedded into or fixed to the wall with plugs, screws, nails etc. Hole shall be made in the wall, if they are not left for fixing the brackets and shall be made good after fixing. The gap shall be filled with 1:2 cement mortar and finishing shall be done with white / matching colour cement.

3.32.04 THE RATE INCLUDES FOR :

1. Supplying and fixing the brackets.
2. Painting brackets with two coats of flat oil paint over a coat of primer.
3. Cutting hole in wall beam etc. wherever required and making good the same to original condition after fixing.
4. All necessary materials, labour and use of tools.

3.32.05 MODE OF MEASUREMENT : The measurement shall be for each pair of bracket fixed included in the items of sink, wash basin, cistern etc. as specified in schedule of quantities.

4.0 WATER SUPPLY SYSTEM

4.1 G.I. PIPING WORK (Exposed) :

4.1.01 GENERAL : The item includes provision of G.I. pipes with G.I. fitting of specified nom. bore and class as mentioned in the schedule including laying, fixing. The G.I. pipes and fittings shall run on the surface of the walls or ceilings unless otherwise specified.

4.1.02 MATERIAL : The pipes and fittings shall be of M.S. galvanised as specified in the schedule. They shall conform to IS 1239 (P-I). All the pipes and fitting shall have ISI certification mark. The specified nominal bore of the pipe shall refer to inside approximate bore according to the thickness corresponding to outside fixed diameter. The pipe and fittings shall be smooth, sound, free from any imperfections and neatly dressed. The pipe and fitting shall be able to withstand a hydrostatic test pressure of 5 MPa (50 Kg/cm2) maintained for at least 3 seconds at manufacturing works (lab test). The table showing the dimensions and different bores of pipes are given below.

WEIGHT OF GALVANISED & BLACK (BOTH) M.S. TUBES FOR ORDINARY USES IN WATER CONFORMING TO IS: 1239 (PART-1) 2004

Nominal Bore	Class	Outside Diameter		Wall thickness	Nominal Weight (Kg/M)	
		Maximum	Minimum			
		Mm	mm	in mm	Plain Ended	Screwed & Socketed
15	L	21.4	21.0	2.0	0.947	0.956
	M	21.8	21.0	2.6	1.21	1.22
	H	21.8	21.0	3.2	1.44	1.45
20	L	26.9	26.4	2.3	1.38	1.39
	M	27.3	26.5	2.6	1.56	1.57
	H	27.3	26.5	3.2	1.87	1.88
25	L	33.8	33.2	2.6	1.98	2.00
	M	34.2	33.3	3.2	2.41	2.43
	H	34.2	33.3	4.0	2.93	2.95
32	L	42.5	41.9	2.6	2.23	3.27
	M	42.9	42.0	3.2	3.10	3.13
	H	42.9	42.0	4.0	3.79	3.82
40	L	48.4	47.8	2.9	3.23	3.27
	M	48.8	47.9	3.2	3.56	3.60
	H	48.8	47.9	4.0	4.37	4.41
50	L	60.2	59.6	2.9	4.08	4.15
	M	60.8	59.7	3.6	5.03	5.10
	H	60.8	59.7	4.5	6.19	6.26
65	L	76.0	75.2	3.2	5.71	5.83
	M	76.6	75.3	3.6	6.42	6.54
	H	76.6	75.3	4.5	7.93	8.05
80	L	88.7	87.9	3.2	6.72	6.89
	M	89.5	88.0	4.0	8.36	8.53
	H	89.5	88.0	4.8	9.90	10.10
100	L	113.9	113.0	3.6	9.75	10.00
	M	115.0	113.1	4.5	12.20	12.50
	H	115.0	113.1	5.4	14.50	14.80
125	M	140.8	138.5	4.8	15.90	16.40
	H	140.8	138.5	5.4	17.90	18.40
150	M	166.5	163.9	4.8	18.90	19.50
	H	166.5	163.9	5.4	21.30	21.90

Mark	Class	Colour Code	TOLERANCES					
			THICKNESS		WEIGHT			
					For Single Tube		For 10 tones load	
			(+)	(-)	(+)	(-)	(+)	(-)
L	"Light " class	Yellow Band	Not limited	8.0%	10.0%	8.0%	7.5%	5.0%
M	"Medium'" class	Blue Band	Not limited	10.0%	10.0%	10.0%	7.5%	7.5%
H	"Heavy" class	Red Band	Not limited	10.0%	10.0%	10.0%	7.5%	7.5%
Random length of tube:- unless otherwise specified 4.0 to 7.0 m includes one socket for screwed & socketed tubes				COATING:- Zinc coating as per IS 4736 (latest revision)				

4.1.03 LAYING : The plumbing contractor shall set the layout of the plumbing approved by the Engineer-in-charge as may be required by the bye-laws. Pipes shall be laid in plumb and in straight and parallel lines. When unavoidable, pipes may be buried for short distances provided additional protection is given against damage and where so required joints are not buried. Where directed by the Engineer –in-charge, A M.S. tube sleeve shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion , contraction and other movements. In case the pipe is embedded in walls or floors the pipes shall be painted with anticorrosive bitumastic paints of approved quality. The pipe shall not come in contact with mortar or lime concrete as the pipe is affected by lime. Under the floors the pipe shall be laid in layer of sand filling as done under concrete floors.

4.1.04 FIXING : The entire pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in- charge. All pipes shall be fixed truly vertical and horizontal unless unavoidable. The pipe line shall be supported with "U" type G.I. clamps not less than 2 mm thick and G.I. nails not less than 40 mm long, wooden gutties etc keeping the pipe about 15 mm clear of the wall .

Spacing between clamps for fixing internal piping shall be as per IS 2065 – 1983 as given below :

Nom. bore of pipe	For Horizontal Runs	For Vertical Runs
15mm	2.0 M	2.5 M
20 mm to 32 mm	2.5 M	3.0 M
40 mm to 50 mm	3.0 M	3.5 M
65 mm to 80 mm	3.5 M	5.0 M

No joints shall be located inside the wall. If the pipe is required to be cut and the end threaded, the hums of the cut end shall be filed smooth and any obstruction in bore shall be entirely eliminated, down take line shall be provided with union of every floor for easy maintenance. This shall be made of line threaded pipe ends and coupler with checknut to avoid leakage. Die cast union shall not be permitted in the shaft.

4.1.05 JOINTING : While fixing the pipe line the joints shall be made by applying a few turns of hemp yarn dipped in linseed oil shall be taken over the threaded end of the pipe and socket screwed home using the pipe wrench, pipe connected shall touch each other and the socket covering each end about equally. The branch connection shall not protrude in the bore of parent pipe.

4.1.06 PAINTING : G.I. pipes and fittings running exposed shall be painted with two coats of oil paint of approved make and shade over a coat of approved primer.

4.1.07 TESTING : The pipes and fittings after they are laid and jointed shall be tested to hydraulic pressure of 1 MPa (10 Kg/sq.cm). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually, Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least 2 (two) hours. The pipes and fittings shall be tested in sections as the work of paying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found leaking shall be replaced and joints found leaking shall be redone, without extra payment.

4.1.08 THE RATE INCLUDES FOR :

4.1.08.1 Supplying GI pipes and GI fittings such as sockets, elbows, bends, tees, enlargers, reducers, checknuts, plugs, unions etc. of specified diameter & class including hemp yarn, linseed oil, clamps, screws, wooden gutties etc.

4.1.08.2 Laying, jointing and fixing the pipe with fittings including threading, cutting pipes, wastage etc.

4.1.08.3 All necessary materials, labour and use of tools

4.1.09 MODE OF MEASUREMENT : The measurement shall be for unit running metre length of pipe line of specified nom. bore laid or fixed and shall be taken along center line of the pipe line.

4.2 G.I. PIPING WORK (Concealed) :

4.2.01 GENERAL : The item includes provision of G.I. pipes with concealed type fittings of specified nom. bore and class mentioned in the schedule including laying, fixing, wrapping with hessian cloth, painting and testing.

4.2.02 MATERIAL : Please refer 4.1.02

4.2.03 CHASES : Chases of size 75 mm x 75 mm shall be cut in the wall, floor, slab wherever required or as directed by chases cutting machine. After testing the pipe line the chases shall be filled with cement mortar 1:3 and surface made good to its original condition.

4.2.04 LAYING : : The plumbing contractor shall set the layout of the plumbing approved by the Engineer-in-charge as may be required by the bye-laws. Pipes shall be laid in plumb and in straight and parallel lines. No lime plaster or composition containing lime shall be allowed to come in direct contract with the pipe, which are to be concealed as the pipe is affected by lime.

4.2.05 FIXING : The entire pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in- charge. All pipes and fittings, which are to be concealed, shall be properly embedded in the wall, flooring etc. after being treated. No moulding or plaster design or any ornamental plaster work shall be done over the walls or flooring or ceiling where concealed pipes have been laid.

If the pipe is required to be cut and the end threaded, the burns of the cut end shall be filed smooth and any obstruction in bore shall be entirely eliminated.

4.2.06 JOINTING : Please refer 4.1.05

4.2.07 PAINTING : All the concealed piping work shall be thoroughly painted with two coats of anti-corrosive black bitumastic paint of approved quality shade over a coat of approved primer before concealing and filling the mortar.

4.2.08 INSULATION : The hot water pipe line concealed on the wall, floor etc. after painting shall be insulated with 2.5 mm thick 95% asbestos magnesia compound of approved make all round the pipe and fittings.

4.2.09 WRAPPING : After painting the cold water pipe line, it shall be wrapped with two layers of hessian cloth of approved quality.

4.2.10 TESTING : Please refer No.4.1.07

4.2.11. THE RATE INCLUDES FOR :

1. Supplying GI pipes and concealed type G.I. fittings such as sockets, elbows, bends, tees, enlargers, reducers, checknuts, plugs, unions etc. of specified diameter and class including hemp yarn, linseed oil etc.
2. Laying, jointing and fixing the pipe with fittings including threading, cutting pipes, wastage, etc.
3. Wrapping the cold water pipe line with hessian cloth including painting and testing.
4. Wrapping the hot water pipe line with asbestos cloth
5. Cutting 75 mm x 75 mm size chases in the wall, floor, slab, etc. and making good the same using 1:3 cement mortar after the pipeline is laid.
6. All necessary materials, labour and use of tools.

4.2.12 MODE OF MEASUREMENT : The measurement shall be for unit running metre length of pipe line of specified nom. bore laid or fixed and shall be measured along the center line of the pipe line.

4.3 UNDER GROUND G.I. PIPING WORK :

4.3.01 GENERAL : The item includes supplying G.I. pipes and fittings of specified nom. bore and class as mentioned in the schedule including laying, jointing and painting.

4.3.02 MATERIAL : Please refer 4.1.02

4.3.03 TRENCHES : The galvanised iron pipes and fittings are to be laid in trenches. The widths and depths of the trenches for different diameter of the pipes shall be as given below :

Diameter of pipe (mm)	Min. Width of trench (mm)	Min. Depth of trench (mm)
15 to 50	300	600
65 to 100	450	750

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand of min. 7.5 cm.

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earth work in trenches as per 2.0.

4.3.04 LAYING : Where a pipe is to be laid under ground, the particular length of pipe should be protected by first painting before laying and then wrapping around the pipe a layer of jute or hessian cloth in the form of bandage, so that this cloth in the form of bandage, stick to the composition which has been freshly applied.

The pipe shall be laid into the trench and screwed with sockets, elbows, tees, bends etc. as necessary. The pipe line laid near electric train lines, power transmission lines, electric railway, power houses etc. should be provided with insulating joints at frequent intervals to guard against electrolysis.

Pipes shall be so laid as not to expose to sun or be subjected to any injury or risk to the pipe. As far as possible pipes shall be laid in straight and parallel lines. They shall be used in standard length pipe pieces being used only where necessary to make up the exact length.

4.3.05 JOINTING : Please refer 4.1.05

4.3.06 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

4.3.07 TESTING : Please refer 4.1.05

4.3.08 PAINTING : G.I. pipes and fittings shall be painted with two coat of anticorrosive paint before pipe line is laid and wrapping the pipe and fitting with jute or hessian cloth in the form of bandage.

4.3.09 THE RATE INCLUDES FOR :

4.3.09.1 Supplying G.I. pipes and fittings such as sockets, elbows, bends, tees, enlarges, plugs, reducers, checknuts, unions etc. of specified diameter including hemp yarn, linseed oil etc.

4.3.09.2 Laying, jointing and fixing the pipe with fittings including threading, cutting pipes, wastage etc.

4.3.09.3 Covering with hessian cloth, painting and testing the pipe line.

4.3.09.4 Dewatering the trench or pit till completion of work.

4.3.09.5 All necessary labour, material and use of tools.

4.3.10 MODE OF MEASUREMENT : The measurement shall be for unit running metre length of pipe line of specified nom. bore laid or fixed and shall be measured along the center line of the pipe line.

4.4 HIGH DENSITY POLYETHYLENE (HDPE) PIPES:

4.4.01: GENERAL: The item includes supplying of High Density Polyethylene Ultra Violet Stabilized pipes with fittings of specified diameter including laying, fixing, cutting and jointing.

4.4.02: MATERIAL: The pipes and fittings shall confirm to series IV of IS 4984 (for water supply) (Latest Revision) or IS 14333 (for sewerage) (Latest Revision). The material used for the manufacture of pipes should not constitute toxic hazard, should not support microbial growth and should not give rise to unpleasant taste or odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material.

For pipe length more than 1 km, contractor should compulsorily provide test certificate for Melt Flow Rating (MFR), density, % of anti-oxidant & addition of Reworked material.

Pipe shall be classified according to the grade of material as PE 63, PE 80 & PE 100 as per IS 4984.

Pipe shall be classified by Pressure Rating (PN) corresponding to the maximum permissible working pressure at 30°C, as follows:

Pressure Rating of Pipe	Maximum Permissible working Pressure
PN 2.5	0.25 Mpa
PN 4	0.40 Mpa
PN 6	0.60 Mpa
PN 10	1.00 Mpa
PN 12.5	1.25 Mpa
PN 16	1.60 Mpa

In order to take care of the possible deteriorating effect of direct sunlight or plastic pipes, certain additives, one of which is carbon black or stabilizers are generally incorporated in their manufacture: however it is advisible to take further precautions by burying such pipes or by laying them in ducts wherever possible or otherwise to prevent direct exposure to sunlight.

4.4.03: STORAGE AND HANDLING:-

4.4.03.1: Storage: Black polythene pipe may be stored either under cover or in the open. It is suitably protected from ageing due to sunlight by the addition of the appropriate quantity and type of carbon black.

Coils may be stored either on edge or stacked flat one on top of the other, but in either case should not be allowed to come into contact with hot water or steam pipes and should be kept away from hot surface.

Straight length should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.

Storage of pipes in hot areas should be avoided. While storing the pipes at temperature above 45°C continuous support may be given by levelled san layer or other suitable methods.

4.4.03.2: Handling: Polythene is a tough resilient material which may be handled easily. However, because it is softer than metals it is more prone to damage by abrasion and by objects with a cutting edge. Such practices as dragging coils over rough ground should therefore be avoided.

If, due to unsatisfactory storage or handling, a pipe is damaged or 'kinked', the damaged portion should be cut out completely.

The material is not affected by low temperatures as much as are some other plastics materials, and there is no need for more cautious handling during cold weather.

4.4.04: INSTALLATION : While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. While laying in rocky areas suitable bed of sand or pebbles should be provided. The initial back fill to about 10 to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, bed concrete M-100, 15 cm thick may be provided, before putting in the soft sand/gravel.

Provisions shall be made for the effects of thermal movements between the anchors/supports.

HDPE pipes in general need not be painted. Painting may disguise its character. Even if it is to be painted then water based distemper shall be used. Hazard might occur by mistaking this pipe for metal one in using it for load bearing support, or for electrical grounding.

HDPE pipes shall not be installed near hot water pipes or near any other heat sources.

Pipe clamps may be used to support the pipe. Standard pipe clips may also be used but care shall be taken not to over tighten and cause the clips to bite into the pipe. Pipe clips should be correctly aligned and should provide a smooth flat surface for contact with pipe, if required rubber inserts shall be used. Sharp edged supports should be avoided. All types of manual controls, and valves in particular should be anchored firmly so as to minimize the turning moment imparted to the pipe by operation of the hand wheel. Typical Support arrangement for valve chamber shall be as per IS: 7634 Part 2 or similar approved.

4.4.05: EFFECT OF TEMPERATURE

4.4.05.1: Expansion and Contraction — The coefficient of expansion is about twenty times (for low density polyethylene pipes) and fourteen times (for high density polyethylene pipes) than that for expansion experienced with metal pipes. This also holds good for contraction due to fall in temperature.

4.4.05.2: In many instances the normal changes in the direction of the pipe provide an adequate means of accommodating expansion.

4.4.05.3: In continuous straight runs of pipe it is necessary except where pipes are laid underground to insert units to absorb the expansion. Expansion loops, bellows or sliding gland expansion joints may be used.

4.4.05.4: Care should be taken to account for the high increase in surface temperatures of these pipes in cases of exposed laying or laying in the close proximity of artificial heat sources.

4.4.06: FIXING: The entire pipe line shall be fixed in position or as directed by the Engineer-in-charge. All pipes shall be fixed truly vertical and horizontal unless unavoidable.

Spacing between clamps for fixing internal/external/exposed piping shall be as per pipe manufactures recommendations.

4.4.07: JOINTING TECHNIQUES: - The commonly used joints are as follows:

a) Insert type joints
b) Compression fittings
c) Fusion welding
d) Threaded joints
e) Flanged joints and
f) Telescopic joints.

Of the above the following important techniques are elaborated: -

4.4.07.1: Compression Fittings: They are detachable joints and are made of metals or plastics. In this type of

joint the dimensions of the pipe are generally not altered. The joint is effected by an internal liner and a compression ring or sleeve which shrinks and therefore compresses the pipe wall on to the liner, thus gripping to the wall of the pipe.

Compression Joints with Collar/Pipe ends and Flat Gaskets: Aluminium alloy or brass fittings with male and female coupling parts are available for jointing with metallic fittings. The male and female ends of the coupling are inserted face to face on two ends of the pipes to be jointed. Collars are made on the pipe ends by heating the ends with hot plate or electric coil. The two collars are brought together and the female end of the coupling is tightened on the male end. A water tight seal is made between the flanges. This is a detachable type of jointing and is practicable up to 50mm dia pipes.

4.4.07.2: Fusion Welding: *Procedure of Butt Welding of HDPE Pipes*: It is a permanent type of joint. The pipe should be cut square and the face of the pipe should be slightly scraped prior to welding to remove oxidized layer. At the time of welding, levelling of the pipes is essential particularly in case of larger diameter pipes. Welding temperature should be 200°C and surfaces of heating mirror should be 210° ± 5°C [heating mirror is a metallic plate heated up to the required temperature either by electrical coil embedded inside or by blow torch. The word mirror has come because this heating plate radiates heat (see Fig. 5 of IS 7634 (Part-II-1975)]. The pipes to be welded should be held on either side of the heating mirror with only contact pressure of about 20 kPa (0.2 kgf/cm2). When the rim of molten material is found, the pipes are removed from the heating mirror and immediately the joint is made by application of moderate pressure of approximately 1 to 2 kg/cm2 for 2 to 3 seconds. The initial heating time for achieving molten rim, varies from 1 to 5 min depending upon the pipe wall thickness and size.

Cautions:

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

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

c) The mirror should be kept exactly around 210°C which needs about 30 min time (for electrical mirror). It is also essential to see that the temperature is maintained constant by the proper setting of regulator. For detecting the correct temperature, crayon chalk is used. For example at 210°C the colour of crayon dot on the mirror changes within 2 seconds. But the dot made should be thin and if not, time taken will be more, indicating a wrong temperature.

Strength — A satisfactory butt welded joint of HDPE will have the strength factor of one. Temperature is of primary importance and weld efficiency may decrease if the temperature does not fall within the range of 200 ± 10°C.

4.4.07.3: Flanged Joints: These are used for jointing LDPE and HDPE pipes particularly of larger size to valves and vessels and large size metal pipes where strength in tension is required.

It consists of flanges either loose or welded to the pipe ends. It is recommended that suitable metallic backing plates be used to support the polyethylene flanges to enable them to be bolted together. Injection moulded polyethylene flanges with metal inserts of 6 to 9 mm thickness may also be used. In most cases, sealing is improved by incorporating a natural or synthetic rubber gasket between polyethylene flanges (see Fig. 6 of IS 7634 (Part-II).

4.4.08: DIMENSIONS OF PIPES:

4.4.08.1*:* **Outside Diameter**: The outside diameters of pipes, tolerance on the same and ovality of pipe shall be as given in Table 2 (see A-2) of IS 4984 as produced below:

OUTSIDE DIAMETRE, TOLERANCE AND OVALITY OF PIPES

Nominal Diameter (DN)	Outside Diameter (mm)	Tolerance (mm) (only positive tolerance)	Ovality (mm)
(1)	(2)	(3)	(4)
16	16	0.3	1.2
20	20	0.3	1.2
25	25	0.3	1.2
32	32	0.3	1.3
40	40	0.4	1.4
50	50	0.5	1.4
63	63	0.6	1.5
75	75	0.7	1.6
90	90	0.9	1.8
110	110	1.0	2.2
125	125	1.2	2.5
140	140	1.3	2.8
160	160	1.5	3.2
180	180	1.7	3.6

Nominal Diameter (DN)	Outside Diameter (mm)	Tolerance (mm) (only positive tolerance)	Ovality (mm)
200	200	1.8	4.0
225	225	2.1	4.5
250	250	2.3	5.0
280	280	2.6	9.8
315	315	2.9	11.1
355	355	3.2	12.5
400	400	3.6	14.0
450	450	4.1	15.6
500	500	4.5	17.5
560	560	5.0	19.6
630	630	5.7	22.1
710	710	6.4	24.9
800	800	7.2	28.0
900	900	8.1	31.5
1000	1000	9.0	35.0

4.4.08.2: Wall Thickness : The minimum and maximum wall thickness of pipes for the three grades of materials, namely, PE 63, PE 80 and PE 100 shall be as given in Tables 3,4 and 5 respectively (see A-3) of IS 4984.

4.4.09: METHOD OF MEASUREMENT: - The outside diameter of shall be taken as the average of two measurements taken at right angles for pipes upto 110 mm diameter. Alternatively and for higher sizes, the diameter shall be measured preferably by using a flexible Pi tape or a circometer, having an accuracy of not less than 0.1 mm. The wall thickness shall be measured by a dial vernier or ball ended micrometer. The resulting dimension shall be expressed to nearest 0.1 mm.

NOTES: - 1) The outside diameter shall be measured at a distance of at least 300 mm from the end of the pipe.

2) In the case of dispute, the dimension of pipes shall be measured after conditioning at room temperature for 4 hours.

4.4.08.1: LENGTH OF STRAIGHT PIPE: - The length of straight pipe shall be 5m to 20m, as agreed between the manufacturer and the purchaser. Short lengths of 3 m (min) up to a maximum of 10% of the total supply may be permitted.

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

4.4.09: VISUAL APPEARANCE: - The internal and external surfaces of the pipes shall be smooth, clean and free from grooving and other defects. The ends shall be cleanly cut and shall be square with axis of the pipes. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible provided that the wall thickness remains within the permissible limits.

4.4.10: SAMPLING, FREQUENCY OF TESTS AND CRITERIA FOR CONFORMITY:

4.4.10.1: **TYPE TESTS**: -Type tests are intended to prove the suitability and performance of a new composition, a new technique or a new size of a pipe. Such tests, therefore, need to be applied only when a change is made in polymer composition or method of manufacture, or when a new size of pipe is to be introduced. The contractor needs to get the certificates for type test from the manufacturers as & when required in lines with IS 4984.

PERFORMANCE REQUIREMENTS: - Certificate for following needs to be produced by the purchaser & details as per IS 4984 (latest Revision):-

a) Hydraulic Characteristics

b) Reversion Test

c) Overall Migration Test

d) Density

e) Melt Flow Ratio (MFR)

f) Carbon black Content & dispersion

4.4.10.2: **ACCEPTANCE TESTS**:- Acceptances tests are carried out on samples selected from a lot for the purpose of acceptance of the lot. The following to be considered for acceptance tests as per IS 4984:

(i) Lot

(ii) Dimensional and Visual Requirements: The number of test samples shall be in accordance with Table 7 of IS 4984 (Latest Revision) as below.

Scale of sampling for visual and dimensional requirements for Water supply & Sewerage.

No. of pipes in the Lot	Sample No.	Sample Size	Cumulative Sample size	Acceptance No.	Rejection No.
(1)	(2)	(3)	(4)	(5)	(6)
Up to 150	First	13	13	0	2
	Second	13	26	1	2
151 to 280	First	20	20	0	3
	Second	20	40	3	4
281 to 500	First	32	32	1	4
	Second	32	64	4	5
501 to 1200	First	50	50	2	5
	Second	50	100	6	7
1201 to 3200	First	80	80	3	7
	Second	80	160	8	9
3201 to 10000	First	125	125	5	9
	Second	125	250	12	13
10001 to 35000	First	200	200	7	11
	Second	200	400	18	19

(iii) Hydraulic Characteristics, Reversion Test, Overall Migration Test, Density,
Melt Flow Ratio (MFR) and Carbon black Content /Dispersion tests.

A separate sample size for each of the test shall be taken as stipulated in Table 8 of IS: 4984 (latest Revision) as given below:

Scale of sampling for Tests for Hydraulic Characteristics, Reversion Test, Overall Migration Test, Density, Melt Flow Ratio (MFR) and Carbon black Content /Dispersion tests.

No. of pipes	Sample Size
Up to 150	3
151 to 1200	5
1201 to 35000	8

4.4.11: TESTING OF INSTALLATIONS: All pipe work, fittings and appliances shall be inspected and tested hydraulically after the completion of installation. Before starting 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 pipe line together with appliances, valves and fittings are laid in the prescribed manner.

All control valves shall be positioned 'open' for the duration of the test and open ends temporarily closed with water-tight fittings. The testing pressure should not be less than one and a half times the rated pressure of the pipe under use.

Pressure should be applied either by hand pump or power driven pump. Pressure gauges should be correctly positioned and closely observed to ensure that at no time are the test pressures exceeded. The system should be slowly and carefully filled with water, to avoid surge pressure of water hammer. Air vents should be open at all high points so that air may be expelled from the system during filling.

When the system has been fully charged with water and air displaced from the line, air vents should be closed and the line initially inspected for seepage at joints and the firmness of support under load. Pressure then may be applied until the required test pressure is reached. Thermoplastic pipes expand under pressure to a greater extent than pipes of asbestos cement or cast iron. This expansion is due to low modulus of elasticity of the material and results in initial fall of pressure even though there is no leakage for all the four pressure classifications of pipes. The amount of water required to build up a steady test pressure for the plastics pipes is given in Table 2 of IS 7634 Part 1 as produced below. The values are approximate. The time taken to build up approximately steady pressure is 12 hours. Without any additional requirement of make up water, the test pressure should not fall more than 0.2 kg/cm2 at the end of one hour test duration. This extra quantity of water required is normally termed as make up water.

Nominal Size mm	Litre / 100 m Line
25	1.1
32	1.6
40	2.6
50	4.0
65	5.9
80	8.5
100	16.4
125	26.9

After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to pressure test at working pressure as mentioned in IS 4984/ as indicated in the schedule of item.

4.4.12: MARKING:- Each straight length of pipe shall be clearly marked in indelible ink/paint on either end and for coil at both ends or hot embossed on white base every metre throughout the length of pipe/coil with the following information:

a) Manufacture's name/Trade mark
b) Designation of pipe and
c) Lot number/ batch number.

4.4.13: THE RATE INCLUDES FOR:

4.4.13.1. Supplying of HDPE pipes and fittings of specified diameter.

4.4.13.2. Laying and cutting the pipe wherever necessary and wastage.

4.4.13.3 Making required & specified joints.

4.4.13.4 Fixing the pipeline on exposed surface with clamps and nails, screws not less than 40 mm including providing clamps and required hardware and equipments.

4.4.13.5 Incase of underground pipes, dewatering the pit or trench till completion of work.

4.4.13.6 All necessary labour, material and tools & equipments.

4.4.14: MODE OF MEASUREMENT: The measurement shall be for unit running meter length of pipe line laid or fixed. The measurement shall be taken along the centre line of pipe. No measurement shall be recorded separately for fitting, making joint, painting if mentioned in schedule of quantities and testing.

4.5 : <u>UNPLASTICIZED POLYVINYL CHLORIDE (uPVC) PRESSURE PIPES:</u>

4.5.01. GENERAL: The item includes supplying of Unplasticized Polyvinyl Chloride (uPVC) pipes with fittings of specified diameter including laying, fixing, cutting and jointing, painting etc for vent, overflow, waste water pipeline, etc.

4.5.02. MATERIAL: The pipes and fittings shall confirm to series IV of IS 4985-1978. PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand pressure as mentioned in the schedule of quantities.

The material from which the pipe is produced shall consist substantially of un plasticized polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of the pipe and the production of sound and durable pipe of good surface finish, mechanical strength and opacity under conditions of use.

The pipes shall be classified by pressure ratings (working pressures) at 27°C as follows:

Class of Pipe	Working pressure *(PN)*
Class 1	0.25 MPa (2.5 kg/cm2)
Class 2	0.4 MPa (4.0 kg/cm2)
Class 3	0.6 MPa (6.0 kg/cm2)
Class 4	0.8 MPa (8.0 kg/cm2)
Class 5	1.0 MPa (10.0 kg/cm2)
Class 6	1.25 MPa (12.5 kg/cm2)

4.5.03 COMPOSITION: Composition for the pipe shall be as per relevant IS code.

4.5.04 DIMENSIONS OF PIPE

Diameters

The mean outside diameter, outside diameter at any point and their tolerances shall be as given in Table 1. This shall be measured according to the method given in IS 12235 (Part 1).

Mean outside diameters

The permissible variation (dem - dn) between the mean outside diameter *(dem'*) and the nominal outside diameter *(dn)* of a pipe shall be positive in the form +x, where x is less than or equal to the greater of the following two values:

a) 0.3 mm, and

b) 0.003 *dn* rounded off to the next higher 0.1mm.

Diameter at any point

The permissible variation between the outside diameter at any point *(de)* and the nominal diameter *(da)* of a pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

a) 0.5 mm, and

b) 0.012 *dn* rounded off to the next higher 0.1mm.

Wall Thickness

The wall thickness of plain pipe and the plain portion of socket ended pipe shall be as given in Table 1.

To check the conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non-destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

Tolerance on wall thickness

a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness *(emin.)* and the wall thickness at any point *(e), (e* - emin) shall be positive in the form of +y, where y = 0.1 emin + 0.2mm.

b) For pipes of minimum wall thickness greater than 6 mm, the permissible variation of wall thickness shall again be positive in the form of +y, where y would be applied in two parts.

c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute maximum and the absolute minimum values. The tolerance applied to this average wall thickness from these measurements shall be within the range 0.1*e*min. + 0.2 mm (*see* Table 1 of IS 4985: 2000).

d) The maximum wall thickness at any point shall be within the range 0.15 e - *(see* Table 1of IS 4985: 2000).

e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

The mean outside diameter, outside diameter at any point, and wall thickness of plumbing pipes shall be as given in Table 2 of IS 4985: 2000.

Length

Effective length (Le) — If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 4, 5, or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

a) *Plain ended pipe* — For plain ended pipes, the overall length measured shall be the effective length as shown in Fig. 2(a).

b) *Socketed pipe for elastomeric sealing ring jointing*— The effective length of such pipes shall be determined by subtracting from the overall length the insertion length as shown in Fig. 2(b).

c) *Socketed pipe for solvent cement jointing* — The effective length of such pipes shall be determined by subtracting from the overall length the socket length as shown in Fig. 2(c).

4.5.05 Dimensions of Sockets

Sockets formed on the ends of the pipes shall be reasonably parallel to the axis of the pipe.

Sockets for solvent cement jointing — These shall conform to dimensions given in Table 3 and Fig. 3.

The minimum length of any socket shall be given by the expression *Ls* = 0.5 *dn* + 6 mm, where

L = minimum socket length, and

dn = nominal outside diameter of the pipe.

Table 1 Dimensions of Unplasticised PVC Pipes

(*Clauses* 7.1.1 *and* 7.1.2)

All dimensions in millimetres.

Nominal Outside Diameter (Nominal Size)	Mean Outside Diameter		Outside Diameter At Any Point		Working Pressure, MPa															
					Class 1 0.25			Class 2 0.40			Class 3 0.60			Class 4 0.80			Class 5 1.00			Class 6 1.25		
	Min	*Max*	*Min*	*Max*	*Avg Max*	*Min*	*Max*	*Avg Max*	*Min*	*Max*	*Avg Max*	*Min*	*Max*	*Avg Max*	*Min*	*Max*	*Avg Max*	*Min*	*Max*	*Avg Max*	*Min*	*Max*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
20	20.0	20.3	19.5	20.5													1.5	1.1	1.5	1.8	1.4	1.8
25	25.0	25.0	24.5	25.5										1.6	1.2	1.6	1.8	1.4	1.8	2.1	1.7	2.1
32	32.0	32.3	31.5	32.5										1.9	1.5	1.9	2.2	1.8	2.2	2.7	2.2	2.7
40	40.0	40.3	39.5	40.5							1.8	1.4	1.8	2.2	1.8	2.2	2.7	2.2	2.7	3.3	2.8	3.3
50	50.0	50.3	49.4	50.6							2.1	1.7	2.1	2.8	2.3	2.8	3.3	2.8	3.3	4.0	3.4	4.0
63	63.0	63.3	62.2	63.8				1.9	1.5	1.9	3.7	2.2	2.7	3.3	2.8	3.3	4.1	3.5	4.1	5.0	4.3	5.0
75	75.0	75.3	74.1	75.9				2.2	1.8	2.2	3.1	2.6	3.1	4.0	3.4	4.0	4.9	4.2	4.9	5.9	5.1	5.9
90	90.0	90.3	88.9	91.1	1.7	1.3	1.7	2.6	2.1	2.6	3.7	3.1	3.7	4.6	4.0	4.6	5.7	5.0	5.7	7.0	6.1	7.1
110	110.0	110.4	108.6	111.4	2.0	1.6	2.0	3.0	2.5	3.0	4.3	3.7	4.3	5.6	4.9	5.6	7.0	6.1	7.1	8.5	7.5	8.7
125	125.0	125.4	123.5	126.5	2.2	1.8	2.2	3.4	2.9	3.4	5.0	4.3	5.0	6.4	5.6	6.4	7.8	6.9	8.0	9.6	8.5	9.8
140	140.0	140.5	138.3	141.7	2.4	2.0	2.4	3.8	3.2	3.8	5.5	4.8	5.5	7.2	6.3	7.3	8.7	7.7	8.9	10.7	9.5	11.0
160	160.0	160.5	158.0	162.0	2.8	2.3	2.8	4.3	3.7	4.3	6.3	5.4	6.2	8.2	7.2	8.3	9.9	8.8	10.2	12.2	10.9	12.6
180	180.0	180.6	177.8	182.2	3.1	2.6	3.1	4.9	4.2	4.9	7.0	6.1	7.1	9.0	8.0	9.2	11.1	9.9	11.4	13.7	12.2	14.1
200	200.0	200.6	197.6	202.4	3.4	2.9	3.4	5.3	4.6	5.3	7.7	6.8	7.9	10.0	8.9	10.3	12.3	11.0	12.7	15.2	13.6	15.7
225	225.0	225.7	222.3	227.7	3.9	3.3	3.9	6.0	5.2	6.0	8.6	7.6	8.8	11.2	10.0	11.5	13.9	12.4	14.3	17.1	15.3	17.6
250	250.0	250.8	247.0	253.0	4.2	3.6	4.2	6.5	5.7	6.5	9.6	8.5	9.8	12.4	11.2	12.9	15.4	13.8	15.9	18.9	17.0	19.6
280	280.0	280.9	276.6	283.4	4.8	4.1	4.8	7.3	6.4	7.4	10.7	9.5	11.0	14.0	12.5	14.4	17.2	15.4	17.8	21.1	19.0	21.9
315	315.0	316.0	311.2	318.8	5.3	4.6	5.3	8.2	7.2	8.3	12.0	10.7	12.4	15.6	14.0	16.1	19.3	17.3	19.9	23.8	21.4	24.7
355	355.0	356.1	350.7	359.3	5.9	5.1	5.9	9.2	8.1	9.4	13.4	12.0	13.8	17.6	15.8	18.2	21.8	19.6	22.6	26.8	24.1	27.8
400	400.0	401.2	395.2	404.8	6.6	5.8	6.7	10.3	9.1	10.5	15.1	13.5	15.6	19.8	17.8	20.5	24.4	22.0	25.3	30.2	27.2	31.3
450	450.0	451.4	444.6	455.4	7.4	6.5	7.5	11.6	10.3	11.9	17.0	15.2	17.5	22.2	20.0	23.0	27.5	24.8	28.6	33.8	30.5	35.1
500	500.0	501.5	494.0	506.0	8.2	7.2	8.3	12.8	11.4	13.2	18.8	16.9	19.5	24.8	22.3	25.7	30.5	27.5	31.7	37.5	33.9	39.0
560	560.0	561.7	553.2	566.8	9.2	8.1	9.4	14.3	12.8	14.8	21.0	18.9	21.8	27.6	24.9	28.7	34.1	30.8	35.5	42.0	38.0	43.7
630	630.0	631.9	622.4	637.6	10.3	9.1	10.5	16.1	14.4	16.6	23.7	21.3	24.5	31.0	28.0	32.2	38.4	34.7	40.0	47.2	42.7	49.2

NOTES

1 The table is based on metric series of pipe dimensions given in ISO 161/1 in respect of pipe dimensions and ISO DIS 4422.

2 The wall thickness of pipes is based on a safe working stress of 8.6 MPa at 27°C and the working pressure gets reduced at sustained higher temperatures. Occasional rise in temperature as in summer season with concurrent corresponding reduction in termperature during nights has no deleterious effect on the life working pressure of the pipes considering the total life of pipes.

For class 1, 2 and 3 of all sizes, this requirement need not to be satisfied as the ratio of minimum wall thickness to nominal outside diameter does not exceed 0.035 in these cases.

Table 3 Dimensions of Sockets for Solvent Cement Jointing
***(Clause 7.2.1.1 and** Fig.* **3)**

Nominal Size *DN*	Socket Length L_s	Mean Socket internal Diameter at Mid-Point of Socket Length, d_{im}	
	Min	*Min*	*Max*
(1)	(2)	(3)	(4)
20	16.0	20.1	20.3
25	19.0	25.1	25.3
32	22.0	32.1	32.3
40	26.0	40.1	40.3
50	31.0	50.1	50.3
63	37.5	63.1	63.3
75	43.5	75.1	75.3
90	51.0	90.1	90.3
110	61.0	110.1	110.4
125	68.5	125.1	125.4
140	76.0	140.2	140.5
160	86.0	160.2	160.5
180	96.0	180.2	180.5
200	106.0	200.3	200.6
225	118.5	225.3	225.7
250	131.0	250.4	250.8
280	146.0	280.4	280.9
315	163.5	315.4	316.0
355	183.5	355.4	356.0
400	206.0	400.4	401.0
450	231.0	450.4	451.0
500	256.0	500.4	501.0
560	286.0	560.4	561.0
630	321.0	630.4	631.0

NOTE — For nominal sizes 20 mm to 225 mm, the dimensions are based on IS 727-1985 (E).

All dimensions in millimetres.

NOTES

1. The mean inside diameter of the socket is defined as die arithmetical mean of two diameters measured at 90 degrees to each other at the mid-point of the socket length. The diameter of the socket may be decreased from the mouth to the root; for all pipe sizes, the total included angle of taper shall not exceed 0° 30[1].

2. Only the manufacturer of the pipe is equipped to measure the socket inside diameter. Since the socket length is minimum (No tolerance is given to this dimension), it is not practical, other than for the manufacturer, to establish the exact position of the midpoint of the socket. He can therefore tool up to measure his own pipe but such equipment will not necessarily give the correct figures for a pipe of other manufacturer.

4.5.05.1 Sockets for elastomeric sealing ring joints: shall be as per IS 4985: 2000 (latest to be referred)

4.5.05.2. SEALING RINGS

These shall be in accordance with one of the types (Type 1 to Type-6) as per IS 5382. The manufacturer has to however specify the type of sealing ring (namely 1,2,3,4, 5 or 6) that is being offered. The design of the profile of the sealing ring is left to the manufacturer as long as the pipe with sealing ring meets the requirements of the specification.

NOTE—A test report or conformity certificate may be obtained from the manufacturer of the sealing ring for conformity to IS 5382. The frequency of this test report or conformity certificate shall be once in three months.

4.5.06. PIPE ENDS

The ends of the pipes meant for solvent cementing (both plain and bell ended) shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

Pipes with plain end(s) to be used for elastomeric sealing ring type joints shall be chamfered at approximately 15 degrees to the axis of the pipe.

Approximately two thirds of the full wall thickness shall be chamfered as shown in Fig. 6.

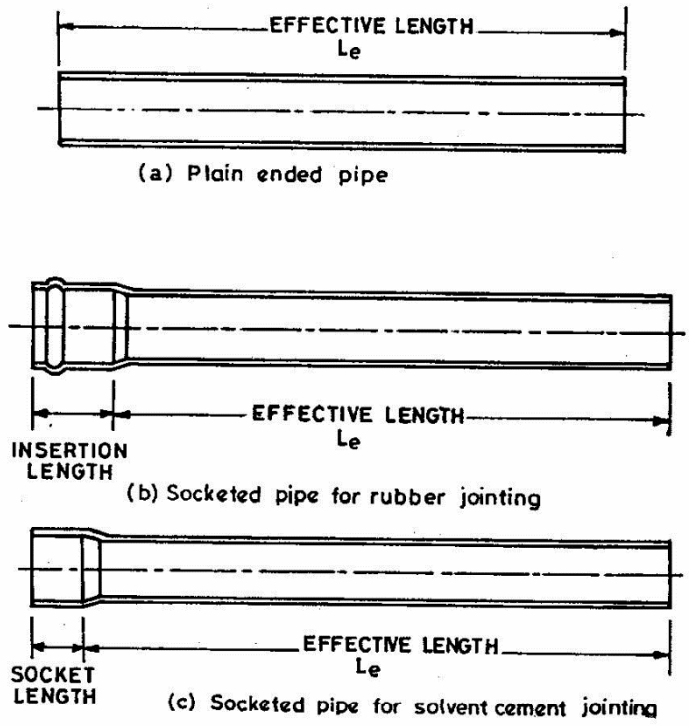
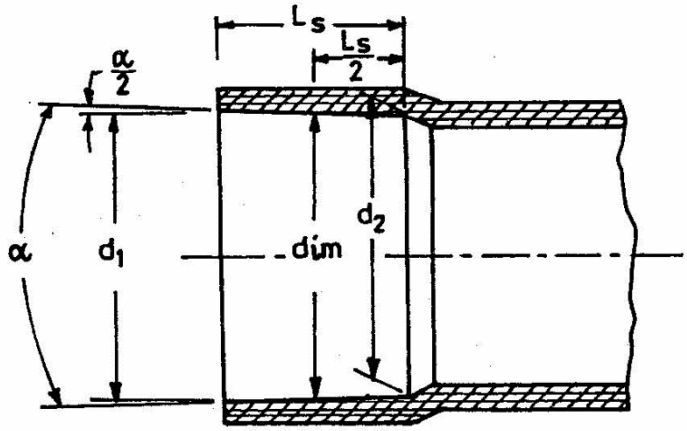


FIG. 2 EFFECTIVE LENGTHS OF PIPE



d_{im} = diameter at mid point of socket length
d_1 = diameter at mouth
d_2 = diameter at root
l_s = socket length
α = total included angle of taper

FIG. 3 SOCKET DIMENSIONS FOR SOLVENT CEMENT JOINTS

4.5.07 PHYSICAL AND CHEMICAL CHARACTERISTICS

Visual Appearance: The colour of the pipes shall be light grey. Slight variations in the appearance of the colour are permitted. The pipes may also be supplied in any other colour as agreed to between the buyer and seller.

The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. Slight shallow longitudinal grooves or irregularities in the pipe shall be permissible provided the wall thickness remains within the permissible limits.

Opacity: The wall of the plain pipe shall not transmit more than 0.2 percent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).The convex (outer) surface of the pipe specimen shall face the light source.

Effect on Water: The pipes shall not have any detrimental effect on the composition of water flowing through them and relevant tests certificate from competent government accredited laboratories shall be produced.

Reversion Test: When tested by the immersion method prescribed in IS 12235 (Part 5), a length of pipe 200 ± 20 mm long shall not alter in length by more than 5 percent. In the case of socket end pipes, this test shall be carried out on the plain portion of the pipe taken at least 100 mm away from the root of the socket.

Vicat Softening Temperature: When tested by the method prescribed in IS 12235 (Part2), the Vicat softening temperature of the specimen shall not be less than 80°C.

Density: When determined in accordance with IS 12235 (Part 14), the density of the pipe shall be between 1.40 and 1.46 gms/cm^3.

Sulphated Ash Content Test: When tested as per Annex B, the sulphated ash content in the pipe shall not exceed 11 percent.

4.5.08 MECHANICAL PROPERTIES

Hydrostatic Characteristics: When subjected to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/sec 1 y), the pipe shall not fail during the prescribed test duration. The temperatures and duration of the test shall conform to the requirements given in Table 6. The test shall be carried out not earlier than 24 h after the pipes have been manufactured. The requirements for integral sealing ring sockets are given in Table 7.

Table 6 Requirements of Pipes for Internal Hydrostatic Pressure Test

Test	Test Temperature (*Min*) °C	Test Duration (Minimum Holding Time) h	Test Pressure (*Min*) MPa
(1)	(2)	(3)	(4)
Type test	60	1 000	1.16 × *PN* (MPa)
Acceptance test	27	1	4.19 × *PN* (MPa)

Table 7 Requirements of Integral Sealing Ring Sockets for Internal Hydrostatic Pressure Test

Diameter Range mm	Test	Test Temp. (*Min*) °C	Time h	Test Pressure (*Min*) MPa
(1)	(2)	(3)	(4)	(5)
$d_n < 90$	Acceptance test	27	1	2.88 × *PN* [MPa]
	Type test	27	1 000	2.20 × *PN* [MPa]
$d_n \geq 90$	Acceptance test	27	1	3.60 × *PN* [MPa]
	Type test	27	1 000	2.74 × *PN* [MPa]

Acceptance test at 27°C as given in Table 6 shall not apply to plumbing pipes. For plumbing pipes, the test pressure for acceptance test at 27°C shall be 3.6 MPa for 1 h, as these pipes are designed with a higher wall thickness for rigidity and not for providing a higher working pressure.

The type tests do not apply to plumbing pipes due to the same reason as above.

When tested in accordance with the method prescribed in IS 12235 (Part 8/ Sec 4),

the joints made with elastomeric sealing ring sockets shall fulfil the requirements given in Table 7.

Resistance to External Blows at 0°C

When tested by the method prescribed in Annex C, the pipe shall have a True Impact Rate of not more than 10 percent. In case of socket-ended pipes, this test shall be carried out on the plain portion of the pipe taken at least 100 mm away from the root of the socket.

4.5.09 SAMPLING AND CRITERIA FOR CONFORMITY

The sampling procedure and the criteria for conformity shall be as given in Annex D

a) TYPE TESTS

Type tests are intended to prove the suitability and performance of a new composition or a new size of pipe. Such tests, therefore, need to be applied only when a change is made in polymer composition or when a new size of pipe is to be introduced. Type tests for compliance with 10.2,103 and 11.1 (type test only) shall be carried out.

(i) Opacity
(ii) Test for Effect on Water
(iii) Internal Hydrostatic Pressure Test

b) ACCEPTANCE TESTS:-

Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot.

(i) Lot

All PVC pipes in a single consignment of the same class, same size and manufactured under essentially similar conditions shall constitute a lot.

For ascertaining conformity of the lot to the requirements of the specification, samples shall be tested from each lot separately.

(ii) Visual and Dimensional Requirements

The number of test samples to be taken from a lot shall depend on the size of the lot and the outside diameter of the pipes, and shall be in accordance with Table 13.

Table 13 Scale of Sampling for Visual Appearance and Dimensional Requirements

(Clauses D-1.4.1 *and D-I.4.3)*

Number of Pipes in the Lot	Sample Number	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)
Up to 1 000	First	13	13	0	2
	Second	13	26	1	2
1 001 to 3 000	First	20	20	0	2
	Second	20	40	1	2
3 001 to 10 000	First	32	32	0	3
	Second	32	64	3	4
10 001 and above	First	50	50	1	4
	Second	50	100	4	5

(iii) Reversion Test, Density, Vicat Softening Test, Sulphated Ash Content Test, Resistance to External Blows at 0°C, Internal Hydrostatic Pressure Test

Number of tests & criteria for conformity.

The number of test samples shall be as given in Table 17. The lot shall be considered to have satisfied the requirements for this test, if the number of test samples failing in this requirement is equal to the corresponding acceptance number given in col. 3 of Table 17.

Table 17 Scale of Sampling for Internal Hydrostatic Test

(Clauses D-I. 10.1 *and* D-I. 10.3)

Number of Pipes in the Lot	Sample Size	Acceptance Number
(1)	(2)	(3)
Up to 3 000	2	0
3 001 to 10 000	3	0
10 001 and above	5	0

4.5.10 MARKING

Each pipe shall be clearly and indelibly marked in colour using ink/paint as given below at intervals of not more than 3 meters. Alternatively, inkjet printing in any contrasting colour can also be used for marking at intervals of not more than 3 metres. The markings shall show the following:

a) Manufacturer's name or trade-mark,

b) Outside diameter,

c) Class of pipe and pressure rating,

d) Batch or lot number, and

e) The word plumbing in the case of plumbing pipes.

The information according to **4.5.12** shall be marked in colour as indicated below for different classes of pipes (in the case of indelible marking by ink/paint). In the case of inkjet printing, the pipes shall also be provided near the end with a circumferential colour band as indicated below for different classes of pipes to identify the class of pipe:

Class of Pipe	*Colour*
Class 1	Red
Class 2	Blue
Class 3	Green
Class 4	Brown
Class 5	Yellow
Class 6	Black
Plumbing pipes	Pink

In the case of plumbing pipes, the information given in 4.5.12 & 4.5.13 shall be marked in pink colour.

In the case of hot embossing, the pipes shall also be provided near the end with a circumferential colour band as indicated above, so as to identify the class of pipe.

4.5.11 TRANSPORT, HANDLING AND STORAGE OF PIPES

Because UPVC pipes are durable and light, they are more 1ikcly to be mishandled. Care should be taken to ensure that pipes are not damaged during handling, storage and transport.

Transport

When transporting pipes, flat bed vehicles should be used. The bed should be free from nails and other projections. When practical, pipes should rest uniformly on the vehicle over the whole length (see Fig. 12).

The vehicles should have side supports approximately 2 m apart and the pipes should be secured effectively during transport. All posts should be flat with no sharp edges.

When loading spigot and socket pipes, the pipes should be stacked on the vehicle so that the sockets do not take excessive loads.

Where pipes overhang the vehicle, the amount of overhang should not exceed 1m.

High stiffness pipes should be -placed at the bottom of the load and low stiffness pipes at the top. Care should be taken to avoid positioning the pipes near to any exhaust systems or any other potential hazards such as diesel oil, paints or solvents.

Pipes should be inspected prior to off-loading. When pipes are transported in bundles, the bunches should be secured effectively and off-loaded as described above.

Handling

UPVC pipes should be handled keeping in mind that they are made of plastic and are also susceptible to damage if mishandled. They should not be thrown, dropped or dragged. Single pipe of up to 250 mm can be lifted by two men without difficulty (see Fig, 13, 14 and 15).

Mechanical lifting equipment used for lifting pipes and pipe bundles should not damage the pipe. Fork-lift forks should be flat and protected. Cranes should have spreader bars. No wire ropes, chains or hooks should be used. Slings should be made of rope or webbing 7 to 10 cm wide (see Fig. 16). If pipes have been telescoped for transporting, the inner pipes should be removed first and stacked separately.

Resistance to impact is reduced in cold weather. Extra care needs to be taken at temperatures around O“C. At temperatures below –15“C, special instructions from the manufacturer should be obtained.

Storage

Pipes should be stacked on a surface flat and free from sharp objects, stones or projections in order to avoid deformation or damage. Ends of pipes should be protected from abrasion and chipping.

The pipes should be supported evenly over their whole length. The bottom layer of the stack should be supported on wooden battens of uniform size, at least 50 mm

wide and placed not more than 2 m apart. The sockets should not bear on the ground (see Figs. 17 and 18).

Pipes of different diameters and different pressure classes should preferably be stacked separately.

Factory packed pipes should packed in bundles with timber battens at minimum three places. These should not be unpacked until required for use.

Bundles in depots should be stacked no more 4.3.7 Timber framed bundles should be stacked timber than three units or 2 m high, whichever is lower, as to timber shown in Fig. 19.

On the site, bundles should be stacked no more than two units or 1 m, whichever is lower.

Timber framed bundles should be stacked timber to timber.

It should be necessary to store pipes loose or if they are received loose, care should be taken to see that each layer of the stack lies alternatively with the sockets on opposite ends of the stack. The sockets of each pipe must project sufficiently for the pipes to be supported correctly along the whole length (parallel stacking) [see Fig. 20(A)].

The sides of the stack must be supported with timber battens to prevent stack collapse. The side supports should be spaced not more than 3 m apart. The width of the bottom layer should not exceed 3 m.

Alternatively, pipes can also be stacked with adjacent layers 1ying at right angles to each other (cross stacking), while observing that the sockets lie as stated in 4.3.8 [see Fig. 20 (B)].

Stack height should not exceed 1.5 m in depots and stores or 1 mat construction sites (see Fig. 17 and 18).

Prolonged exposure of the pipes to sunlight must be avoided. “Pipes must be protected from ultra-violet light (sunlight), which would otherwise cause discoloration and can reduce the impact strength of the pipe. However, resistance to internal water pressure is not reduced. Suitable protection by a free-venting cover (canvas tarpaulin or polyethylene sheeting) is recommended if the total exposed time is likely to exceed 4 weeks (see Fig. 2 1).

Pipes should be stored away from any heat source and should not be in contact with any other potential hazards such as diesel oils, paints or solvents.

If PVC pipes are date coded at the time of manufacture, it is recommended to rotate stocks on a 'first-in-first-out' basis.

4.5.12: FIXING: The entire pipe line shall be fixed in position or as directed by the Engineer-in-charge. All pipes shall be fixed truly vertical and horizontal unless unavoidable.

Spacing between clamps for fixing internal/external/exposed piping shall be as per pipe manufactures recommendations or as below:

Spacing between clamps for fixing internal piping shall be as given below :

Pipe dia	For Horizontal Runs	For Vertical Runs
20 mm	700 mm	1050 mm
25 mm	750 mm	1125 mm
32 mm	825 mm	1240 mm
40 mm	975 mm	1460 mm
50 mm	975 mm	1460 mm

4.5.13: JOINTING TECHNIQUES:

General

Unplasticized PVC pipes are made by a continuous extrusion process and are generally available as rigid (hard), in-factory cut lengths. Pipes are supplied with one of the following four end conditions:

a) Plain end, for jointing by means of separate couplers, including mechanical joints.

b) Integral socket on one end, for solvent cement jointing

c) Integral socket on one end for jointing with elastomeric sealing rings, and

d) Threaded, for jointing with threaded couplers.

Satisfactory jointing plays an important role in successful performance of these pipes, commonly used joints are as follows:

a) Solvent welded joints,

b) Integral elastomeric sealing ring joints,

c) Mechanical compression joints,

d) Flanged joints,

e) Screwed or threaded joints and Union coupled joints.

Solvent Welded Joints

These are permanent in nature and can withstand axial thrust (end-load bearing). This technique is used with plain ended pipes with couplers, for pipes with integral sockets as well as with injection moulded fittings (see Fig.1),

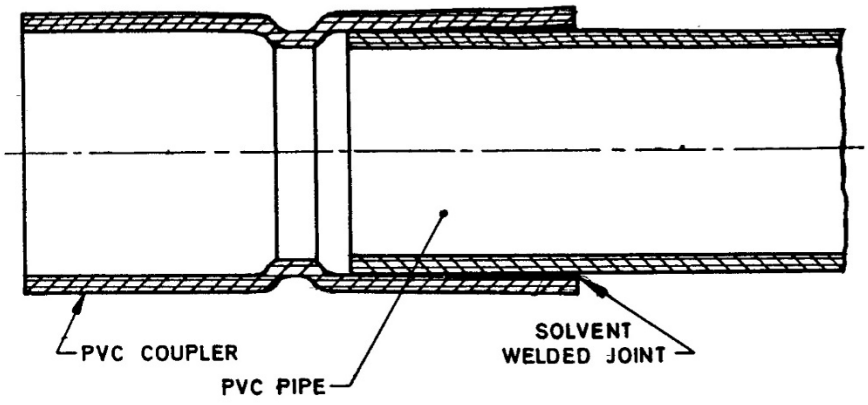


FIG. 1 PVC SOLVENT WELDED JOINT

Pipes and fittings are manufactured to certain tolerances to provide for small variations in the extrusion, moulding and socket processes and are not exact in size.

Solvent Cement

Consists essentially of a solution of vinyl chloride polymer or copolymer dissolved in a suitable volatile mixture of organic solvents. The solvent constituents soften the mating surfaces, which diffuse into one another to form a 'cold weld'.

Specification

Solvent cement shall conform to all the requirements of IS 14182.

Selection

Solvent cement is available in three grades of viscosity as given below to cover a range of pipe sizes from 20 mm to *630* mm. Sufficient solvent cement shall be applied so that a wet-film thickness adequate enough to fill a gap in a pipe joint is formed. Selection is also dependent on the climatic conditions prevalent at the site.

Pipe Size	*Cement Type*	*Minimum Viscosity*		*Minimum Wet Film Thickness*
mm		MPa.s	cp	mm
Up to 50	Regular bodied	90	90	0.15
63 to 160	Medium bodied	500	500	0.3
Above 200	Heavy bodied	1600	1600	0.6

Medium bodied and heavy bodied cements may be used for smaller pipe sizes than that shown in the table above. The reverse does not hold good.

Storage

PVC Solvent cement should be stored as per IS 7634 (Part-3) or as per manufacturer's recommendation.

PROCEDURE

Pipes are supplied with square-cut and de-burned ends. However, if pipes need to be cut to smaller lengths, use a fine-toothed hand saw and a mitre box or a power saw with wood-working blades, with a Suitable guide. The cutting must not raise a burr or ridge on the cut end of the pipe. Failure to remove the ridge will result in cement in the fitting or socket being scraped away from the jointing surfaces, leading to a dry joint with probability of join; failure, Remove-all bums 'and ridges with a deburring knife, file, or abrasive paper (see Fig.2 from IS:7634 Part3).

Chamfering

Provide an approximately 2 mm wide, 15° chamfer on pipe ends. A chamfer prevents the cement film from being wiped off into the interior of the socket during assembly.

Dry fjt test

Before applying cement, insert the pipe end into the socket of the next pipe or fitting to check that interference occurs at about 1/3 to 2/3 of the socket depth. When the pipe and the socket are at their extreme tolerances, the pipe can bottom (travel full y into) in the socket. In such a case, it should be a snug fit. A loose or wobbly fit will result in joint failure. Another pipe end or the socket should be selected until these conditions are fulfilled. Mark the insertion depth on the pipe end with a felt tip pen or marker.

Cleaning

Surfaces to be joined must be free of dust, dirt, oil, moisture and other foreign material. Wipe clean with a dry cloth. If this is not sufficient, use a chemical (such as dichloro-methane, methyl ethyl-ketone or mechanical cleaner). With chemical cleaners, observe safety precautions. Ketones are inflammable.

Application of cement

PVC solvent cement is quick drying, therefore it shall be applied as quickly and carefully .as possible and in consistence with good workmanship. For larger sizes, it is advisable for two workers to work simultaneously on the pipe and socket. The surface temperature of the mating surfaces should be above O"C but should not exceed 45°C. Water can be used to cool the surfaces, but these should be wiped thoroughly dry before application of cement.

Dip the applicator brush in the solvent cement and apply a liberal coat of cement to the end of the pipe up to the insertion depth.

Apply a uniform thin coat of cement inside the socket, working axially from the inside of the socket to the outside. Do not apply any cement on the shoulders of the socket (socket-to-pipe transition area). Care should be taken not to apply excess cement inside the socket. Excess cement m the socket will be pushed further into the pipe during assembly and cause the pipe to soften and weaken at that point. Hot and dry climates generally require slightly thicker coatings of solvent cement.

In climates with large differences between day and night temperatures, it is advisable to make joints early in the morning or in the evening when it is cooler. Thus, the joints are prevented from being pulled apart if the pipes

contract.

Within 20s after the last application of solvent cement, insert the pipe into socket in a single steady and every controlled but forceful action. Press it in fully until it bottoms. No hammer blows should be used. If there is any sign of drying of the cement coat before insertion; the surface should be re-coated, avoiding application of excess cement in the socket. Once the insertion is complete, hold in place for 1 min without shifting the pipe in the socket.

For large diameter pipes, two or more workers may be needed for this operation. Mechanical equipment such as levers and winches may be used. Care shall be taken to ensure that force is not transmitted to previously made joints. Until the cement is set, the pipe must be prevented from backing out of the socket.

Immediately after assembly, wipe the excess solvent cement from the pipe at the end of the socket. A properly made joint will have a uniform bead around its entire perimeter. Any gaps in this bead may be indicative of an improper joint due to insufficient cement or the use of a lighter-bodied cement than the one recommended.

Setting times

Joints should not be handled until the requisite setting time has elapsed. Recommended setting times are a function of the ambient temperature at the job site as given below:

Temperature *°C*	*Recommended setting times, Min* h
15to 40	1
5to15	2
-5 to 5	4
-20 to -5	6

Installation and commissioning

After the setting time has elapsed, the pipe may be handled carefully for installation. Pressure testing may be carried out only after a curing period of 24 h.

4.5.14 Integral Elastomeric Sealing Ring Joints

Pipes are cut to length and bell socket in-line, to form a groove for the elastomeric sealing ring, and supplied in nominal lengths. Couplers and bends fabricated out of UPVC pressure pipes are likewise socket.

Elastomeric sealing ring joint consists of an elastomeric sealing element located in the groove in the socket formed integrally with the pipe or fitting. The sealing element (sealing ring) is automatically compressed to form a pressure tight seal when the spigot of the pipe is inserted into the socket.

These joints are non-end load bearing and it is essential to ensure the probability of joint separation due to axial thrust. Joint separation can be prevented in below ground applications by incorporating concrete anchor blocks at appropriate places. In above ground applications, anchor blocks must be provided (see 6.4). Where large diameter pipes operating at high pressures are involved, axial thrusts of several tonnes can be developed.

In order to meet water quality and biodegradation requirements, elastomeric sealing rings are usually made from synthetic materials like ethylenepropylene- diene (EPDM) copolymer, styrenebutadiene rubber (SBR) or a combination of synthetic and natural rubber. The material should conform to 1S 5382.

Procedure

Pipes are supplied with the spigot end chamfered. However, if pipes have to be shortened for any reason, preparation of the ends will be necessary before assembly.

Cutting of pipes, if required, must be done on a jig to ensure that the cut is square to the axis of the pipe. It is recommended that the pipe be marked around the entire circumference prior to cutting. The pipe ends must be chamfered at an angle of 15° with a medium grade tile and de-burred. (see Fig. 2 from IS:7634 Part3).

Clean the spigot end of the pipe upto the insertion depth (depth of the corresponding socket). Remove all traces of mud, dirt, grease and gravel. Do not use any chemicals or solvents for cleaning. For stubborn areas of dirt. a very fine grade of emery or sand paper can be used lightly. Wipe the pipe with a clean cloth moistened with water and allow to dry completely.

Clean the inside of the socket. Remove all traces of mud, dirt, grease and gravel. Do not use any chemicals or solvents for cleaning. For stubborn areas of dirt, a very fine grade of emery or sand paper can be used lightly. Wipe the inside of the groove with a damp cloth and allow to dry completely.

Mark the insertion depth on the spigot of the pipe, if not already applied by the manufacturer. The insertion depth is equal to the depth of the socket of the pipe, measured upto the end of the parallel portion of the socket (excluding the shoulder). This distance is marked on the spigot (excluding the chamfer) with an indelible felt-tip marking pen.

Insert the elastomeric sealing ring into the groove. Rings to be used are system specific and shall be those supplied by the manufacturer for his own system. Form the ring into a heart shape by pinching a portion of the

ring from the inside (see Fig. 3 from IS:7634 Part3). Insert into the socket and release to seat into the groove. Ensure proper seating of the ring in the groove. If the ring is wrongly inserted it will lead to leakage. It may

also dislocate completely during assembly. Follow instructions of the manufacturer.

Apply lubricant to the outside of the spigot (consult the manufacturer). The lubricant should cover the entire surface of the spigot for at least half the insertion depth, starting from the end of the pipe. The lubricant used should not have any detrimental effect on the pipe, fittings or the elastomeric sealing ring and shall not be toxic, shall not impart any taste or odour to the water or encourage growth of bacteria. Do not use oil-based or solvent-based lubricants.

Align the socket and spigot correctly in the horizontal and vertical planes. Ensure that no sand or dirt adheres to the lubricated surfaces of the pipe.

Insert the spigot end carefully into the socket. Place a firm wooden block against the other end of the pipe and, using a crow-bar as a lever, push home the spigot upto the insertion depth mark (see Fig. 4 from IS:7634 Part3). For larger sizes of pipe, the use of a jointing jack may be helpful. The jack can also be used to extricate a pipe from a socket.

4.5.15 UNDERGROUND INSTALLATION

General

The long term performance of UPVC pressure pipelines is directly affected by the quality of workmanship and materials used in installing the product. Competent supervision of all stages is important.

In buried pipelines, the pipe and the soil form an integral structure. When installed properly, UPVC pipe gains strength due to the support of the soil. The soil and pipe wall deflect or compress depending on any one combination of the following three factors:

a) Pipe stiffness,

b) Soil stiffness, and

c) Load on the pipe.

Trenching

Location

Drinking water pipelines should not be located below sewerage pipelines.

Where a pipeline runs parallel to other pipelines or cables, the distance between them should not be less than 0.4 m.

At points of congestion, a distance of 0.2 m should be maintained unless steps are taken to prevent direct contact.

Width

Trenches should be of adequate width to allow the burial of pipe, while being as narrow as practical. If expansion and contraction are not problems and snaking of pipe is not required, minimum trench widths may be obtained by joining the pipe outside the trench and then lowering the piping into the trench after the testing. A trench width of two or three times the pipe diameter is a good rule of thumb. See Tables 1 and 2 for narrow (unsupported) and supported trench widths. Where necessary to prevent cave-ins, trench excavations in unstable soil shall be adequately supported. As backfill is placed and sheeting withdrawn, the void left by the withdrawn sheeting shall be filled and compacted before withdrawing the next increment.

Trench Bottom

The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipeline. There should be no sharp objects that may cause point loading. Any large rocks, hard pan, or stones larger than 20 mm should be removed to permit a minimum bedding thickness of 100-150 mm under the pipe. For pipes of diameters 100 mm or greater, bell holes in the bedding, under each socket joint, shall be provided by removing some of the bedding material, to accommodate the larger diameter of the joint and to permit the joint to be made properly.

Excavated Material

Excavated material should be deposited at a sufficient distance away from the trench to prevent damage to the pipeline through falling stones or debris.

Soil

The type of soil and the amount of compaction of the pipe embedment directly affect the performance of the pipeline. With proper embedment soil and compaction, greater burial depths are possible and higher external pressure capability and less pipe deflection will occur.

Minimum Cover

The following guidelines should be followed:

a) If frost is anticipated, locate the pipeline below the frost line.

b) A minimum cover of 0.9 m when truck traffic is expected.

c) A minimum cover of 1.8 m when heavy truck or locomotive traffic (dynamic loads) is expected. Usually pipe below 2.0 m of cover are not affected significantly by dynamic loads. If the application prevents deep burial of the pipe and heavy traffic passing over the pipe is expected, it would be advisable to use steel or reinforced concrete casing to prevent damage to the pipe.

d) For high static and/or surcharge loads, it is important to use pipes of an appropriate stiffness in order to ensure the initial deformation of the pipe is maintained within a limit of 5 percent, maximum

Laying

Lay the pipes in the trench after ensuring that bell holes have been provided for at the appropriate places in the bedding (pipes of diameter 110 mm or less, with no live load application, do not require bell holes in the trench bottom). These have to be refilled carefully after testing of the pipeline and prior 10 complete backfilling of the trench. Though not essential, the pipes should be laid with the spigots entered into the sockets in the same direction as the intended flow of water.

Anchoring

To sustain 'thrust caused by internal pressure, concrete anchor blocks should be provided at all changes of direction, tees, blank ends, large reductions in diameter and valves. The purpose of the anchor block is to transfer the total thrust to the

trench sides. It is therefore important to take account of the load-bearing capacity of the surrounding ground (see Fig. 22 of IS 7634 Part-3).

Recommended mixture for concrete is one part cement, two parts washed sand and two parts gravel.

Backfilling

The first sidefill or haunching layer should be placed by hand and compacted in layers under the lower quadrants of the pipe upto the spring level (half the vertical diameter) of the pipe. Compaction can be done by careful trampling with the feet or with tamping tools.

Care should be taken to leave adequate area around the joint free of backfill to allow for inspection during testing of the pipeline.

Successive layers of backfill of 75 mm thickness may then be placed over and compacted to a height above the crown of not less than 150 mm. Light vibrating machinery may be used, but not directly above the pipe.

4.5.16 ABOVE GROUND INSTALLATION

Since solvent cemented joints will sustain axial thrust caused by internal pressure (see 3.2 from IS:7634 Part3), it is strongly recommended that UPVC pipes and fittings systems installed above ground or in service ducts constructed below ground are jointed by the solvent cement method. In certain circumstances the manufacturer's advice should be considered. Other forms of end-load bearing joints are also acceptable for inclusion in above ground installations.

UPVC pipes may fracture if fluids contained within the pipes are allowed to freeze. Sections which are likely to freeze should be isolated and drained, or insulation provided to prevent damage.

Pipes should be installed in such away as to ensure that the minimum amount of stress is induced in the system from movement caused by expansion/ contraction or any other forces.

Examples of correct and incorrect installation are shown in Fig. 26 of IS:7634 Part 3.

UPVC pipes should not be restrained in the hoop direction by straps or clamps made from unyielding material. The use of a compressible material such as rubber of foamed polyethylene between clamp and pipe is recommended.

Pipes should be free to move in the longitudinal direction unless otherwise fixed for expansion contraction control.

Recommended distances for horizontal or vertical support centres are given in Table 4 from IS:7634 Part3.

4.5.17 INSTALLATION IN-DUCTS

Where possible, pipes with end-load bearing joints should be used for installation inside inaccessible ducts. In addition, rings should be fitted to the pipe to provide optimum support and to facilitate the withdrawal of the pipe in the event of rupture. For large diameter pipes, or where the duct is large compared to the pipe but not large enough to be accessible, other methods of securing the pipe maybe necessary (see Fig. 28 from IS:7634 Part3). The opening between the pipes and the ducting system should be sealed at the ends.

Installation of pipes inaccessible ducts should be as described for above ground installation under7.

4.5.18: PAINTING: If required Piping system shall be painted using water base paints. Painting shall be done only with permission of Engineer In charge

4.5.19 TESTING

Pressure tests should never be carried out using compressed air or gasses.

Preparation: Pipe systems should be hydraulically tested in lengths appropriate to the diameters and site conditions. Pipelines longer than 800 m may require testing in sections. Preferably, the length selected for test is between 300 m and 500 m.

Preferably, the test should be carried out between blank flanges (see Fig. 29 from IS:7634 Part3). Testing against closed valves is not recommended, unless there is no alternative.

Do not support the end pieces of the test section against the already laid pipes of the proceeding section.

Testing should not take place until any concrete used for anchoring has fully cured (normally 72 h) and attained its required strength. Solvent cemented joints must be allowed to harden for a minimum of 24 h before being subjected to test conditions.

It is important to provide sufficient backfill over the main barrel of the pipe, to prevent displacement and to maintain stable temperature conditions. Leave joints free for inspection.

The test position should be located at the lowest point of the pipeline profile to encourage expulsion of air as the pipe is being filled with water. Adequate air release mechanisms should be located at all high points along the line.

Test-ends should be designed to enable the measured filling and subsequent emptying of the pipeline. Air bleed should also be incorporated at each end.

Pressurizing equipment should be adequately sized. Check all seals and non-return valves prior to the test. Pressure gauges should have an accuracy of + 0.2 bar. Automatic pressure recording equipment is recommended.

Before filling the pipeline, all line valves and air venting systems should be checked open. All air must be removed from the system.

Fill the system slowly. Water velocity must not exceed 0.6 m/s. Potable water pipelines should be tested with potable water only. After charging, close all air valves and check proper action of automatic valves.

During filling, a number of movements will be seen in the pipeline. Allow the pipeline to stabilize under a nominal pressure for a minimum of 2 h.

Test Pressures

The test should conform to the following conditions:

a) be carried out at ambient temperature;

b) be applied for at least 1 h, but not more than 24 h; and

c) not exceed 1.5 times the maximum rated pressure of the lowest rated component.

Applying the Test: Allow the system to stabilize for 2 h after filling. Apply pressure steadily. Observe pressure gauges throughout and record the rates of pressure increase recorded.

The pressure should be increased till the specified pressure is reached at the lowest part of the section.

Maintain test pressure at this level, by additional pumping if necessary, for a period of 1 h.

Close all valves and disconnect the pressurizing unit. No further water should be allowed to enter the system for a further period of 1 h.

During the test period, carry out a visual examination of all joints and exposed connections.

4.5.20 CORROSION PROTECTION

UPVC pipes are resistant to all normal soil conditions and require no corrosion protection. UPVC pipe has a high resistance to chemicals and withstands attack by concentrated mineral acids (except nitric acid above 50 percent concentration), alkalis, oils aromatic free petrol and alcohols. However, UPVC pipes are sensitive to aromatic, or chlorinated hydrocarbons, nitro compounds, esters, ketones and strong oxidizing agents such as dry chlorine

gas.

Where adjacent metallic parts are protected, no hot-or cold-applied coatings, or varnishes which contain solvents, should come in contact with UPVC. Soil above and around the trench containing the pipeline should be protected from pollution through spilled aromatic hydrocarbons, paint, solvents, etc. Anti-corrosion tape or similar protective materials applied to metal connecting pieces should be of a type which does not damage the UPVC pipes or fittings if they come into contact with the pipeline.

4.5.21 BIS Certification Marking

Each pipe may also be marked with the Standard Mark.

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

4.5.22 THE RATE INCLUDES FOR:-

Supplying of PVC pipes and fittings of specified diameter.

1. Laying and cutting the pipe wherever necessary and wastage.
2. Making required & specified joints.
3. Fixing the pipeline with G.I clamps not less than 2 mm thick and G.I. /M.S. nails length not less than 40 mm or with PVC clamps, screws, wooden gutties, etc.
4. In case of underground piping, dewatering till completion of work.
5. All necessary labour, material and tools & equipments.

4.5.23: MODE OF MEASUREMENT: - The measurement shall be for unit running meter length of pipe line laid or fixed. The measurement shall be taken along the centre line of pipe. No measurement shall be recorded separately for fitting, making joint, painting if mentioned in schedule of quantities and testing.

4.6: ASTM-uPVC PIPING WORK:

4.6.1: GENERAL: The item includes providing ASTM-uPVC (Poly Vinyl Chloride) non threaded pipes with uPVC fitting of specified nominal size and class as mentioned in the schedule including laying, fixing. The uPVC pipes and fittings shall run on the surface of the walls or ceilings unless otherwise specified.

4.6.2: MATERIAL: The pipes and fittings shall be of uPVC as specified in the schedule and UV stabilized. They shall conform to ASTM D-1785, ASTM D-2466 and ASTM D-2467. The specified nominal size of the pipe shall refer to inside approximate diameter. The pipe and fittings shall be smooth, sound, free from any imperfections and neatly dressed. The pipe and fitting shall be able to withstand a hydrostatic test pressure as prescribed / referred in ASTM D-1785, ASTM D-2466 and ASTM D-2467. The table showing the dimensions and different bores of pipes are given below.

Dimensions and Allowable Maximum Operating Pressure of uPVC Pipes

As per ASTM D-1785

Sr. No.	Nominal size (inch)	Nominal Outside Diameter (mm)		Schedule 40			Schedule 80		
		OD	Toler-ance	Wall Thickness Min(mm)	Working Pressure		Wall Thickness Min(mm)	Working Pressure	
					Mpa	psi		Mpa	psi
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i	½	21.34	± 0.10	2.77+0.51	4.14	600	3.73+0.51	5.86	850
ii	¾	26.67	± 0.10	2.87+0.51	3.31	480	3.91+0.51	4.76	690
iii	1	33.40	± 0.13	3.38+0.51	3.10	450	4.55+0.53	4.34	630
iv	1 ¼	42.16	± 0.13	3.56+0.51	2.55	370	4.85+0.58	3.59	520
v	1½	48.26	± 0.15	3.68+0.51	2.28	330	5.08+0.61	3.24	470
vi	2	60.32	± 0.15	3.91+0.51	1.93	280	5.54+0.66	2.76	400
vii	2½	73.02	± 0.18	5.16+0.61	2.07	300	7.01+0.84	2.90	420
viii	3	88.90	± 0.20	5.49+0.66	1.79	260	7.62+0.91	2.55	370

ix	4	114.30	± 0.23	6.02+0.71	1.52	220	8.56+1.02	2.21	320
x	5	141.30	± 0.25	6.55+0.79	1.31	190	9.52+1.14	2.00	290
xi	6	168.28	± 0.28	7.11+0.86	1.24	180	10.97+1.32	1.93	280
xii	8	219.08	± 0.38	8.18+0.99	1.10	160	12.70+1.52	1.72	250

No negative tolerances are allowed.

Pipes and fittings shall be solvent welded conform to manufacturers recommendations.

PVC compound grade shall be equivalent to PVC 1120/1220/2120.

Material shall be marked as per relevant codal provisions.

Poly Vinyl Chloride plastics use to make pipe meeting the requirements of this specification are categorized by means of two criteria, namely,

1) Short-term strength tests
2) Long-term strength tests

Basic Material: This specification covers pipe made from PVC plastics having certain physical and chemical properties as described in Specification D1784.

Compound: The PVC compounds used for this pipe shall equal or exceed the following classes described in Specification D1784, PVC 12454-B, 12454-C or 14333-D

Rework Material: Clean, rework material of the same type and grade (cell classification), generated from the manufacturer's own pipe production, may be used by the same manufacturer, as long as the pipe produced meets all the requirements of this specification.

4.6.3: REQUIREMENTS AND TESTS:

(i) Dimensions and Tolerances:

Dimensions and tolerances shall be as shown in Tables 1 & 2 when measured in accordance with Method D 2122. The tolerances for out-of-roundness (ovality) shall apply only to pipe prior to shipment.

TABLE 1 Outside Diameters and Tolerances for PVC Plastic Pipe Schedules 40, 80, in.(mm)

Nominal Pipe Size	Outside Diameter	Tolerances		
		Average	For Maximum and Minimum Diameter (Out-of-Roundness)	
			Schedule 40 sizes 3½ in. and over; Schedule 80 sizes 8 in. and over	Schedule 40 sizes 3 in. and less; Schedule 80 sizes 6 in. and less; Schedule 120 sizes all
⅛	0.405 (10.29)	±0.004 (±0.10)	...	±0.008 (±0.20)
¼	0.540 (13.72)	±0.004 (±0.10)	...	±0.008 (±0.20)
⅜	0.675 (17.14)	±0.004 (±0.10)	...	±0.008 (±0.20)
½	0.840 (21.34)	±0.004 (±0.10)	...	±0.008 (±0.20)
¾	1.050 (26.67)	±0.004 (±0.10)	...	±0.010 (±0.25)
1	1.315 (33.40)	±0.005 (±0.13)	...	±0.010 (±0.25)
1¼	1.660 (42.16)	±0.005 (±0.13)	...	±0.012 (±0.30)
1½	1.900 (48.26)	±0.006 (±0.15)	...	±0.012 (±0.30)
2	2.375 (60.32)	±0.006 (±0.15)	...	±0.012 (±0.30)
2½	2.875 (73.02)	±0.007 (±0.18)	...	±0.015 (±0.38)
3	3.500 (88.90)	±0.008 (±0.20)	...	±0.015 (±0.38)
3½	4.000 (101.60)	±0.008 (±0.20)	±0.050 (±1.27)	±0.015 (±0.38)
4	4.500 (114.30)	±0.009 (±0.23)	±0.050 (±1.27)	±0.015 (±0.38)
5	5.563 (141.30)	±0.010 (±0.25)	±0.050 (±1.27)	±0.030 (±0.76)
6	6.625 (168.28)	±0.011 (±0.28)	±0.050 (±1.27)	±0.035 (±0.89)
8	8.625 (219.08)	±0.015 (±0.38)	±0.075 (±1.90)	±0.045 (±1.14)
10	10.750 (273.05)	±0.015 (±0.38)	±0.075 (±1.90)	±0.050 (±1.27)
12	12.750 (323.85)	±0.015 (±0.38)	±0.075 (±1.90)	±0.060 (±1.52)

TABLE 2 Wall Thicknesses and Tolerances for PVC Plastic Pipe, Schedules 40, 80,

Nominal Pipe Size	Wall Thickness[A]			
	Schedule 40		Schedule 80	
	Minimum	Tolerance	Minimum	Tolerance
⅛	0.068 (1.73)	+0.020 (+0.51)	0.095 (2.41)	+0.020 (+0.51)
¼	0.088 (2.24)	+0.020 (+0.51)	0.119 (3.02)	+0.020 (+0.51)
⅜	0.091 (2.31)	+0.020 (+0.51)	0.126 (3.20)	+0.020 (+0.51)
½	0.109 (2.77)	+0.020 (+0.51)	0.147 (3.73)	+0.020 (+0.51)
¾	0.113 (2.87)	+0.020 (+0.51)	0.154 (3.91)	+0.020 (+0.51)
1	0.133 (3.38)	+0.020 (+0.51)	0.179 (4.55)	+0.021 (+0.53)
1¼	0.140 (3.56)	+0.020 (+0.51)	0.191 (4.85)	+0.023 (+0.58)
1½	0.145 (3.68)	+0.020 (+0.51)	0.200 (5.08)	+0.024 (+0.61)
2	0.154 (3.91)	+0.020 (+0.51)	0.218 (5.54)	+0.026 (+0.66)
2½	0.203 (5.16)	+0.024 (+0.61)	0.276 (7.01)	+0.033 (+0.84)
3	0.216 (5.49)	+0.026 (+0.66)	0.300 (7.62)	+0.036 (+0.91)
3½	0.226 (5.74)	+0.027 (+0.68)	0.318 (8.08)	+0.038 (+0.96)
4	0.237 (6.02)	+0.028 (+0.71)	0.337 (8.56)	+0.040 (+1.02)
5	0.258 (6.55)	+0.031 (+0.79)	0.375 (9.52)	+0.045 (+1.14)
6	0.280 (7.11)	+0.034 (+0.86)	0.432 (10.97)	+0.052 (+1.32)
8	0.322 (8.18)	+0.039 (+0.99)	0.500 (12.70)	+0.060 (+1.52)
10	0.365 (9.27)	+0.044 (+1.12)	0.593 (15.06)	+0.071 (+1.80)
12	0.406 (10.31)	+0.049 (+1.24)	0.687 (17.45)	+0.082 (+2.08)

(ii) *Sustained Pressure:* The pipe shall not fail, balloon, burst or weep as defined in Test Method D 1598, at the test pressures given in Tables 3,4 or 5 of relevant code when tested in accordance with 8.4 of ASTM D 1785.

Accelerated Regression Test: At the option of the manufacturer, an accelerated regression test may be substituted for the sustained pressure test. The test shall be conducted in accordance with 8.4.1 of relevant code.

(iii) *Burst Pressure:* The minimum burst pressures for PVC plastic pipe shall be as given in Table 6 of relevant code, when determined in accordance with Test Method D1599.

(iv) *Flattening: There shall be no evidence of splitting, cracking or breaking when the pipe is tested in accordance with 8.5 of relevant code.*

(v) *Extrusion Quality: The pipe shall not flake or disintegrate when tested in accordance with Test Method D 2152.*

4.6.4: Workmanship, Finish and Appearance: The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practicable in color, opacity, density and other physical properties.

4.6.5: Tests Methods: This shall be as per relevant ASTM code.

4.6.6: Certification: Certification shall conform to ASTM D-1785, ASTM D-2466 and ASTM D-2467. The pipes and fittings shall be certified by competent approved laboratories/ authority.

4.6.7: Product Marking:

Quality of Marking: The marking shall be applied to the pipe in such a manner that it remains legible after installation and inspection.

Content of Marking: Marking on the pipe shall include the following, spaced at intervals of not more than 5 ft (1.5 m):

a) Nominal pipe size (for eg: 2 in. (50mm))
b) Type of plastic pipe material in accordance with the designation code prescribed in relevant ASTM, for eg: PVC 1120.
c) Schedule (40 or 80, whichever is applicable) and the pressure rating in pounds per sq. inch (megapascals) for water at 73°F (23°C) shown as the number followed by psi (for eg: 200psi (1.4 MPa)
d) ASTM designation D 1785, with which the pipe complies.
e) Manufacturer's name (or trademark) and code (see Note 3 of relevant code)

4.6.8: Quality Assurance : When the product is marked with this designation "ASTM-D1785", the manufacturer shall affirm that the product was inspected, sampled and tested in accordance with this specification and has been found to meet the requirements of this specification.

4.6.9: LAYING: In case of external application on ceiling or walls, where long lengths are installed, the effects of expansion contractions shall be considered while assembly of uPVC pipe system. This problem can be solved by using suitable expansion loops.

The plumbing contractor shall set the layout of the plumbing and should get approval by the Engineer-in-charge. Pipes shall be laid in plumb and in straight and parallel lines.

For Concealed piping Chases of size 75 mm x 75 mm shall be cut in the wall, floor wherever required or as directed, by chases cutting machine. After testing the pipe line the chases shall be filled with cement mortar 1:3 and surface made good to its original condition.

For Underground use, the trench bottom shall be carefully examined for the presence of hard objects such as flints, rock projection or tree roots etc. Pipe shall be embedded in sand or soft soil, free from rock & gravel, back fill 150mm above the pipe shall also be of fine sand or soft soil. Pipe shall not be painted. The width of trench

shall not be less than outside diameter of pipe plus 300 mm in case of gravel soils. Pipe shall be laid at-least 900 mm below the ground level (measured from the surface of the ground to the top of pipe). When pressure pipelines are laid in hot climatic conditions it is advisable to fill the pipe with cold water to bring the pipe lengths to normal contracted dimension, before laying.

The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

Wherever threaded joint is intended for accepting CP fittings etc. brass threaded fittings shall be used / provided with appropriate support to resist forces developed while operating fittings.

4.6.10: FIXING: The entire pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. All pipes shall be fixed truly vertical and horizontal unless unavoidable.

Spacing between clamps for fixing internal/external/exposed piping shall be as per pipe manufactures recommendations or as below:

Spacing between clamps for fixing internal piping shall be as given below :

Pipe dia	For Horizontal Runs	For Vertical Runs
20 mm	700 mm	1050 mm
25 mm	750 mm	1125 mm
32 mm	825 mm	1240 mm
40 mm	975 mm	1460 mm
50 mm	975 mm	1460 mm

4.6.11: JOINTING: Cut the pipe as square as possible. Please ensure that fitment of pipe with socket of fitting is correct. Total length of insertion of socket shall be marked on pipe (for most of the cases the pipe inserted should be up to the marked line and in no case shall be less than 2/3rd of the pipe end up to the marked line). The pipe and the socket should be clean and dry. Dust, oil, water, grease etc. should be wiped out with dry cloth or cleaned from the surfaces to be coated with solvent cement. Roughen the outside of the pipe and the inside of the socket using sand paper or piece of hacksaw blade up to the entry mark. Stir adhesive i.e. solvent cement thoroughly. Apply a thick coat of suitable grade of good quality solvent cement using a flat clean brush evenly on the inside of the socket mouth for full length of insertion and then on outside of the pipe end up to the marked line. After application of solvent cement, insert the pipe within one minute into the socket. Hold the joint for few seconds and ensure that pipe does not come out of the fitting. Wipe off extra cement. Let it dry and curing for 24 hours before pressure testing.

Solvent cement recommended by pipe manufacturer shall be used as per manufactures instructions and procedures.

4.6.12: PAINTING: If required Piping system shall be painted using water base paints. Painting shall be done only with permission of Engineer In charge.

4.6.13: TESTING: The pipes and fittings after they are laid and jointed shall be tested to hydraulic pressure of 1.5 times of Maximum Working pressure as per ASTM (table above). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually, Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least 2 (two) hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found leaking shall be replaced and joints found leaking shall be redone & retested, without extra payment.

4.6.14: THE RATE INCLUDES FOR:

4.6.14.1.Supplying uPVC pipes and uPVC fittings such as Union, Nipples, Bends, Elbows, Tees, Reducers, End caps, Couplers, Adaptors, Saddles, Plugs, Tank connectors, Expansion loops, Bypass bends, check-nuts, sockets, plugs, etc. of specified diameter & class including clamps and fixing material, tools & plants.

4.6.14.2. Laying, jointing and fixing the pipe with fittings including welding, cutting pipes, wastage etc.

4.6.14.3. All necessary materials, labour and use of tools.

4.6.15: MODE OF MEASUREMENT: The measurement shall be for unit running metre length of pipe line of specified nom. bore laid or fixed and shall be taken along center line of the pipe line.

4.7 C-PVC PIPING WORK:

4.7.1 GENERAL: The item includes provision of C-PVC (Chlorinated Polyvinyl chloride) pipes with C-PVC fitting of specified nom. size and class as mentioned in the schedule including laying, fixing, testing etc. The C-PVC pipes and fittings shall run on the surface of the walls / ceilings (Exposed) or concealed in walls, beams, columns, below floor etc. or laying below the ground / floor as specified in the schedule of quantities.

4.7.2 MATERIAL: The pipes and fittings shall be of C-PVC as specified in the schedule and UV stabilized. They shall conform to IS: 15778 upto 50mm dia and ASTM above 50mm dia. All the pipes and fitting shall have ISI/ASTM certification mark. The specified nominal size of the pipe shall refer to approximate inner diameter. The pipe and fittings shall be smooth, sound, free from any imperfections and neatly dressed. The pipe and fitting shall be able to withstand a hydrostatic test pressure as prescribed / referred in IS: 15778.

4.7.3 EXAMINING: Before laying the pipe line, it shall be examined for damages and cracks or any other imperfections. No cracked or damaged pipes shall be used in the work and they shall be removed from the site by the Contractor at his own cost & charges. The colour of the pipe shall be off-white. Slight variations in the appearance of the colour are permitted. The internal & external surfaces of the pipe shall be smooth, clean & free from grooving & other defects.

The pipes & fittings shall be inspected at site before put into use to ascertain that they conform to the specification above. Keep the pipes & Fittings in original Packaging until needed and stored pipes in covered area. Wherever necessary pipes should be cut square, deburred & beveled as required by the manufacturer before jointing. The screw threads of pipes, Specials and Fittings shall be protected from damage until they are fitted.

The table showing the dimensions and different bores of pipes are given below.

S.N	Nominal Size in **mm**	Nominal Outside Diameter (D) in **mm**	Mean Outside Diameter At Any Point		Outside Diameter At Any Point		**Wall Thickness**					
							Class 1 (SDR-11)		**Class 2 (SDR-13.5)**		**Class 3 (SDR-17)**	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i	15	15.9	15.8	16.0	15.8	16.0	1.7	2.2	1.4	1.9	-	-
ii	20	22.2	22.1	22.3	22.0	22.4	2.0	2.5	1.7	2.2	-	-
iii	25	28.6	28.5	28.7	28.4	28.8	2.6	3.1	2.1	2.6	-	-
iv	32	34.9	34.8	35.0	34.7	35.1	3.2	3.7	2.6	3.1	-	-
v	40	41.3	41.2	41.4	41.1	41.5	3.8	4.3	3.1	3.6	-	-
vi	50	54.0	53.9	54.1	53.7	54.3	4.9	5.5	4.0	4.6	-	-
vii	65	73.0	72.8	73.2	72.2	73.8	-	-	-	-	4.3	4.8
viii	80	88.9	88.7	89.1	88.1	89.7	-	-	-	-	5.2	5.9
ix	100	114.3	114.1	114.5	113.5	115.1	-	-	-	-	6.7	7.5
x	150	168.3	168.0	168.6	166.5	170.1	-	-	-	-	9.9	11.1

Materials shall be marked as per relevant codal provisions. Working Pressure for C-PVC Pipes as per IS: 15778

All values are in MPa

Sr. No.	Pressure Class	Working Pressure At		
		SDR	27°C	82°C
(1)	(2)	(3)	(4)	(5)

i	1	11	2.76	0.68
ii	2	13.5	2.18	0.55
iii	3	17	1.73	0.42

4.7.4. LAYING & FIXING: The pipes shall be carefully laid straight to correct, line, level & alignment in gradients. All pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

A) Exposed over walls/columns/beams/ceiling etc.

The plumbing contractor shall set the layout of the plumbing as per the drawing and/or approved by the Engineer-in-charge. Pipes shall be laid in plumb and in straight and parallel lines and shall be fixed in position using G.I clamps having not less than 2 mm thick or with suitable PVC Straps / clamps. The clamps shall be fixed on the wall with CP brass screws of not less than 40 mm long and wooden gutties. The spacing for horizontal & vertical supports at different temperature is given below:

S.N	Nominal Size in **mm**	21°C (70°F)		49°C (120°F)		71°C (160°F)		82°C (180°F)	
		FT	cm	FT	cm	FT	cm	FT	cm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i	15	5.5	168.0	4.5	137.0	3.0	91.0	2.5	76.0
ii	20	5.5	168.0	5.0	152.0	3.0	91.0	2.5	76.0
iii	25	6.0	183.0	5.5	168.0	3.5	107.0	3.5	107.0
iv	32	6.5	198.0	6.0	183.0	3.5	107.0	3.5	107.0
v	40	7.0	213.0	6.0	183.0	3.5	107.0	3.5	107.0
vi	50	7.0	213.0	6.5	198.0	4.0	122.0	3.5	107.0

It is not necessary to insulate hot water concealed C-PVC pipe. However, for water supply where central heating system is used for distribution of hot water, it is necessary to insulate distribution lines to prevent excessive loss of heat and energy wastage. Apply two coats of water based Paint of approved make & shade for exposed piping matching the surrounding surface, if required.

B) Concealed piping

The entire pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. All pipes shall be fixed truly vertical and horizontal unless unavoidable.

Chases of size 75 mm x 75 mm shall be cut in the wall, floor or slab wherever required or as directed using chases cutting machine. After laying, jointing & testing the pipe line, the chases shall be filled with cement mortar 1:3 and surface made good to its original condition. No concealed pipe shall be painted.

C) Underground piping

For Underground use, the trench bottom shall be carefully examined for the presence of hard objects such as flints, rock projection or tree roots etc. Pipe shall be embedded in sand or soft soil, free from rock & gravel, back fill 150 mm above the pipe shall also be of fine sand or soft soil. Pipe shall not be painted. The width of trench shall not be less than outside diameter of pipe plus 300 mm in case of gravel soils. Pipe shall be laid at-least 900 mm below the ground level (measured from the surface of the ground to the top of pipe).

The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing.

Wherever threaded joint is intended for accepting CP fittings etc. brass threaded fittings shall be used / provided with appropriate support to resist forces developed while operating fittings. No underground pipe shall be painted.

4.7.5 JOINTING : Ensure that there are no sharp edges in contact with the pipe while embedding the pipes on walls or in the floors. In order to make a proper and neat joint, measure the pipe length accurately & make a small mark. Ensure that the pipes & Fittings are size compatible. Pipes can be easily cut with a wheel type plastic pipe cutter or hacksaw blade. Cutting tubing as squarely as possible facilitates optimal bonding area within a joint. Debarking tool, pocket Knife or File shall be used to remove burrs & fillings. Use a clean, dry rag, wipe dirt & moisture from the Fitting sockets & tubing end. The tubing shall make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket. Use only C-PVC cement or an all purpose cement conforming to IS 15225 and Teflon tapes for threaded joints. When making a joint, apply a heavy even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can clog the water ways. Immediately insert the tubing into the fitting socket, rotate the tube ¼ to ½ turn while inserting.

Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set up.

4.7.6 PAINTING: If required Piping system shall be painted using water base paints. Painting shall be done only with permission of Engineer In charge.

4.7.7 TESTING: The pipes and fittings after they are laid and jointed shall be tested to hydraulic pressure of 2 MPa (20 Kg/sq.cm) at normal temperature. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually, Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least 2 (two) hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found leaking shall be replaced and joints found leaking shall be redone, without extra payment.

4.7.8 THE RATE INCLUDES FOR :

4.7.8.1. Supplying C-PVC pipes and fittings such as Union, Nipples, Bends, Elbows, Tees, Reducers, End caps, Couplers, Adaptors, Saddles, Plugs, Tank connectors, Expansion loops, Bypass bends, check-nuts, sockets, plugs, etc. of specified diameter & class including clamps and fixing material, tools & plants.

4.7.8.2. Laying, jointing and fixing the pipe with fittings including, cutting pipes, wastage etc.

4.7.8.3. All necessary materials, labour and use of tools

4.7.9 MODE OF MEASUREMENT: The measurement shall be for unit running meter length of pipe line of specified nominal size laid or fixed and shall be taken along center line of the pipe line.

4.8. PP-R PIPING WORK:

4.8.01 GENERAL: The item includes provision of PP-R (Polypropylene Random Copolymer) pipes with PP-R fitting of specified nominal size and class as mentioned in the schedule including laying, fixing. The PP-R pipes and fittings shall run on the surface of the walls or ceilings unless otherwise specified.

4.8.02 MATERIAL: The pipes and fittings shall be of PP-R as specified in the schedule and UV stabilized. They shall conform to IS: 15801-2008. All the pipes and fitting shall have ISI certification mark. The specified nominal size of the pipe shall refer to outside approximate diameter. The pipe and fittings shall be smooth, sound, free from any imperfections and neatly dressed. The pipe and fitting shall be able to withstand a hydrostatic test pressure as prescribed / referred in IS: 15801-2008. The table showing the dimensions and different bores of pipes are given below.

Dimensions of Polypropylene Random Copolymer Pipes

As per IS:15801-2008

All dimensions in millimeters

Sr. No.	Nominal size	Nominal Outside Diameter	Outside Diameter		Wall Thickness							
					SDR 11		SDR 7.4		SDR 6		SDR 5	
			Toler-ance	Ova-lity	Max	Min	Min	Max	Min	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i	16	16	0.3	1.2	-	-	2.2	2.7	2.7	3.2	3.3	3.9
ii	20	20	0.3	1.2	1.9	2.3	2.8	3.3	3.4	4.0	4.1	4.8
iii	25	25	0.3	1.2	2.3	2.8	3.5	4.1	4.2	4.9	5.1	5.9
iv	32	32	0.3	1.3	2.9	3.4	4.4	5.1	5.4	6.2	6.5	7.4
v	40	40	0.4	1.4	3.7	4.3	5.5	6.3	6.7	7.6	8.1	9.2
vi	50	50	0.5	1.4	4.6	5.3	6.9	7.8	8.3	9.4	10.1	11.4
vii	63	63	0.6	1.6	5.8	6.6	8.6	9.7	10.5	11.8	12.7	14.2
viii	75	75	0.7	1.6	6.8	7.7	10.3	11.6	12.5	14.0	15.1	16.9
ix	90	90	0.9	1.8	8.2	9.3	12.3	13.8	15.0	16.7	18.1	20.2
x	110	110	0.9	2.2	10.0	11.2	15.1	16.9	18.3	20.4	22.1	24.6
xi	160	160	1.5	3.2	14.6	16.3	21.9	24.3	26.6	29.5	32.1	35.6

No negative tolerances are allowed.

Pipes and fittings shall be fusible and fusion joint shall conform to IS recommendations.

Material shall be marked as per relevant codal provisions.

Allowable Maximum Operating Pressure for PP-R Pipes

As per IS:15801-2008

Sr. No.	SDR 11		SDR 7.4		SDR 6		SDR 5	
	Temp °C	Pressure MPa	Temp °C	Pressure MPa	Temp °C	Pressure MPa	Temp °C	Pressure MPa
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i	10	1.91	10	3.02	10	3.80	10	4.78
ii	20	1.63	20	2.58	20	3.24	20	4.09
iii	30	1.37	30	2.17	30	2.73	30	3.44
iv	40	1.15	40	1.84	40	2.30	40	2.90
v	50	0.98	50	1.55	50	1.95	50	2.46
vi	60	0.82	60	1.28	60	1.62	60	2.04
vii	70	0.62	70	0.98	70	1.23	70	1.55
viii	80	0.39	80	0.62	80	0.77	80	0.98
ix	95	0.27	95	0.41	95	0.52	95	0.65

4.8.03 **LAYING**: In case of external application on ceiling or walls, where long lengths are installed, the effects of expansion contractions shall be considered while assembly of PP-R pipe system. This problem can be solved by using suitable expansion loops. It is not necessary to insulate hot water concealed PP-R pipe. However, for water supply where central heating system is used for distribution of hot water, it is necessary to insulate distribution lines to prevent excessive loss of heat and energy wastage.

The plumbing contractor shall set the layout of the plumbing approved by the Engineer-in-charge. Pipes shall be laid in plumb and in straight and parallel lines.

For Concealed piping Chases of size 75 mm x 75 mm shall be cut in the wall, floor, and slab wherever required or as directed by chases cutting machine. After testing the pipe line the chases shall be filled with cement mortar 1:3 and surface made good to its original condition.

For Underground use, the trench bottom shall be carefully examined for the presence of hard objects such as flints, rock projection or tree roots etc. Pipe shall be embedded in sand or soft soil, free from rock & gravel, back fill 150mm above the pipe shall also be of fine sand or soft soil. Pipe shall not be painted. The width of trench shall not be less than outside diameter of pipe plus 300 mm in case of gravel soils. Pipe shall be laid at-least 900 mm below the ground level (measured from the surface of the ground to the top of pipe).

The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

Wherever threaded joint is intended for accepting CP fittings etc. brass threaded fittings shall be used / provided with appropriate support to resist forces developed while operating fittings.

4.8.04 **FIXING** : The entire pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. All pipes shall be fixed truly vertical and horizontal unless unavoidable.

Spacing between clamps for fixing internal/external/exposed piping shall be as per as per pipe manufactures recommendations.

4.8.05 **JOINTING** : PP-R pipes and fittings shall be jointed together by poly-fusion welding. Poly-fusion process consists of mixing of melted material of external surface of the pipe and internal surface of fitting, after heating them to 260°C to 280°C on the small welding machine called poly-fusion device. Properly welded joint, when cut through, should not show traces of contact surface between pipe and fitting in the entire volume of joint. Fusion process should give homogeneous, integral, long lasting, leak proof joints.

Procedure:

Cut the pipe square to the required length by cutter. Deburr the cut end if necessary. Pipe ends must be clean cut at right angles.

Prior to welding, the pipe and fitting should be dried and properly cleaned.

Mark the required insertion depth (welding depth) on the pipe with the help of suitable marker.

Ensure that welding device is hot enough for welding. Heat the pipe and fitting on the polyfusion device as per the recommendation of pipe and device manufacturer and proceed the process as per recommendations.

4.8.06 PAINTING: If required Piping system shall be painted using water base paints. Painting shall be done only with permission of Engineer In charge.

4.8.07 TESTING : The pipes and fittings after they are laid and jointed shall be tested to hydraulic pressure of 2 MPa (20 Kg/sq.cm) at normal temperature. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually, Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least 2 (two) hours. The pipes and fittings shall be tested in sections as the work of paying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found leaking shall be replaced and joints found leaking shall be redone, without extra payment.

4.8.08 THE RATE INCLUDES FOR :

4.8.07.1 Supplying PP-R pipes and PP-R fittings such as Union, Nipples, Bends, Elbows, Tees, Reducers, End caps, Couplers, Adaptors, Saddles, Plugs, Tank connectors, Expansion loops, Bypass bends, check-nuts, sockets, plugs, etc. of specified diameter & class including clamps and fixing material, tools & plants.

4.8.07.2 Laying, jointing and fixing the pipe with fittings including welding, cutting pipes, wastage etc.

4.8.07.3 All necessary materials, labour and use of tools

4.8.09 MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line of specified nom. size laid or fixed and shall be taken along center line of the pipe line.

4.9 GUN METAL/ BRASS COPPER ALLOY FULL WAY (GATE / GLOBE) VALVE :

4.9.01 GENERAL : The item includes provision of full way (gate or globe) valve of specified diameter as mentioned in the schedule including fixing. Full way valve is a valve suitable for controlling or stopping the flow in water supply lines.

4.9.02 MATERIAL : Full way valve shall be of either Brass fitted with a cast iron hand wheel or Gun metal fitted with a C.I. hand wheel or copper alloy as the case may be and shall be of Gate valve type opening full way and of the size as specified conforming to IS 778. The weight of the full way gate valve shall be as per the table given below with a tolerance of 5 percent.

Diameter in mm	Flanged arch (Kg)	Screwed arch (Kg)
15	1.021	0.567
20	1.503	0.680
25	2.495	1.077
32	3.232	1.559
40	4.082	2.268
50	6.691	3.232
65	10.149	6.804
80	13.381	8.845

4.9.03 FIXING : The valves shall be fixed in position in the pipeline as shown in the drawing or as directed with necessary socket or union, nuts etc. The screwed, flanged joint shall be made with few turns of fine hemp yarn dipped in linseed oil taken over the threaded ends to obtain complete water tightness.

4.9.04 TESTING : The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm^2) along with the testing of pipe line.

4.9.05 THE RATE INCLUDES FOR :

4.24.05.1 Valve, G.I. fittings, hemp yarn, linseed oil, zinc, fixing and testing.

4.24.05.2 All necessary labour, materials and use of tools.

4.9.06 MODE OF MEASUREMENT : The measurement shall be for each unit valve of specified diameter fixed.

4.10 WATER METER :

4.10.01 GENERAL : The item includes provision of Water meter with or without end flanges or non-return valve of specified diameter as mentioned in the schedule with strainer, sockets, flange, union, nuts etc. including fixing and testing.

4.10.02 MATERIAL : Water Meter shall conform to IS 779 (Domestic type) or IS 2373 (Bulk type) as specified in Schedule of Quantities and should have ISI certification mark. Non return valve and strainer shall be of the same diameter as that of water meter. Strainer, sockets, flange, union, union nuts, rubber packing etc. shall be as per the description of item.

4.10.03 FIXING : Water meter shall be fixed in position on the inlet pipe line and the joints shall be

made either screwed or flanged with necessary sockets, flanges and union nuts as required or as directed by the Engineer-in-charge.

4.10.04 SCREWED JOINT : A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tight joint.

4.10.05 FLANGED JOINT : The flange joint shall be made for flange type water meter and the joint shall be as per the specification of flanged joint.

4.10.06 TESTING : The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm^2) along with testing of pipe line for a minimum duration of two hours.

4.10.07 THE RATE INCLUDES FOR :

4.10.07.1 Water meter, hemp yarn, linseed oil, zinc, fixing and testing.

4.10.07.2 Supplying of strainer non-return valve, sockets, union nut etc.

4.10.07.3 Making screwed or flanged joints.

4.10.07.4 All necessary labour, material and use of tools.

4.10.08 MODE OF MEASUREMENT : The measurement shall be for each unit of water meter of specified diameter fixed.

4.11 PRESSURE REDUCING VALVE :

4.11.02 GENERAL : The item includes provision of pressure reducing valve of specified diameter as mentioned in the schedule including fixing.

4.11.03 MATERIAL: Pressure reducing valve is a device with suitable means of connection for insertion in a vertical pipe line for controlling the water pressure. Valve shall be of brass and shall be vertical flow type, conforming to IS 9739-1981.

4.11.03 FIXING : The valve shall be fixed in position on the pipe line as shown in the drawing or as directed. The screwed or flanged joint shall be made to obtain complete water tight joint.

4.11.04 TESTING : The joints shall be tested to a hydraulic pressure of 1MPa (10 kg/cm^2)along with testing of pipe line for a minimum duration of 2 hrs.

4.11.05 THE RATE INCLUDES FOR :

4.11.05.1 Supplying Valve including fixing and testing.

4.11.05.2 All necessary labour, materials and use of tools.

4.11.06 MODE OF MEASUREMENT : The measurement shall be for each unit of valve of specified diameterfixed.

4.12 CAST IRON WATER QUALITY PIPING WORK :

4.12.01 GENERAL : The item includes the provision of supplying water quality cast iron pipe of specified diameter including cutting, laying, fixing, and painting the pipe line.

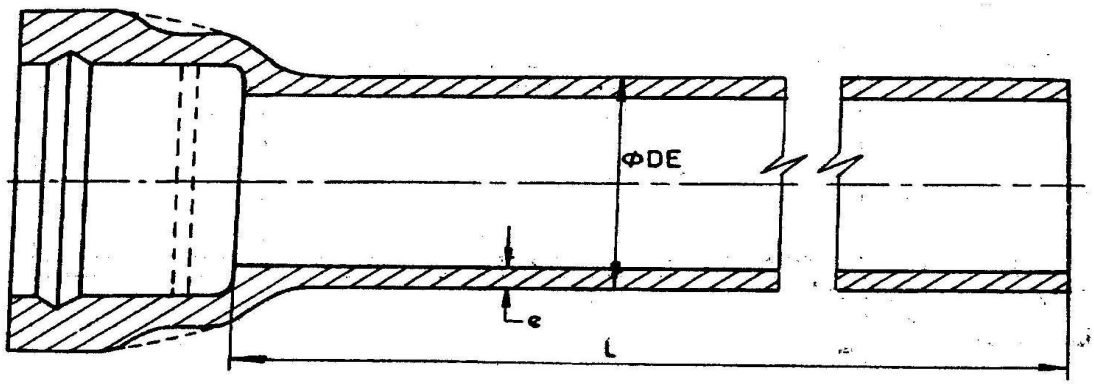
4.12.02 MATERIAL : The pipes shall be centrifugally cast (spun) Iron Pressure pipe conforming to IS 1536 and shall be of class “LA”, ‘A’ or “B”. These shall be of socket and spigot or double flanged. All the pipes shall be cylindrical reasonably true with inner and outer surfaces and nearly concentric as practicable. The outer surface shall be smooth, sound, free from pin holes, cracks and other imperfections. The pipes shall be treated with solution of Dr. Angus Smith’s solution. The coated surface shall give glossy finish. The table showing the dimensions & weight of different diameter of pipes is given below:

CENTRIFUGALLY CAST (SPUN) IRON ‘WATER QUALITY’ PIPES

Tolerences : a) Length ± 25 mm (b) weight 5% (c) Thickness ± (1+0.05e)mm Value of `e` for

(i) LA class pipe e = 10/12 (7 + 0.02 DN) (ii) A class pipe e = 11/12 (7 + .02 DN)

(iii) B class pipe e = (7 + 0.02 DN)



CENTRIFUGALLY CAST (SPUN) IRON 'WATER QUALITY' PIPES WEIGHT FOR SOCKET & SPIGOT PIPES (IS 1536-2001)

Nom. Dia.	Cla -ss	Barrel				Socket Mass	Total weight for one working length ' L' in meter					
DN Mm		Lead joint	Push-on joint	Thick-ness	Mass for 1 Mt		3.66	4	4.5	5	5.5	6
		DE mm	DE mm	e mm	kg	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.
80	LA	98	95	7.2	14.7	5.5	59.0	64.0	-	79.0	-	-
	A	98	95	7.9	16.0	5.5	64.0	70.0	78.0	86.0	-	-
	B	98	95	8.6	17.3	5.5	69.0	74.0	83.0	92.0	-	-
100	LA	118	115	7.5	18.6	7.1	75.0	82.0	91.0	100.0	109.0	119.0
	A	118	115	8.3	20.5	7.1	82.0	89.0	99.0	109.0	120.0	130.0
	B	118	115	9.0	22.0	7.1	88.0	95.0	106.0	117.0	128.0	139.0
125	LA	144	141	7.9	24.2	9.2	98.0	106.0	118.0	130.0	142.0	154.0
	A	144	141	8.7	26.4	9.2	106.0	115.0	128.0	141.0	155.0	168.0
	B	144	141	9.5	28.7	9.2	114.0	124.0	138.0	153.0	167.0	181.0
150	LA	170	167	8.3	30.1	11.5	122.0	132.0	147.0	162.0	177.0	192.0
	A	170	167	9.2	33.2	11.5	133.0	144.0	161.0	178.0	194.0	211.0
	B	170	167	10.0	35.9	11.5	143.0	155.0	173.0	191.0	209.0	227.0
200	LA	222	219	9.2	44.0	16.5	178.0	193.0	215.0	237.0	259.0	281.0
	A	222	219	10.1	48.1	16.5	193.0	209.0	233.0	257.0	281.0	305.0
	B	222	219	11.0	52.1	16.8	207.0	225.0	251.0	278.0	304.0	329.0
250	LA	274	271	10.0	59.3	22.9	240.0	260.0	290.0	319.0	349.0	379.0
	A	274	271	11.0	65.0	22.9	261.0	283.0	315.0	348.0	380.0	413.0
	B	274	271	12.0	70.6	22.9	281.0	305.0	341.0	376.0	411.0	447.0
300	LA	326	323	10.8	76.5	29.8	310.0	336.0	374.0	412.0	450.0	489.0
	A	326	323	11.9	84.0	29.8	337.0	366.0	408.0	450.0	492.0	534.0
	B	326	323	13.0	91.4	29.8	364.0	395.0	441.0	487.0	533.0	578.0
350	LA	378	375	11.7	96.3	37.5	390.0	423.0	471.0	519.0	567.0	615.0
	A	378	375	12.8	105.0	37.5	422.0	458.0	510.0	563.0	615.0	668.0
	B	378	375	14.0	114.5	37.5	457.0	495.0	553.0	610.0	667.0	725.0
400	LA	429	426	12.5	116.9	46.3	474.0	514.0	572.0	631.0	690.0	748.0
	A	429	426	13.8	128.7	46.3	517.0	561.0	625.0	690.0	754.0	819.0
	B	429	426	15.0	139.5	46.3	557.0	604.0	674.0	744.0	814.0	883.0
450	LA	480	477	13.3	141.0	56.0	572.0	620.0	690.0	761.0	832.0	902.0
	A	480	477	14.7	156.0	56.0	627.0	680.0	758.0	836.0	914.0	992.0
	B	480	477	16.0	169.0	56.0	675.0	732.0	816.0	901.0	986.0	1070.0
500	LA	532	529	14.2	165.2	66.0	671.0	727.0	809.0	892.0	974.0	1057.0
	A	532	529	15.6	181.0	66.0	728.0	790.0	880.0	971.0	1061.0	1152.0
	B	532	529	17.0	196.7	66.0	786.0	853.0	951.0	1049.0	1148.0	1246.0
600	LA	635	632	15.8	219.8	89.3	894.0	968.0	1162.0	1188.0	1298.0	1408.0
	A	635	632	17.4	241.4	89.3	973.0	1055.0	1141.0	1272.0	1404.0	1544.0
	B	635	632	19.0	262.9	89.3	1052.0	1141.0	1272.0	1404.0	1535.0	1667.0
700	LA	738	735	17.5	283.2	116.8	1153.0	1250.0	1391.0	1538.0	1675.0	1816.0
	A	738	735	19.3	311.6	116.8	1257.0	1363.0	1519.0	1675.0	1830.0	1986.0

	B	738	735	21.0	338.2	116.8	1355.0	1470.0	1639.0	1808.0	1977.0	2146.0
750	LA	790	787	18.3	317.2	131.7	1293.0	1400.0	1559.0	1718.0	1876.0	2035.0
	A	790	787	20.2	348.9	131.7	1409.0	1527.0	1702.0	1876.0	2051.0	2225.0
	B	790	787	22.0	380.6	131.7	1525.0	1644.0	1844.0	2029.0	2225.0	2415.0
800	LA	842	839	19.2	354.9	147.8	1447.0	1567.0	1745.0	1922.0	2100.0	2277.0
	A	842	839	21.1	389.1	147.8	1572.0	1704.0	1899.0	2093.0	2288.0	2482.0
	B	842	839	23.0	423.1	147.8	1696.0	1840.0	2052.0	2263.0	2475.0	2686.0
900	LA	945	942	20.8	421.8	182.6	1763.0	1910.0	2126.0	2342.0	2558.0	2773.0
	A	945	942	22.9	474.3	182.6	1918.0	2080.0	2317.0	2554.0	2791.0	3028.0
	B	945	942	25.0	516.6	182.6	2073.0	2249.0	2507.0	2766.0	3024.0	3282.0
1000	LA	1048	1045	22.5	518.3	222.3	2119.0	2295.0	2555.0	2814.0	3073.0	3392.0
	A	1048	1045	24.8	570.0	222.3	2308.0	2502.0	2787.0	3072.0	3357.0	3642.0
	B	1048	1045	27.0	619.2	222.3	2489.0	2699.0	3009.0	3318.0	3621.0	3938.0
1050	LA	1124	1118	23.6	583.4	309.6	2445.0	2643.0	2935.0	3227.0	3518.0	3810.0
	A	1124	1118	26.0	641.2	309.6	2656.0	2874.0	3195.0	3516.0	3836.0	4157.0
	B	1124	1118	29.0	713.3	309.6	2920.0	3163.0	3519.0	3876.0	4233.0	4589.0

4.12.03 UNLOADING : The pipe shall be unloaded where they are required. Where mechanical handling facility are not available, pipes weighing upto 60 kg shall be handled by two persons by hand passing and heavier pipes shall be unloaded from the lorry or wagon by holding them in loops, formed with ropes and sliding over plank set not steeper than 45 degrees. Two ropes always shall be used and only one pipe shall be unloaded at a time. Under no circumstances shall pipes be thrown down from the carriers or be dragged or rolled along hard surfaces. The pipes shall be checked for any visible damage while unloading and shall be sorted out for reclamation**.**

4.12.04 STORING : The pipes shall be lined upon on one side of the alignment of the trench, socket facing upgrade when line runs uphill and up stream when line runs on level ground. Each stack shall contain pipes of same class and size. Storage shall be done on firm, level and clean ground. Wedges shall be provided at the bottom layer to keep the stack stable.

4.12.05 CLEANING : The pipes shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and inside of socket and outside of the spigot shall also be cleaned in similar way.

4.12.06 EXAMINATION : Before pipe is laid it shall be first examined for damage and cracks. No cracked or damaged pipe shall be used. The pipe shall be tested with a hammer to prove its soundness

4.12.07 DAMAGED MATERIAL : If any material found damaged or cracked, the same shall not be used in the work. The contractor has to replace the same at his own cost and charges.

4.12.08 TRENCHES : The depth of the trenches shall not be less than 1000 mm measured from the top of the pipe to the surface of the ground under roads and not less than 750 mm elsewhere. The width of the trench shall be the nominal diameter of the pipeline plus 400mm, but it shall not less than 550 mm in case of all kind of soil, excluding rock and not less than 1000 mm in case of rock.

Trench shall be so deep that the pipes may be laid to the required alignment and at required depth. The width of trench at bottom between face of sheeting shall be such as to provide not less than 200 mm clearance on either side of the pipe. Trenches shall be of such extra width, when required as will permit the convenient placing of timber supports strutting and planking handling of specials etc. The bed of trench, in soft or made up earth, shall be well watered and rammed before laying the pipes and depression, if any, shall be properly filled with earth and consolidated in 20 cm layers.

If the trench bottom is extremely hard or rocky or loose stoney soil, the trench shall be excavated 150mm below the trench grade. Rocks, stones or other hard substances from the bottom of the trench shall be removed & trench brought back to the required grade by filling with selected fine earth or sand or fine murrum & compact so as to provide a smooth bedding for pipe.

After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipe. The barrels of the pipes shall rest through their entire length on the solid ground that sufficient space left for jointing the under side of the pipe joints. These socket holes shall be refilled with sand after jointing the pipe.

The trench shall be kept free from water shoring and timbering shall be provided wherever required. Excavation below water table shall be done after dewatering the trenches.

The road crossing shall be excavated half at a time and where the pipe line/drain crosses on existing road after the pipe have been laid in the first half and the trench refilled. Care shall be taken not to disturb the electrical & communication cable net with during the course of excavation.

4.12.09 LOWERING : The pipe shall then be placed in trenches by means of proper sheer legs, chains and other tacts and shall be properly driven home. In no case pipe shall be rolled or dropped into the trench. One end of rope may be tied to a wooden or steel Pag or driven into ground and other end hold by men which when slowly released till lower the pipe into trench

4.12.10 LAYING : The pipes shall be carefully laid straight to correct alignment in raising or falling gradients. The socket end of the pipe shall face uphill. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. While jointing the spigot it should be neatly placed into the socket for full length and properly supported. The pipe shall be carefully packed underneath so that they shall bear loads arising from traffic evenly through out their whole length. The entire length of pipe shall be supported on bed of the trench evenly through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of the day's work the open end shall be suitably plugged.

No pipe shall be laid until the trench has been excavated to its required depth for a distance of about 5 M in front of the pipe to be laid. No pipe shall be covered until it has been passed by the Engineer-in-charge.

In unstable soils, such as soft soil and dry lumpy soil it shall be checked whether the soil can support the pipe and if required, suitable special foundation shall be provided.

Where the soils are drastically affected by extremes of saturation and dryness, those soils are subjected to extraordinary shrinkage which from wide and deep cracks in the earth surface may result in damage to underground pipe because of tight gripping bond between pipe and clay, subjecting to it excessive stresses as the clay shrinks. In such case an envelop of minimum 100 mm of tamped sand shall be made around the pipe line to avoid any bonding.

In places where rock is encountered, cushion of fine earth or sand shall be provided for a depth of 150mm by excavating extra depth of the trench where the gradient of the bad slopes is more than 30 depths, it may necessary do and or fine pipe against sliding downwards.

4.12.11 FIXING: The contractor shall first get the layout for pipe line approved by the Engineer-in-charge as may be required by the bye-laws. The pipe line shall be so fixed / laid as not to expose to the heat or subject to any injury or risk to the pipe. The socket end of the pipe shall be facing up. All the pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

4.12.12 THRUST BLOCK : .Thrust blocks are required to transfer the resulting hydraulic thrust from the fittings of pipe on to a larger load bearing soil section. Thrust blocks shall be installed wherever there is a change in the direction/size of the pipe line or the pressure line diagram, or the pipe line ends at a dead end. If necessary, thrust blocks may be constructed at valves also. Thrust block shall be constructed taking into account the pipe size, water pressure, type of filling, gravity component when laid on slopes and the type of soil. In case of pipe line laid in soft soil, joints/couplings are to be anchored on each side by providing side thrust blocks without restricting the coupling.

Pipes on slopes need be anchored only when there is a possibility of the backfill around the pipe sloping down the hill and carrying the pipe with it. Generally for slopes upto 30 degrees, good, well drained soil carefully damped in layers.of 100mm under and over the pipe, right up to the top of trench will not require anchoring.

For steeper slopes, one out of every three pipes shall be held by straps fastened to vertical supports anchored in concrete.

4.12.13 BACK FILLING: Back filling shall follow the pipe installation as closely as possible to protect pipe from falling boulders, eliminating possibility of lifting of the pipe due to flooding of open trench and shifting pipe out of line by caved in soil.

The soil under the pipe and coupling shall be solidly tamped. The initial back fill material shall be free of large stones and dry lumps.

In bags and Monshers gravel or crushed stone may be used for this purpose. The initial back fill shall be placed evenly in a layer of 100 mm thick and consolidated up to a cushion of at least 300 mm cover over the pipe. Joints shall be taken care to resist the movement of the pipe due to pressure while testing.

4.12.14 TESTING :

After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests :

a) Pressure test at a pressure of at least double the maximum working pressure-pipe and joints shall be absolutely water tight under the test.

b) Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for a duration of two hours.

Hydrostatic Tests :

Portions of the line shall be tested by subjecting to pressure test as the laying progresses before the entire line is completed. In this way any error of workmanship will be found immediately and can be corrected at a minimum cost. Usually the length of the section to be tested shall not exceed 500 m.

Where any section of a main is provided with concrete thrust blocks or anchorages, test shall not be made until atleast two days have elapsed.

Prior to testing, enough back fill as described in 4.9.12 shall be placed over the pipe line to resist upward thrust. All thrust blocks forming part of the finished line shall have been sufficiently cured and no temporary

bracing shall be used.

The open end of the section shall be sealed temporarily with an end cap having an outlet which can serve as an air relief vent or for filling the line, as may be required. The blind face of the end cap shall be properly braced during testing by screw jacks and wooden planks or steel plate

The section of the line to be tested shall be filled with water manually or by a low pressure pump. Air shall be vented from all high spots in the pipe line before making the pressure strength test because entrapped air gets compressed and causes difficulty in raising the required pressure for the pressure strength test.

The test pressure shall be gradually raised at the rate of approximately one kg/ sqcm/ mm. The duration of the test period if not specified shall be sufficient to make a careful check on the pipe line section.

Procedure for pressure test :

Each valved section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants and blow offs. If these are not available at high places, necessary tapping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.

If the trench has been partially back-filled the specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer-in-Charge. The duration of the test shall not be less than 5 minutes.

Examination under Pressure : All exposed pipes, fittings, valves, hydrants and joints should be carefully examined during the open-trench test. When the joints are made with lead, all such joints showing visible leaks shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the authority. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until satisfactory to the Engineer- in-Charge.

If the trench has been back-filled to the top, the section shall be first subjected to water pressure normal to the area and the exposed parts shall be carefully examined. If any defects are found, they shall be repaired and the pressure test repeated until no defects are found. The duration of the final pressure tests shall be at least one hour.

Procedure for Leakage Test :

Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No pipe installation shall be accepted until the leakage is less than the number of cm3/h determined by the formula :

$$ql = \frac{ND\sqrt{P}}{3.3}$$

Where ql = the allowable leakage in cm^3/h.

N = number of joints in the length of the pipe line. D = diameter in mm, and

P = the average test pressure during the leakage testing kg/cm^2.

Variation from Permissible Leakage : Should any test of pipe laid in position discloses leakage greater than that specified in above para., the defective joints shall be repaired until the leakage is within the specified allowance.

4.12.15 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

4.12.16 THE RATE INCLUDES FOR :

4.12.16.1 Supplying spigot and socket or monolithic double flanged C.I. Pipe of specified class & diameter.

4.12.16.2 Laying the pipe and cutting the pipe wherever necessary and wastage.

4.12.16.3 Dewatering the Trench or pit if found necessary till completion of work.

4.12.16.4 Fixing the pipe line using M.S. clamps not less than 3 mm thick with wooden gutties etc. if required.

4.12.16.5 Testing the pipe line.

4.12.16.6 All necessary labour, materials and use of tools.

4.12.17 MODE OF MEASUREMENT: The measurement shall be for unit running metre length of pipe line laid or fixed. Measurement shall be taken along the centre line of the pipe deducting outer to outer

length of specials.

4. 13 SPECIALS FOR C.I. WATER SUPPLY PIPE LINE :

4.13.01 GENERAL : The item includes supplying cast iron water quality or M.S. specials of specified diameter for C.I. water supply pipe including laying, fixing and painting the specials.

4.13.02 MATERIALS : The specials for cast iron water quality pipe shall be conforming to IS 1538 & 13382 with socket and spigot or monolithic double flanged. All the fittings shall be cylindrical, reasonably true with inner and outer surfaces and nearly concentric as practicable. The outer surface shall be smooth, sound, free from pin holes, cracks and other imperfections.

M.S. specials shall be made out of M.S. plate of thickness of 6 mm for pipes upto 100mm and 8 mm thick for pipes above 100 mm to 300. 10 mm thick for pipe above 300 mm.

M.S. specials shall be treated with Anticorrosive coating of Bituminous based coro coat.

4.13.03 CLEANING : The specials and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside the socket and outside of the spigot.

4.13.04 EXAMINING : Before special is laid, it shall be first examined for damage and cracks. No cracked or damaged pipe shall be used. The pipe shall be tested with a hammer to prove its soundness.

4.13.05 DAMAGED MATERIAL : If any material found damaged or cracked, the same shall not be used in the work. The contractor has to replace the same at his own cost and charges.

4.13.06 LOWERING : The specials shall then be placed in trenches by means of proper sheer legs, chains and other tacts and shall be properly driven home.

4.13.07 FIXING : The specials shall be fixed by means of lead or flanged joint on C.I. Pipe line wherever required and as shown in the drawing or as directed by the Engineer-in-charge.

4.13.08 TESTING : Joints shall be tested to a hydraulic pressure of 10 kg/cm2 alongwith testing of pipe line and shall be maintained for minimum two hours. All leakages, defects etc. shall be rectified.

4.13.09 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till the completion of work.

4.13.10 THE RATE INCLUDES FOR :

- **4.14.10.1** Supplying spigot and socket or monolithic double flanged C.I. or M.S. specials.
- **4.14.10.2** Fixing the specials wherever necessary.
- **4.14.10.3** Dewatering the trench or pit if found necessary till completion of work.
- **4.14.10.4** All necessary labour, materials and use of tools.

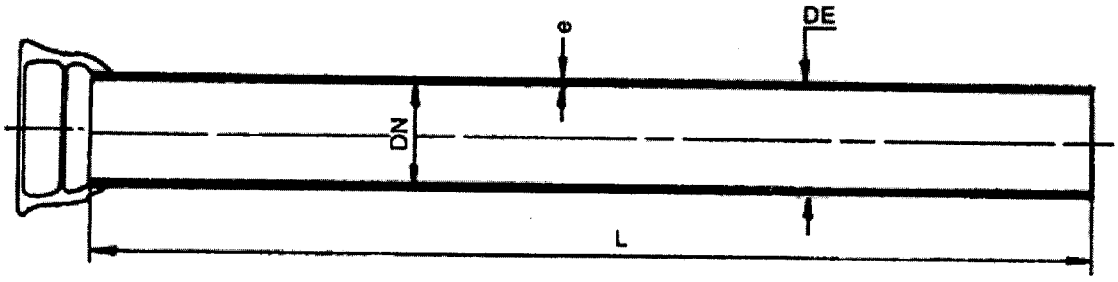
4.13.11 MODE OF MEASUREMENT : The measurement shall be on the basis of IS 1538 for standard weight of specials and/or on the basis of actual unit weight for fixed specials.

4.14. DUCTILE-IRON WATER QUALITY PIPING WORK ;

4.14.01 GENERAL: The item includes the provision of supplying water quality Ductile Iron pipe of specified diameter including cutting, laying, fixing, and painting the pipe line.

4.14.02 MATERIAL: The pipes shall be centrifugally cast (spun) Pressure pipe conforming to IS:8329 and shall be of class "K9" OR "K7". These shall be Push on Flexible Jointed / Mechanical Flexible Jointed / Restrained Jointed / Flanged Jointed. All the pipes shall be cylindrical and all dimension shall be within the tolerance as per IS:8329. The outer surface shall be smooth / textured, sound, free from pin holes, cracks and other imperfections. Outer diameter of pipe shall be metallic zinc coated. Mass of zinc coating shall not be less than 200g/m^2. Above zinc coating bitumen coating shall be applied. Pipe shall be centrifugally cement mortar lined as per IS:8329. The table showing the dimensions of different diameter of pipes is given below:

CENTRIFUGALLY CAST (SPUN) DUCTILE IRON 'WATER QUALITY' PIPES



Dimensions of Sockets and Spigot Pipes

Nominal Diameter	External Diameter	Barrel Wall Thickness (e)		-ve Tolerance	
DN	DE	K7	K9	Thickness(e)	DE
80	98	5.0	6.0	-1.38	-2.2
100	118	5.0	6.0	-1.40	-2.8
125	144	5.0	6.0	-1.43	-2.8
150	170	6.0	6.0	-1.45	-2.9
200	212	5.0	6.3	-1.50	-3.0
250	274	5.3	6.8	-1.55	-3.1
300	326	5.6	7.2	-1.60	-3.3
350	378	6.0	7.7	-1.65	-3.4
400	429	6.3	8.1	-1.70	-3.5
450	480	6.6	8.6	-1.75	-3.6
500	532	7.0	9.0	-1.80	-3.8
600	635	7.7	9.9	-1.90	-4.0
700	738	9.0	10.8	-2.00	-4.3
750	790	9.7	11.3	-2.05	-4.4
300	842	10.4	11.7	-1.60	-4.5
900	945	11.2	12.6	-2.20	-4.8
1000	1048	12.0	13.5	-2.30	-5.0

The tolerance given is subjected to minimum thickness 5mm for K7

a) Tolerances on External Diameter: External Diameter +1 and negative tolerance as per table

b) Tolerance on ovality for Push-on-Joint Pipes:

Allowable Ovality for Push-on- Joint Pipes

Nominal Diameter DN mm	Allowable Difference Between Minor Axis and De, Min mm
(1)	(2)
80 to 300	1.0
350 to 600	1.75
700	2.0
750 to 800	2.4
900 to 1000	3.5

Allowable Ovality for Mechanical Joint Pipe

Nominal Diameter DN mm	Allowable Difference Between Minor Axis and De, Min mm
(1)	(2)
80 to 150	5
200 to 350	10
400 to 500	20
600 to 800	30
900 to 1000	40

c) Tolerance on Length:

Tolerance on length of pipes shall be as follows

Type of Casting	Tolerance mm
1. Socket and spigot and plain ended pipes	± 100
2. Flanged pipes	± 10

4.14.03 UNLOADING: Cranes shall be preferred for off-loading. However, for pipes up to 400 mm nominal bore, skid timbers and ropes may be used.

When using mechanical handling equipment, it is necessary to employ sufficient personnel to carry out the operation efficiently with safety. The pipes should be lifted smoothly without any jerking motion and pipe movement should be controlled by the use of guide ropes/straps in order to prevent damage caused by pipes bumping together or against surrounding objects.

Where the crane operator does not have a clear view, he should be guided by the personnel supervising the operation. When cranes are used, title whole sequence of operation should be carried out smoothly and without snatch. Properly designed hooks and adequate stead ropes/straps are essential. The hooks should be of suitable shape to ensure positive engagement when entered into the ends of the pipes and then should pass over any protective packing fitted around the pipe ends.

4.14.04 STAKING: Pipes being taken to a stock ground for storage and held pending further distribution should be arranged into stacks. The first layer of pipes should be laid on a firm foundation consisting of solid timbers set level on the ground. Subsequent layers should be placed according to the method of stacking adopted. Care should be taken so that the pipes do not rest on their sockets. The height of any stack should not exceed 2 m.

Methods adopted for stacking pipes:

a) Square Stacking - In square stacking method, second and subsequent layers are set at right angles to the previous layer with spigots and sockets alternating in each layer and sockets project beyond spigot end. The pipes rest directly upon those beneath it and care is needed in placing to prevent damage.

b) Parallel Stacking with Timbers - All the pipes are parallel with the sockets of successive layers reversed end-to-end with sockets projecting beyond spigot end. Timber battens, placed about 600 mm from each end at right angles to the pipes, are used to separate the successive layers. Wedges at both ends of each batten prevent pipe movement.

c) Nested Stacking (Pyramid Stacking) - Nested stacking consists of placing each pipe between the two pipes underneath it, with the sockets being all at one end of each layer and being reversed in successive layers. The bottom layer should be firmly anchored to prevent the stack collapse. Bitumen-sheathed pipes should be handled with care to avoid any damage to the sheathing. Sheathed pipes should be lifted by means of properly designed straps/hooks, fittings into the spigot or socket, or by specially designed slings which will not damage the sheathing.

d) Stringing - Stringing consists of placing pipes on the ground in line ready for laying. Care should be taken to prevent damage during this operation.

4.14.06 CLEANING: The pipes shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and inside of socket and outside of the spigot shall also be cleaned in similar way.

4.14.07 EXAMINATION: Before pipe is laid it shall be first examined for damage and cracks. No cracked or damaged pipe shall be used. The pipe shall be tested with a hammer to prove its soundness

4.14.08 DAMAGED MATERIAL: If any material found damaged or cracked, the same shall not be used in the work. The contractor has to replace the same at his own cost and charges.

4.14.09 TRENCHES: The depth of the trenches shall not be less than 1000 mm measured from the top of the pipe to the surface of the ground under roads and not less than 750 mm elsewhere. The width of the trench shall be the nominal diameter of the pipeline plus 400mm, but it shall not less than 550 mm in case of all kind of soil, excluding rock and not less than 1000 mm in case of rock.

Trench shall be so deep that the pipes may be laid to the required alignment and at required depth. The width of trench at bottom between face of sheeting shall be such as to provide not less than 200 mm clearance on either side of the pipe. Trenches shall be of such extra width, when required as will permit the convenient placing of timber supports strutting and planking handling of specials etc. The bed of trench, in soft or made up earth, shall be well watered and rammed before laying the pipes and depression, if any, shall be properly filled with earth and consolidated in 20 cm layers.

If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated 150mm below the trench grade. Rocks, stones or other hard substances from the bottom of the trench shall be removed & trench brought back to the required grade by filling with selected fine earth or sand or fine murrum & compact so as to provide smooth bedding for pipe. After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipe. The barrels of the pipes shall rest through their entire length on the solid ground that sufficient space left for jointing the underside of the pipe joints. These socket holes shall be refilled with sand after jointing the pipe.

The trench shall be kept free from water shoring and timbering shall be provided wherever required. Excavation below water table shall be done after dewatering the trenches.

The road crossing shall be excavated half at a time and where the pipe line/drain crosses on existing road after the pipe have been laid in the first half and the trench refilled. Care shall be taken not to disturb the electrical 85 communication cable net with during the course of excavation.

4.14.10 LOWERING: The pipe shall then be placed in trenches by means of proper sheer legs, chains and other tacts and shall be properly driven home. In no case pipe shall be rolled or dropped into the trench. One end of

rope may be tied to a wooden or steel Pag or driven into ground and other end hold by men which when slowly released till lower the pipe into trench

4.14.11 LAYING:

a) Laying Below Ground - The pipes shall be carefully laid straight to correct alignment in raising or falling gradients. The socket end of the pipe shall face uphill. All the pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. While jointing the spigot it should be neatly placed into the socket for full length and properly supported. The pipe shall be carefully packed underneath so that they shall bear loads arising from traffic evenly through out their whole length. The entire length of pipe shall be supported on bed of the trench evenly through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of the day's work the open end shall be suitably plugged.

No pipe shall be laid until the trench has been excavated to its required depth for a distance of about 5 M in front of the pipe to be laid. No pipe shall be covered until it has been passed by the Engineer-in-charge.

In unstable soils, such as soft soil and dry lumpy soil it shall be checked whether the soil can support the pipe and if required, suitable special foundation shall be provided.

Where the soils are drastically affected by extremes of saturation and dryness, those soils are subjected to extraordinary shrinkage which from wide and deep cracks in the earth surface may result in damage to underground pipe because of tight gripping bond between pipe and clay, subjecting to it excessive stresses as the clay shrinks. In such case envelop of minimum 100 mm of tamped sand shall be made around the pipe line to avoid any bonding.

In places where rock is encountered, cushion of fine earth or sand shall be provided for a depth of 150mm by excavating extra depth of the trench where the gradient of the bed slopes is more than 30°, it may necessary to bind pipe against sliding downwards.

b) Laying Above Ground • The ground should be dressed to match the curvature of the pipe shell for an arch length subtending and angle of 120° at the centre of the pipes- Alternatively, the pipe line should be laid either on saddle, roller or rocker supports as specified by authority. The pipes may be allowed to rest on ground if the soil is non aggressive. *Supporting Pipes above Ground* - The following recommendations assume that no additional bending moments above those due to the self weight of the pipe and its contents are present.

With spigot and Socket Pipes - It is recommended that above ground installations of spigot and socket pipes be provided with one support per pipe, the supports being positioned behind the socket of each pipe.

Pipes should be fixed to the supports with mild steel straps so that axial movement due to expansion or contraction resulting from temperature fluctuation is taken up at individual joints in the pipeline. In addition points should be assembled with the spigot end withdrawn 5 to 10mm from the bottom of the socket to accommodate these thermal movements.

Pipes supported in this way are capable of free deflection and axial movement at the joints which accommodate small movements of the pipe supports.

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

Where a pipeline crosses a watercourse, the design and method of construction should take into account the characteristics of the water course.

With Flanged Pipes - The recommended maximum unsupported span is 8 m. The supports shall be located at the centre of every second pipe. The supports of all flanges pipe work spans should be stable and unyielding due to movements in the pipeline. The straps should prevent any lateral movement or lifting of the pipelines but not restrict expansions and constructions caused by temperature fluctuations.

4.14.12 CUTTING OF PIPES: The cutting of pipe for inserting valves, fittings etc., shall be done in a neat and workman like manner without damage to the pipe or lining so as to leave a smooth end at right angles to the axis of the pipe. Methods of cutting ductile iron pipes are given below:

a) By Hacksaw - Hand or power operated hacksaw should be used with blades having teeth at a pitch of 1mm.

b) By Manually Operated Wheel Cutter - The type of cutting wheel used for cast iron is not suitable for ductile iron pipe. Special wheels are used for cutting steel pipes, shall be used and cut ends are trimmed with a file.

c) By Pipe Cutting Machine - Machines with cutter heads or abrasive wheels shall be used. Cutter head should have a front rake angle 7° as used for steel pipes.

End Preparation of Cut Pipes for Jointing - The burr left after cutting should be trimmed off by light grinding or by filing.

4.14.13 FIXING: The contractor shall first get the layout for pipe line approved by the Engineer-in-charge as may be required by the bye-laws. The pipe line shall be so fixed / laid as not to expose to the heat or subject to any injury or risk to the pipe. The socket end of the pipe shall be facing up. All the pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

4.14.14 THRUST BLOCK: Thrust blocks are required to transfer the resulting hydraulic thrust from the fittings of pipe on to a larger load bearing soil section. Thrust blocks shall be installed wherever there is a change in the

direction/size of the pipe line or the pressure line diagram, or the pipe line ends at a dead end. If necessary, thrust blocks may be constructed at valves also. Thrust block shall be constructed taking into account the pipe size, water pressure, type of filling, gravity component when laid on slopes and the type of soil. In case of pipe line laid in soft soil, joints/couplings are to be anchored on each side by providing side thrust blocks without restricting the coupling.

Pipes on slopes need be anchored only when there is a possibility of the backfill around the pipe sloping down the hill and carrying the pipe with it. Generally for slopes upto 30°, good well drained soil carefully damped in layers of 100mm under and over the pipe, right up to the top of trench will not require anchoring.

For steeper slopes, one out of every three pipes shall be held by straps fastened to vertical supports anchored in concrete.

4.14.15 BACK FILLING: Back filling shall follow the pipe installation as closely as possible to protect pipe from falling boulders, eliminating possibility of lifting of the pipe due to flooding of open trench and shifting pipe out of line by caved in soil.

The soil under the pipe and coupling shall be solidly tamped. The initial back fill material shall be free of large stones and dry lumps.

In bags and Monshers gravel or crushed stone may be used for this purpose. The initial back fill shall be placed evenly in a layer of 100 mm thick and consolidated up to a cushion of at least 300 mm cover over the pipe. Joints shall be taken care to resist the movement of the pipe due to pressure while testing.

4.14.16 TESTING:

After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests:

a) Pressure test at a pressure of at least double the maximum working pressure-pipe and joints shall be absolutely water tight under the test.

b) Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for duration of two hours.

Hydrostatic Tests:

Portions of the line shall be tested by subjecting to pressure test as the laying progresses before the entire line is completed. In this way any error of workmanship will be found immediately and can be corrected at a minimum cost. Usually the length of the section to be tested shall not exceed 500 m.

Where any section of a main is provided with concrete thrust blocks or anchorages, test shall not be made until at least two days have elapsed.

Prior to testing, enough back fill as described in previous section shall be placed over the pipe line to resist upward thrust. All thrust blocks forming part of the finished line shall have been sufficiently cured and no temporary bracing shall be used.

The open end of the section shall be sealed temporarily with an end cap having an outlet which can serve as an air relief vent or for filling the line, as may be required. The blind face of the end cap shall be properly braced during testing by screw jacks and wooden planks or steel plate.

The section of the line to be tested shall be filled with water manually or by a low pressure pump. Air shall be vented from all high spots in the pipe line before making the pressure strength test because entrapped air gets compressed and causes difficulty in raising the required pressure for the pressure strength test.

The test pressure shall be gradually raised at the rate of approximately one kg/sqcm/min. The duration of the test period if not specified shall be sufficient to make a careful check on the pipe line section. **Procedure for pressure test:**

Each valved section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants and blow offs. If these are not available at high places, necessary tapping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.

If the trench has been partially back-filled the specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer-in-Charge. The duration of the test shall not be less than 5 minutes. **Examination under Pressure:**

All exposed pipes, fittings, valves, hydrants and joints should be carefully examined during the open-trench test. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until satisfactory to the Engineer-in-Charge.

If the trench has been back-filled to the top, the section shall be first subjected to water pressure normal to the area and the exposed parts shall be carefully examined. If any defects are found, they shall be repaired and the pressure test repeated until no defects are found. The duration of the final pressure tests shall be at least one hour.

4.14.17 DEWATERING: The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

4.14.18 THE RATE INCLUDES FOR:

4.14.18.1. Supplying spigot and socket pipe with SBR Gasket or double flanged D.I. Pipe of specified class & diameter.

4.14.18.2. Laying the pipe and cutting the pipe wherever necessary and wastage.

4.14.18.3. Supplying spigot and socket or monolithic double flanged D.I specials.

4.14.18.4. Fixing the specials wherever necessary.

4.14.18.5. Dewatering the Trench or pit if found necessary till completion of work.

4.14.18.5. Fixing the pipe line using M.S. clamps not less than 3 mm thick with wooden gutties etc. if required.

4.14.18.7. Testing the pipe line.

4.14.18.8. All necessary labour, materials and use of tools.

4.14.19 MODE OF MEASUREMENT: The measurement shall be for unit running meter length of pipe line laid or fixed. Measurement shall be taken along the centre line of the pipe deducting outer to outer length of specials.

4.15 SPECIALS FOR D.I WATER SUPPLY PIPE LINE:

4.15.01 GENERAL: The item includes supplying Ductile Iron water quality of specified diameter for D.I water supply pipe including laying, fixing and painting the specials.

4.15.02 MATERIALS: The specials for D.I water quality pipes shall be conforming to IS:9523 with socket and spigot or monolithic double flanged or suitable for mechanical flexible Joint. All the fittings shall be cylindrical, reasonably true with inner and outer surfaces and nearly concentric as practicable. The outer surface shall be smooth, sound and free from pin holes, cracks and other imperfections. Fittings shall be Zinc – Bitumen coated externally and cement mortar lined internally.

4.15.03 CLEANING: The specials and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside the socket and outside of the spigot.

4.15.04 EXAMINING: Before special is laid, it shall be first examined for damage and cracks. No cracked or damaged pipe shall be used. The pipe shall be tested with a hammer to prove its soundness.

4.15.05 DAMAGED MATERIAL: If any material found damaged or cracked, the same shall not be used in the work. The contractor has to replace the same at his own cost and charges.

4.15.06 LOWERING: The specials shall then be placed in trenches by means of proper sheer legs, chains and other tacts and shall be properly driven home.

4.15.07 FIXING: The specials shall be fixed by means of lead or flanged joint on C.I. Pipe line wherever required and as shown in the drawing or as directed by the Engineer-in-charge.

4.15.08 TESTING: Joints shall be tested to a hydraulic pressure of same as for pipeline along with testing of pipe line and shall be maintained for minimum two hours. All leakages, defects etc. shall be rectified.

4.15.09 DEWATERING: The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till the completion of work.

4.15.10 MODE OF MEASUREMENT: Specials shall be measured along with the pipe item.

4.16 LEAD JOINT :

4.16.01 ENERAL : The item includes making lead joints for C.I.water quality pipes and fittings/specials including testing etc.

4.16.02 MATERIAL : Lead shall be conforming to IS 782 and of good quality manufactured by Hindustan zinc or equivalent. Fine hemp yarn shall be the best available in the market.

4.16.03 PREPARATION : Outside of the spigot and inside of the socket shall be thoroughly cleaned with brush. The spigot shall be carefully centred in the socket by one or more laps of spun hemp yarn twisted into ropes of uniform thickness thoroughly soaked in hot coal-tar or bitumen and cooled before use.

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

4.16.05 CAULKING : The caulking shall be carried out with molten lead. Hemp yarn shall be driven into the bottom of the socket and leave the space required. The molten lead shall then be run in sufficient quantity so that after being caulked solid, the lead may project 3 mm beyond the face of the socket against the outside of the spigot, but must be flushed with the outside edge of the socket.

The lead taken from the pot shall be run hot into the joint and the joint filled in one running. The joint shall be caulked well, by a suitable caulking tool and 2 kg hammer and the joint left neat and smooth. In case C.I. fittings are also conforming to the same specification that of pipes, the consumption of lead will be worked out on the basis of actual consumption for each joints.

The following table shows consumption of the weight of lead & yarn per joint as per IS 3114 : 1994

Nominal Internal Dia in mm	Spun Yarn Mass in Kg.	Lead Mass in kg.	Depth of Lead Joint Mm
80	0.17	1.8	45
100	0.23	2.2	45
125		2.6	45
150	0.34	3.4	50
200	0.57	5.0	50
250	0.74	6.1	50
300	0.82	7.2	55
350	1.17	8.4	55
400	1.33	9.5	55
450	1.84	14.0	55
500	1.99	15.0	60
600	2.83	19.0	60
700		22.0	60
750	3.52	25.0	60
800		31.5	65
900	4.25	35.0	65
1000		41.0	65
1100		46.0	65
1200	6.01	52.0	70
1500		66.5	75

NOTE : i) The quantities of lead given are on average basis and a variation of 10 percent is permissible .

ii) Before pipe are jointed on large scale, three a four sample joints shall be made and the average consumption of lead per joint shall be got approved by the Engineer-in-charge.

4.16.06 TESTING : The pipe line after being laid and jointed shall be tested under the supervision of the Engineer-in-Charge. The testing shall be carried out by the contractor at his own cost and charges. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost.

The length of pipes to be tested shall be first filled with water from a higher section of pipe and the test pressure is applied. The test pressure shall be 10 kg per square centimeters and shall be maintained for two hours continuously.

4.16.07 DEWATERING : The contract rate shall include bailing out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till the completion of work.

4.16.08 THE RATE INCLUDES FOR :

4.16.08.1 Pig lead and treated yarn, fuel, wood, etc.

4.16.08.2 Winding the rope on spigot and centering the pipe, caulking, casting molten lead etc.

4.16.08.3 Testing and making good the defective joints.

4.16.08.4 Dewatering the trench or pit till completion of work.

4.16.08.5 All labour, material and use of tools.

4.16.09 MODE OF MEASUREMENT : The measurement shall be for each unit of lead joint made.

4.17 G M GATE VALVE CHAMBER :

4.17.01 GENERAL : The item includes construction of brick masonry valve chamber of size as specified in this schedule including providing M.S./G.I. frame and cover over R.C.C pre-cast cover with or without surface box.

4.17.02 MATERIAL : Brick work, plastering, concreting etc. shall be as per general specification under section II. Precast RCC cover slab, surface box, C.I/M.S frame and cover etc. shall be size and weight as specified in the schedule.

4.17.03 CONSTRUCTION :

a) Foundation concrete of mix 1:4:8 shall be of 150 mm thick with 150 mm offset alround or as specified in the schedule.

b) Brick masonry in cement mortar 1:4 as specified.

c) Plastering inside and outside surfaces of walls in two courses using cement mortar 1:3 of thickness as specified mixed with water proofing compound of specified Quality including inner surfaces finished smooth with neat cement punning.

4.17.04 RCC PRECAST/CAST IRON / D.I. / M.S. COVERS

4.17.04.1 RCC PRECAST COVER (for chambers of size upto 600 x 600 mm) : Chamber cover shall be casted as shown in the drawing having minimum 75 mm thick in cement concrete 1:2:4 or as specified in the schedule by using nominal reinforcement 100 kg/ Cum of concrete including shuttering, finishing, curing, placing in position etc.

4.17.04.2 CAST IRON/ D.I./ M.S COVER : Cast iron/D.I./M.S cover of specified size and weight shall be supplied and placed over the chamber as directed. The cover shall be painted with 3 coats of black bitumastic paint.

4.17.05 DEWATERING : The water accumulated in the pit due to rain, seepage, springs or any other cause during the progress of work shall be pumped/bailed out till the completion of work.

4.17.06 THE RATE INCLUDES FOR :

4.17.06.1 Bed concrete, Brick masonry, cement plaster, RCC pre-cast cover slab with or without surface box cast /MS cover etc.

4.17.06.2 Dewatering the trench or pit if necessary.

4.17.06.3 All necessary labour, materials and use of tools.

4.17.07 MODE OF MEASUREMENT : The measurement shall be for each unit of valve chamber of specified internal size and depth constructed.

4.18 C.I. SLUICE VALVE CHAMBER :

4.18.01 GENERAL : The item includes construction of brick masonry valve chamber of size as specified in this schedule including providing M.S./G.I. frame and cover over R.C.C pre-cast cover with or without surface box.

4.18.02 MATERIAL : Brick work, plastering, concreting etc. shall be as per general specification under section II. Precast RCC cover slab, surface box, C.I/M.S frame and cover etc. shall be size and weight as specified in the schedule.

4.18.03 CONSTRUCTION :

a) Foundation concrete of mix 1:4:8 shall be of 150 mm thick with 150 mm offset around or as specified in the schedule.

b) Brick masonry in cement mortar 1:4 as specified.

c) Plastering inside and outside surfaces of walls in two courses using cement mortar 1:3 of thickness as specified mixed with water proofing compound of specified Quality including inner surfaces finished smooth with neat cement punning.

4.18.04 RCC PRECAST/CAST IRON/D.I. COVERS

4.18.04.01 RCC PRECAST COVER (for chambers of size above 1000 x 1000 mm)

Chamber cover shall be coated in minimum three equal parts or more as directed with lifting hooks as shown in the drawing. RCC slab shall be casted along with galvanised M.S. angle iron frame with stiffness and anchors made out of the sizes as specified in the schedule. The exposed portion of the angle frame shall be painted with the coats of silver paint over a coat of primer.

RCC pre-cast slab shall be of 100 mm thick (unless otherwise specified) in cement concrete 1:2:4 of size as specified in the drawing schedule by using nominal reinforcement 100 kg/ Cum of concrete including shuttering, curing etc. and shall be placed in position as directed. Cast iron road surface of prescribed weight shall be fixed to the cover slab during casting the slab for key rod operation.

Road surface box shall be of size 100x125x150 mm conforming to IS 3950 having hinged and weighting not less than 14 kg. The surface box shall be fixed on top of the RCC cover slab during the casting of slab for key rod operation. The surface box shall be painted with 3 coats of black bitumastic paint.

4.18.04.2 CAST IRON/D.I./ M.S COVER : Cast iron/D.I./M.S cover of specified size and weight shall be supplied and placed over the chamber as directed. The cover shall be painted with 3 coats of black

bitumastic paint.

4.18.05 DEWATERING : The water accumulated in the pit due to rain, seepage, springs or any other cause during the progress of work shall be pumped/bailed out till the completion of work.

4.18.06 THE RATE INCLUDES FOR :

4.18.06.1 Bed concrete, Brick masonry, cement plaster, RCC pre-cast cover slab with or without surface box cast /MS cover etc.

4.18.06.2 Dewatering the trench or pit if necessary.

4.18.06.3 All necessary labour, materials and use of tools.

4.18.07MODE OF MEASUREMENT : The measurement shall be for each unit of valve chamber of specified internal size and depth constructed.

4.19 FLANGES & FLANGED JOINT : (Screwed or welded Flanges)

4.19.01GENERAL : The item includes supplying flanges and providing flanged joint for G.I./ M.S./C.I/D.I/ all Plastic pipes, fittings and specials including testing.

4.19.02MATERIAL : The CI flanges shall be confirming to IS 3516 or IS 1536, D.I flanges shall confirm to IS 8359. The heavy quality G.I./ M.S. flanges shall be conforming to I.S.6392 having thickness not less than 20 mm for pipes having diameter beyond 80 mm and 12 mm for pipes having diameter below 80 mm including drilling holes in new flanges, jointing with the pipe by means of welding or screwed joint. Rubber insertion shall be of three ply not less than 3 mm thick of approved make or fiber board impregnated with chemically neutral mineral oil having smooth & hard surface weighing not less than 112 gm/mm thickness. Bolts, nuts and washers used shall be of good quality.

4.19.03 MAKING JOINT : Flanged joints shall be made by jointing the facing of the flange with the packing of rubber insertion and boiling up evenly on all sides. A thin layer of lead wool shall be provided for making the joints water tight where facing of the pipe is not true. The packing shall be of rubber insertion of three ply and of approved make and thickness. The packing should be of full diameter of the flange with proper pipe hole and bolt hole; cut even at both the inner and outer edges.

4.19.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till the completion of work.

4.19.05 TESTING : The joints shall be tested along with pipe line after the pipe line is laid and jointed. The testing shall be as per testing of the pipe line

4.19.06 THE RATE INCLUDES FOR :

4.17.06.1. Cost of flanges, making bolt holes in flanges, supplying rubber insertion, making flanged joint.

4.17.06.2 Testing and making good the defective joints.

4.17.06.3 Dewatering the trench or pit till completion of work.

4.17.06.4 All labour, material and use of tools.

4.19.07 MODE OF MEASUREMENT : The measurement shall be for each unit of flange joint of specified size made with supplying one or two new flanges as specified in the schedule of quantities.

4.20 FLEXIBLE PUSH-ON JOINT (TYTON/ RING JOINT)

4.20.01 GENERAL : The item includes push-on joint with rubber ring for C.I/ D.I/ all Plastic pipes, fittings and including testing.

4.20.02 MATERIAL: Rubber ring shall be moulded or tubular EPDM or SBR confirming to I.S. 12820.

4.20.03 JOINTING : The groove and the socket shall be thoroughly cleaned before inserting the rubber gasket while inserting the gasket it shall be made sure that it faces the proper direction and that it is correctly seated in the groove. After cleaning dirt or foreign materials from the plain end, non-petroleum lubricant shall be applied in accordance with the pipe manufacturer's recommendations. The plain end of the pipe is pushed into the socket of the pipe and while pushing, the pipe shall be kept straight. If any deflections are to be made in the alignment, it may be made after the joint is assembled. The permissible deflection shall not be exceeded as per IS 3114 for socket and spigot rubber joint is 5 □ for 80 to 300 mm nom. bore, 4□ for 350 to 400 mm nom bore and 3□ for 450 to 750 mm nom bore pipe. A timber header shall be used between the pipe and crowbar or jack to avoid damage to the pipe while the plain end of the pipe is pushed into the socket either with a crowbar or jack or lever puller.

4.20.04 TESTING : The joints shall be tested along with pipe line after the pipe line is laid and jointed. The testing shall be as per testing of the pipe line

4.20.05 DEWATERING : The contract rate shall include bailing out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till the completion of work.

4.20.06 THE RATE INCLUDES FOR :

4.18.06.1 Rubber ring, lubricant etc.

4.18.06.2 Testing and making good the defective joints.

4.18.06.3 Dewatering the trench or pit till completion of work.

4.18.06.4 All labour, material and use of tools.

4.20.07 MODE OF MEASUREMENT : The measurement shall be for each unit of rubber ring joint made.

4.21 C. I./D.I. SLUICE VALVE :

4.21.01 GENERAL : The item includes supplying of C.I./ D.I. Sluice Valve of specified diameter as mentioned in the schedule including fixing.

4.21.02 MATERIAL : The Sluice valve shall be of Class or pressure rating as specified in the schedule of quantities and conforming to I.S. 14846. The valve shall be of cast iron and / or spheroidal (Ductile) iron having non-rising spindle with hand wheel & spindle of stainless steel.

4.21.03 FIXING : The C.I./D.I. sluice valve shall be fixed in position as indicated in the drawing or as directed. They shall be fitted with the tail pieces on both sides by means of flange joints.

4.21.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either form rain, seepage, springs or any other cause till completion of the work.

4.21.05 TESTING : The Sluice Valve and the joints shall be tested as per testing of the pipe line. The testing shall be done along with the pipe line testing.

4.21.06THE RATE INCLUDES FOR :

4.21.06.1 Supplying and fixing of C.I./D.I. Sluice Valve of specified diameter.

4.21.06.2 Dewatering the trench or pit till completion of work.

4.21.06.3 All necessary labour, materials and use of tools.

4.21.07 MODE OF MEASUREMENT : The measurement shall be for each unit of Sluice Valve fixed. Tail piece, making flange joint and lead joint shall be measured under the relevant items.

4.22 C.I. /D.I. NON RETURN VALVE :

4.22.01 GENERAL : The item includes supplying of C.I./D.I. Non-Return Valve of specified size in the schedule of quantities including fixing.

4.22.02 MATERIAL : Non-return valve shall be conforming to IS 9338 or IS 5312 as specified in schedule of quantities. The body, domes, covers, stuffing box, thrust plates, hand wheel, wedges, gland and cap shall be of cast iron not less than of grade FG200 and all in side working parts should be of any nonferrous or ferrous materials such as gun metal. Valve of single door pattern swing type shall have test pressure of PN1.6(50 to 125 mm size), PN1.0 (150 to 300mm size),PN0.6 (350 to 600 mm size)as per IS 5312 (part.1). Valve of multi door pattern swing type shall have test pressure of PN 0.6(400 to 1200 mm size), PN1.0 (400 to 1200mm size) as per IS 5312 (part 2).Valve shall be tested for the body and seat and the defective valve shall be replaced by the contractor at his own cost.

4.22.03 FIXING : The C.I./D.I. Non-Return valve shall be fixed in position as indicated in the drawing or as directed. They shall be fitted with the tail pieces on both sides by means of flange joints.

4.22.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

4.22.05 TESTING : The C.I./D.I Non-Return valve shall be fixed in position shall be tested hydraulically to a minimum pressure as per testing of piping work. The testing shall be done along with the testing of pipe line.

4.22.06 THE RATE INCLUDES FOR :

4.22.06.1 Supplying and fixing of C.I./D.I Non-Return Valve of specified dia.

4.22.06.2 Dewatering the trench or pit till completion of work.

4.22.06.3 All necessary labour, materials and use of tools.

4.22.07 MODE OF MEASUREMENT : The measurement shall be for each unit of Non-Return Valve fixed. Tail piece, making flange joint and lead joint shall be measured under the relevant items.

4.23 FOOT-VALVE :

4.23.01 GENERAL : The item includes supplying of C.I./D.I body. Foot-Valve of specified diameter as mentioned in the schedule including fixing.

4.23.02 MATERIAL : Foot-Valve shall be conforming to IS 4038 and with C.I./D.I. body not less than of grade FG200 and strainer with internal gun metal working parts. The valve shall be screwed end (25 to 150 mm size), flanged end (50 to 450 mm size), single disc type (up to 150 mm size), two disc type

(exceeding 150 mm size), lift type (up to 100 mm size) The valve shall be tested for housing 0.6 MPa (6 kg/cm2) and for seat 0.2 MPa (2 kg/cm2) for 2 minutes as per IS 4038. The ball type foot valve with nytrile rubber ball and with bronze seat may be used as specified in the schedule of quantities. The defective Foot-Valve shall be replaced by the contractor at his own cost.

4.23.03 FIXING : Foot-valve shall be fixed in position as shown in the drawing or as directed. They shall be fitted by means of flange joints.

4.23.04 TESTING : The C.I./D.I. Foot-Valve and the joints shall be tested hydraulically to a minimum pressure as per testing of piping work .The testing shall be done along with the testing of pipe line.

4.23.05 THE RATE INCLUDES FOR :

4.23.05.1 Supplying and fixing of C.I./D.I. Foot-Valve of specified diameter.

4.23.05.2 All necessary labour, material and use of tools.

4.23.06 MODE OF MEASUREMENT : The measurement shall be for each unit of Foot-Valve fixed. Tail piece, making flange joint and lead joint shall be measured under the relevant items.

4.24 AIR VALVE :

4.24.01 GENERAL : The item includes supplying of single, double action or kinetic air Valve of specified diameter as mentioned in the schedule including fixing.

4.24.02 MATERIAL : The Air Valve shall be of heavy quality conforming to IS 14845 with IS certification mark and isolation valve. The body, domes, covers, stuffing box, thrust plates, wedges, gland and cap shall be of cast iron not less than of grade 20 and inside working parts should be of any non-ferrous or ferrous materials.

4.24.03 FIXING : The Air Valve shall be fixed in position as indicated in the drawing or as directed. They shall be fitted by means of flange joints or screwed joint to the pipe line.

4.24.04 TESTING : The Air Valve and the joints shall be tested hydraulically to a minimum pressure as per testing of piping work. The testing shall be done along with the testing of pipe line.

4.24.05 THE RATE INCLUDES FOR :

4.24.05.1 Supplying and fixing Air Valve of specified diameter and type.

4.24.05.2 Supplying ~~G.I.~~ pipe and fittings if required.

4.24.05.3 All necessary labour, material and use of tools.

4.24.06 MODE OF MEASUREMENT : The measurement shall be for each unit of Air Valve fixed C.I. and G.I. specials, making lead or flange joint etc. shall be measured under the relevant items.

4.25 BUTTER FLY VALVE :

4.25.01 GENERAL : The item includes supplying and fixing of butterfly valve of specified diameter as mentioned in the schedule.

4.25.02 MATERIAL : The butterfly valve shall be flanged type or as specified conforming to IS 13095 & BS - 5155. The valve shall be bubble tight, resilient sealed suitable for flow in either direction with accompanying flanges and steel handle.

4.25.03 FIXING : The butterfly valve shall be fixed to the pipe line in position as indicated in the drawing and as directed by the Engineer-In-Charge.

4.25.04 TESTING : The valve and the joints shall be tested to a minimum hydraulically pressure of 10kg/sqcm for a duration of two hours or as per testing of piping work. The testing shall be done along with the testing of pipe line. The leaky joints shall be rectified to the satisfaction of the Engineer-in-Charge.

4.25.05 THE RATE INCLUDES FOR :

4.25.05.1 Supplying and fixing Butterfly Valve of specified diameter.

4.25.05.2 Supplying ~~G.I.~~ pipe and fittings if required.

4.25.05.3 All necessary labour, material and use of tools.

4.23.06 MODE OF MEASUREMENT : The measurement shall be for each unit of butterfly Valve fixed. Specials, making lead or flange joint etc. shall be measured under the relevant items.

4.26 GUN METAL / BRASS / COPPER ALLOY / SS BALL VALVE :

4.26.01 GENERAL : The item includes provision of ball valve of specified diameter and material as mentioned in the schedule including fixing. Ball valve is suitable for stopping the flow in water supply lines with quarter turn liver arrangement.

4.26.02 MATERIAL : Ball valve shall be heavy quality of either brass / gun metal / copper alloy / SS fitted with a GI Handle.

4.26.03 FIXING : The valves shall be fixed in position in the pipeline as shown in the drawing or as directed

with necessary socket or union, nuts etc. The screwed, flanged joint shall be made with few turns of fine hemp yarn dipped in linseed oil taken over the threaded ends to obtain complete water tightness.

4.26.04 TESTING : The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm^2) along with the testing of pipe line.

4.26.05 THE RATE INCLUDES FOR :

4.26.05.1 Valve, pipe fittings, hemp yarn, linseed oil, white zinc, fixing and testing.

4.26.05.2 All necessary labour, materials and use of tools.

4.26.06 MODE OF MEASUREMENT : The measurement shall be for each unit valve of specified diameter fixed.

4.27 FERRULE CONNECTION :

4.27.02 GENERAL : The item includes making ferrule connection with existing C.I./ D.I. water supply line including fittings and fixtures.

4.27.03 MATERIAL : The ferrule shall be of gun metal or hard brass of diameter as specified in the schedule, confirming to IS 2692. It shall be fitted with screwed plug or valve capable of completely shutting off water supply. Coupling shall be casted in one piece with cast iron bell mouth cover.

4.27.04 FIXING : The ferrule shall be fixed to the water supply pipe line of specified diameter without protruding inside including making hole in the water main and covering with cast iron bell mouth cover. The ferrule shall be fitted water tight.

4.27.05 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till completion of the work.

4.27.06 TESTING : Ferrule shall be tested under the testing of pipe line. The testing shall be done along with the testing of pipe line.

4.27.07 THE RATE INCLUDES FOR :

4.27.07.1 Ferrule, coupling and cast iron bell mouth cover.

4.27.07.2 Boring hole in the water main and fixing ferrule.

4.27.07.3 Dewatering the trench or pit till completion of work.

4.27.07.4 All necessary labour, materials use of tools.

4.27.08 MODE OF MEASUREMENT : The measurement shall be for each unit of ferrule connection.

4.28 MAKING CONNECTION WITH WATER MAIN:

4.28.02 GENERAL : The item includes connection with the existing C.I./ D.I. or G.I. water supply line including fittings & fixtures.

4.28.03 MATERIAL : C.I. or G.I. specials shall be conforming to relevant IS code and flange joint or lead joint shall be as per specifications described herein before.

4.28.04 MAKING CONNECTION : The connection shall be made with existing C.I./ D.I. or G.I. water pipe line of specified diameter. The existing water supply pipe line shall be cut or disjointed carefully where the connection is to be made. The connection shall be made with providing C.I. or G.I. specials as per site requirement including making flanged joint or lead joint.

4.28.05 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause till completion of the work.

4.28.06 TESTING : The connection shall be tested under the testing of pipe line. The testing shall be done along with the testing of pipe line.

4.28.07 THE RATE INCLUDES FOR :

4.28.07.1 Cutting, disjointing the C.I./ D.I. or G.I. water supply line.

4.28.07.2 Supplying of C.I. or G.I. specials

4.28.07.3 Making flanged joint, lead or screwed joint including providing new flange.

4.28.07.4 Dewatering the trench or pit till completion of the work.

4.28.07.5 All necessary labour, material and use of tools.

4.28.08 MODE OF MEASUREMENT : The measurement shall be for one job making connection with existing water supply line complete in all respect. Including required fittings, fixtures, specials, making flanged joint or lead joint etc. which shall not be measured separately.

4.29 MAKING CONNECTIONS WITH MUNICIPAL WATER MAIN :

4.29.02 GENERAL : The item includes connection with existing C.I/ D.I. or G.I. water supply line including fittings and fixtures.

4.29.03 MATERIAL : C.I. / D.I. of G.I. specials shall be conforming to relevant IS code and flange joint or lead joint shall be as per specifications described herein before.

4.29.04 MUNICIPAL CHARGES : If the connection shall be made with the water supply line of Municipal Corporation, the contractor shall obtain necessary permission from the concerned municipal authorities. He shall pay all the necessary charges towards the connection being permitted by the Municipality.

4.29.05 MAKING CONNECTION : The connection shall be made with existing C.I/ D.I. or G.I. water pipe line of specified diameter. The existing water supply pipe line shall be cut or disjointed carefully where the connection is to be made. The connection shall be made with providing CI / D.I. or GI. specials as per site requirement including making flanged joint or lead joint.

4.29.06 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

4.29.07 TESTING : The connection shall be tested under the testing of pipe line. The testing shall be done along with the testing of pipe line.

4.29.08 THE RATE INCLUDES FOR :

4.29.08.1 Cutting, disjointing the C.I. / D.I. or G.I. water supply line.

4.29.08.2 Supplying C.I/ D.I. or G.I. specials.

4.29.08.3 Making flanged joint, lead joint or screwed joint including providing new flange.

4.29.08.4 Dewatering the trench or pit till completion of work.

4.29.08.5 All necessary labour, material and use of tools.

4.29.09 MODE OF MEASUREMENT : The measurement shall be for one job of making connection with existing water supply line complete in all respect, including required fittings, fixtures, specials, making flanged joint or lead joint etc. Which shall not be measured separately.

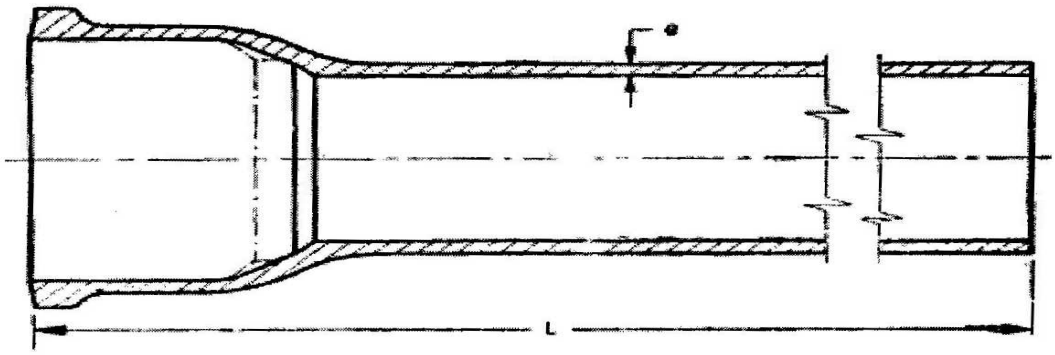
5.0 DRAINAGE SYSTEM

5.1 CAST IRON SOIL QUALITY PIPING WORK :

5.1.01 GENERAL The item includes supplying of soil quality CAST IRON pipe of specified diameter with fittings and fixtures including laying, fixing, cutting, jointing and painting the pipe line.

5.1.02 MATERIAL Cast Iron soil quality pipes and fittings shall have ISI certification mark. Sand -Cast, Cast Iron Soil quality or rain water pipes and fittings shall confirm to IS 1729 and centrifugally cast (Spun Cast) cast iron soil quality pipe shall confirm to IS 3989. All the pipes and fittings shall be cylindrical reasonably true with inner and outer surfaces and nearly concentric as practicable. The outer surface of the pipe and fitting shall be finished well, sound, free from pin hole, cracks and other imperfections. The pipes & fittings shall be treated with solution of Dr. Angus Smith's solution.

The dimensions, weight of Sand-Cast Iron/ Ductile Iron pipes and fittings shall be as per following table of IS 1729 – 2002 or its latest revision.



Tolerance : Mass (-) 5%, thickness (-) –2mm, pipe length (+/-) 20 mm, fitting length (+/-) 10 mm

Sr. No	Nominal Dia.	Thickness of wall	Nominal weight for pipes of overall length (L) (Exclusive of ears)								
			2.0m	1.80m	1.50m	1.20m	0.90m	0.75m	0.6m	0.45m	0.3m
			Kg.	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.
1.	50 mm	5 mm	12.65	11.41	9.56	7.9	6.0	5.1	4.2	3.3	2.4
2.	75 mm	5 mm	18.37	16.52	13.83	11.5	8.8	7.5	6.1	4.8	3.4
3.	100 mm	5 mm	24.15	21.67	18.14	15.1	11.6	9.8	8.0	6.3	4.5
4.	150 mm	5 mm	35.66	31.92	26.70	22.6	17.3	14.7	12.1	9.5	6.9

The Dimensions, weight of Spun cast pipes and fittings shall be as per following table of IS 3989 - 1984 or its latest revision.

Tolerances : ((a) Thickness (-) 15% (b) Weight (-) 10% (c) Length (+ / -) 20 mm) shall as per IS 3989

SN	Nominal Dia.	Thickness	Approximate weight for pipes of overall length (L)				
			3.0m	2.5m	2.0m	1.8m	1.5m
			Kg.	Kg.	Kg.	Kg.	Kg.
1.	50 mm	3.5 mm	13.4	11.3	9.2	8.4	7.1
2.	75 mm	3.5 mm	20.0	16.8	13.8	12.5	10.6
3.	100 mm	4 mm	30.0	25.5	21.0	18.8	16.0
4.	150 mm	5 mm	56.0	47.0	38.5	34.9	29.5

5.1.03 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks. No cracked or damaged pipe and fittings shall be used in the work and they shall remove from the site by the contractor at his own cost & charge.

5.1.04 CLEANING : All pipes and fittings shall thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside of piping material.

5.1.05 FIXING : The pipe shall be fixed as shown in the drawing. If the holes are not left in parapet, wall, beam, slab, floor, etc., they shall be cut and cavity surrounding the pipe made good properly after fixing the pipe. The pipe

shall be fixed with nails and M.S. clamps having thickness not less than 3 mm, 20 mm wide or as specified in the schedule with socket facing up.

Spacing between clamps for fixing internal piping shall be as per IS 2065 – 1983 as given below :

Nom. dia of pipe	Horizontal Runs	Vertical Runs
50 mm	2 M	2 M
80 & 100 mm	2.5 M	2.5 M

The pipe and fitting shall be kept 50 mm away from the wall face to facilitate cleaning and painting etc. For rain water pipe the inlet end shall be carefully fixed to admit water from roof and shoe shall be fixed at outlet. Cowl shall be fixed at top end of the vent pipe.

5.1.06 LAYING : The pipes shall be carefully laid straight to correct alignment in gradients as indicated in the drawing or as directed by the Engineer-in-charge. The socket end of the pipe shall be uphill. All the pipes shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. While joining, the spigot shall be neatly placed into the socket for full length and properly supported. The entire length of pipe shall be evenly supported on the trench bed throughout. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall suitably plugged.

No pipe shall be laid until the trench has been excavated to its required depth for a distance of about 5 M in front of the pipe to be laid. No pipe shall be covered until it has been passed by the Engineer-in-charge.

5.1.07 MAKING LEAD JOINT : The spigot shall be carefully centred in the socket by one or more laps of spun hemp yarn twisted into ropes of uniform thickness thoroughly soaked in hot coal-tar or bitumen and cooled before use. The joints shall be made with molten lead and hemp yarn. The lead shall be melted rendering it thoroughly fluid and each joint shall be filled in one pouring. The lead may project 3 mm beyond the face of the socket against the outside of spigot, but must be flushed with the outside edge of the socket.

After the lead has been run into the joint, the lead shall be thoroughly caulked by a suitable caulking tool and 2 Kg hammer and the joint left neat and smooth. The consumption of lead will be worked out on the basis of actual observation at sit. The following table shows consumption of lead and yarn per joint.

DIAMETER OF PIPE (MM)	YARN (in kg.)	LEAD (in kg.)
50	0.06	0.77
80	0.09	0.88
100	0.11	0.98
150	0.18	1.20

5.1.08 TESTING : The pipe line which is laid on the ground or below the ground level, the joints shall be tested with two meter head of water from a higher section of pipe line.

The pipe line fixed vertically on the wall shall be tested by the smoke test. The Greasy cotton waste shall be burnt in a smoke machine consisting of bellows and a burner. If any lead joint is found to be sweating or leaking, the contractor shall rectify the same till water tightness is attained to the full satisfaction of the Engineer-in-charge.

5.1.09 DEWATERING : In case of underground piping, the contract rate shall include bailing or pumping out all the water till completion of work if accumulated during the progress of work either from seepage, springs, rain or any other cause,

5.1.10 THE RATE INCLUDES FOR :

1. Supplying of C.I. soil quality Pipes and fittings, cowl for vent and shoe for rain water pipe of specified diameter with M.S. clamps and nails.
2. Laying, fixing, cutting and joining the pipe wherever necessary and wastage.
3. Making the lead joint including cost of fuel, wood, jointing with lead, spun yarn etc.
4. Fixing the pipe line with M.S. clamps not less than 3 mm thick, 20 mm wide and M.S. nails length not less than 60 mm and painting the clamps and nails.
5. Supplying and fixing rubber gasket to every cleaning access of cast iron pieces.
6. Painting the pipe line with two coats of black anti corrosive bitumastic paint or painting with synthetic enamel paint over appropriate primer, in case the pipe line exposed in elevation.
7. Testing the pipe line with smoke test or with two meter head of water.
8. Dewatering if necessary till completion of work.
9. All necessary materials, labour and use of tools.

5.1.11 MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line laid or fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded

separately for fittings. Making lead joint, painting and testing.

5.2 UPVC- SWR PIPING WORK :

5.2.01 GENERAL : The item includes supplying of UPVC soil, waste and rain water (SWR) and ventilation pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting if required etc.

5.2.02 MATERIAL : The pipes shall conforming to IS 13592, UPVC - SWR and fittings conforming to IS 13591 shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule of work. Rubber sealing rings conforming to IS 5382 with lubricant for sliding socket joints as mentioned in the schedule of work.

5.2.03 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.2.04 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside surfaces.

5.2.05 LAYING : The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

The entire length of pipe shall be evenly supported on bed of the trench throughout. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

5.2.06 FIXING : The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. The pipe shall be fixed with G.I. clamps not less than 2.0 mm thick of with suitable UPVC clamps/clips, The clamps/clips shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties keeping the pipe about 15 mm clear of the wall.

5.2.07 MAKING JOINT : The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough or rubber sealing rings with lubricant for sliding socket joints . The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

5.2.08 DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

5.2.09 PAINTING : In case of underground piping, the pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer.

5.2.10 DEWATERING : In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.2.11 TESTING : Please see 5.3.10

5.2.12 THE RATE INCLUDES FOR :

1. Supplying of UPVC-SWR pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less than 2mm thick and G.I./M.S. nails length not less than 40mm or with UPVC clamps, screws, wooden gutties etc.
4. Making the solution joint and painting if mentioned in schedule of work the pipe line.
5. In case of underground pipes, dewatering if necessary till completion of work.
6. All necessary materials, labour and use of tools.

5.2.13 MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting if mentioned in schedule of work and testing.

5.3 HIGH DENSITY POLYETHYLENE PIPING WORK FOR DRAINAGE:

5.3.01 GENERAL : The item includes supplying of HDPE pipes with fittings of specified diameter including laying, fixing, cutting, jointing.

5.3.02 MATERIAL : The pipes and fittings shall conform to IS 14333. HDPE pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule.

5.3.03 EXAMINING : Before laying the pipe line, if shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.3.04 LAYING : Please refer 4.4.04.

5.3.05 FIXING : Please refer 4.4.06.

5.3.06 MAKING JOINT : Please refer 4.4.07.

5.3.07 DETACHABLE JOINT : Please refer 4.4.07.

5.3.08 ANTISYPHONAGE : The HDPE pipes shall be used for anti-syphonage including provision, cutting, wastage, bending, dressing, jointing with cement solution, necessary plugs, brass fittings such a brass thimbles, brass union, brass cleaning caps and other brass fittings as required.

5.3.09 DEWATERING : In case of underground piping works, the contract rate shall include bailing or pumping out all the water till completion of work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.3.10 TESTING : The joints shall be tested by either smoke test for vertical stacks or 2.5 m head of water at the highest point of the section under test for horizontal drainage pipes. Smoke shall be pumped into the pipes at the lowest end from a smoke machine which consists of a below and burner .The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell, if there is leak at any point of the drain. The water head test shall be carried out by suitably plugging the lower end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily jointed to it so as to provide required test head , or the top may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitable for observation. The leaky joints shall be remade and section re-tested at no extra cost.

5.3.11 THE RATE INCLUDES FOR :

1. Supplying of HDPE pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Making the solution joint or mirror joint, painting if mentioned in schedule of work.
4. Fixing the pipe line with G.I. clamps not less that 20mm x 1mm thick and G.I./M.S. nails length not less than 40mm or HDPE clamps, screws, rawl plug etc.
5. In case of underground pipes, dewatering the pit or trench till completion of work.
6. All necessary labour, materials and use of tools.

5.3.12 MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line laid or fixed. The measurement shall be taken along the centre line of pipe. No measurement shall be recorded separately for fitting, making joint, painting if mentioned in schedule of work and testing.

5.4 PVC PIPING WORK :

5.4.01 GENERAL : The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting etc. for vent, over flow, waste water pipe line etc.

5.4.02 MATERIAL : The pipes and fittings shall conform to series IV of IS 4985, PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule.

5.4.03 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.4.04 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside surfaces.

5.4.05 LAYING : Please refer 4.5.15-17

5.4.06 FIXING : Please refer 4.5.12

5.4.07 MAKING JOINT : Please refer 4.5.13

5.4.08 DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

5.4.09 PAINTING : If mentioned in schedule of work, the pipe line shall be painted with two coats of approved water base distemper of matching colour or as specified.

5.4.10 DEWATERING : In case of underground pipes, the contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.4.11 TESTING : Please refer 5.3.10

5.4.12 THE RATE INCLUDES FOR :

1. Supplying of uPVC pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less that 20mm x 1mm thick and G.I./M.S. nails length not less than 40mm or HDPE clamps, screws, rawl plug etc.
4. Making the solution joint and painting the pipe line if mentioned in schedule of work.

5. In case of underground piping, dewatering if necessary till completion of work.
6. All necessary materials, labour and use of tools.

5.4.13 MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting and testing.

5.5 GULLY TRAP :

5.5.01 GENERAL : The item includes provision of Stone ware, uPVC, CI or DI Gully trap with C.I., DI or FRP Composite frame and cover including construction of Gully Trap Chamber.

5.5.02 MATERIAL : The Gully Trap shall be of salt glazed stoneware, uPVC, CI or DI with 150 mm nominal square, round inlet or as specified in the schedule with 100mm diameter outlet. Brick work, plastering, concreting shall be as per general specifications under section-II.

5.5.03 CONSTRUCTION :

1. Internal dimension of the Gully trap chamber shall be as specified in the schedule.
2. Foundation of 1:4:8 concrete shall be 150 mm thick, and shall have 100mm offset.
3. Brick masonry shall be of 230 mm thick in cement mortar 1:6 and masonry shall be plastered with 15mm thick plaster in 1:3 cement mortars inside and outside surface with smooth finish.

5.5.04 FRAME AND COVER : Frame and cover of loading class specified in the schedule shall be fixed with the cement concrete 1:2:4 at the top of Gully trap chamber, Metal frame and covers shall be painted with two coasts of black bitumastic paint.

5.5.05 DEWATERING : The contract rate shall include bailing or pumping out all the water till completion or work if accumulated during the progress of work either from seepage, springs, rain or any other cause.

5.5.06 THE RATE INCLUDES FOR :

1. Supplying of gully trap with frame and cover.
2. Concreting, brick work, plastering, fixing frame and cover.
3. Dewatering if necessary till completion of work.
4. All necessary materials, labour and use of tools.

5.5.07 MODE OF MEASUREMENT : The measurement shall be for unit of Gully Trap chamber of specified internal size and depth constructed including Gully Trap and frame and cover fixed.

5.6 C.I. NAHANI / FLOOR TRAP :

5.6.01 GENERAL : The item includes supplying of cast iron nahani / floor trap with CP brass/stainless steel grating of specified diameter with fittings and fixtures including fixing and jointing with the pipe line.

5.6.02 MATERIAL : 65 mm nominal outlet dia C.I. Nahani trap weighing not less than 4.5 kg with an effective water seal of 20 mm or 75mm nom. outlet dia. floor trap (100mm inlet dia.)/ nahani trap (165mm inlet dia.) conforming to IS 3989 or IS1729 shall be provided as specified in the schedule of quantities. Top grating shall be of CP brass or stainless steel of heavy quality of size and shape to suit the trap.

5.6.03 FIXING : C.I. nahani/ floor trap with the bend and pipe piece shall be fixed in position over the bed of 1:2:4 cement concrete. The jointing trap and pipe shall be caulked with 1:1 cement mortar. The grating shall be fixed over the nahani / floor trap flush with the floor level and the gap finished with matching cement. All care shall be taken to avoid lockage from trap, pipe joints and junction space between floor and trap.

5.6.04 THE RATE INCLUDES FOR :

1. C.I. nahani/ floor trap with CP brass or stainless steel grating as specified in the item.
2. Fixing the trap and grating with cement mortar or concrete.
3. All necessary materials, labour and use of tools.

5.6.05 MODE OF MEASUREMENT : The measurement shall be for unit of nahani trap fixed.

5.7 uPVC NAHANI / FLOOR TRAP/Multi FLOOR TRAP :

5.7.01 GENERAL : The item includes supplying of uPVC nahani / floor trap / multi floor trap with uPVC/CP brass/stainless steel grating of specified diameter, height riser or extension piece with fittings and fixtures including fixing and jointing with the pipe line.

5.7.02 MATERIAL : uPVC nahani / floor trap / multi floor trap shall be of heavy quality. Effective water seal shall be minimum 20 mm. Trap top inlet shall minimum 100mm dia. Trap side inlet shall be 50/63 mm dia. or as per schedule. Trap outlet shall be 63/75 mm dia. or as per schedule. Trap shall be conforming to IS 14735 or as specified in the schedule of quantities. Top grating shall be of uPVC/CP brass/stainless steel grating of heavy quality of size and shape to suit the trap and as per schedule.

5.7.03 FIXING : uPVC nahani / floor trap / multi floor trap with the bend and pipe piece shall be fixed in position

over the bed of 1:2:4 cement concrete. The jointing trap and pipe shall be with solvent cement as per schedule. The grating shall be fixed over the uPVC trap flush with the floor level and the gap finished with matching cement. All care shall be taken to avoid lockage from trap, pipe joints and junction space between floor and trap.

5.7.04 THE RATE INCLUDES FOR :

1. uPVC nahani / floor trap / multi floor trap with uPVC/CP brass/stainless steel grating as specified in the item.
2. Fixing the trap and grating with cement mortar or concrete.
3. All necessary materials, labour and use of tools.

5.7.05 MODE OF MEASUREMENT : The measurement shall be for unit of nahani / floor trap / multi floor trap fixed.

5.8 RAIN WATER GRATING :

5.8.01 GENERAL : The item includes supplying of cast iron grating of specified diameter including fixing and painting.

5.8.02 MATERIAL : The rain water grating shall be Cast Iron with closed grained without any casting defects. The thickness should be uniform throughout, one shaped C.I. grating.

5.8.03 FIXING : C.I. rain water grating shall be fixed in position with 1:1 cement mortar.

5.7.04 THE RATE INCLUDES FOR :

1. The cast iron rain water grating cement, sand etc.
2. Fixing the grating.
3. All necessary materials, labour and use of tools.

5.8.05 MODE OF MEASUREMENT : The measurement shall be for each unit of grating fixed.

5.9 RAIN WATER STAINLESS STEEL DOME MESH :

5.9.01 GENERAL : The item includes supplying of Stainless steel Dome mesh of specified diameter including fixing.

5.9.02 MATERIAL : Half Spherical Dome shape rain water grating shall fabricated by welding from 2mm dia 304 grade stainless steel wire, with 5mm x 10mm L base ring of 0.5mm thickness 304 grade Stainless steel. L ring to be embedded in waterproofing & dome to be placed on it or as per drawing. Grating size shall be as per schedule and to suit with rain down take or suit with sheet flashing. SS Dome mesh shall have openings of 5 to 10mm or as per schedule.

5.9.03 FIXING : Stainless steel Dome mesh rain water grating shall be fixed in position with 1:1 cement mortar.

5.9.04 THE RATE INCLUDES FOR :

1. The Stainless steel Dome mesh rain water grating, cement, sand etc.
2. Fixing the grating.
3. All necessary materials, labour and use of tools.

5.9.05 MODE OF MEASUREMENT : The measurement shall be for each unit of grating fixed.

5.10 LEAD SHEET FLASHING :

5.10.01 GENERAL : The item includes supplying lead sheet flashing of specified size including laying, fixing, cutting, jointing and laying.

5.10.02 MATERIAL : Lead sheet flashing shall not be less than 3 mm thick & weight should not be less than 38 Kg. per sqm.

5.10.03 FIXING : The lead sheet shall be fixed all around the rain water pipe. The sheet shall project one diameter of socket all-round beyond the outer face of the socket & shall project inside the socket at least half the diameter of the rain water pipe socket. It shall be fixed by bending & breaking the sheet to shape, placing, tucking below waterproofing courses etc.

5.10.04 THE RATE INCLUDES FOR :

1. The lead sheet flashing, cement concrete and cement mortal etc.
2. Fixing the lead sheet in position.
3. All necessary materials, labour and use of tools.

5.10.05 MODE OF MEASUREMENT : The measurement shall be for each unit of lead sheet flashing fixed.

5.11 HDPE SHEET FLASHING:

5.11.01 GENERAL: The item includes fabricating, supplying and fixing of HDPE sheet having hole equals to the inner dia of HDPE pipe piece welded to it.

5.11.02 MATERIAL: Sheet and pipe piece shall be of HDPE. Sheet shall be of 8mm thickness if not specified. Sheet shall be flexible. Pipe shall be of 160mm outer dia, minimum PN6.0 grade or equivalent thickness. Pipe length shall be 400mm or having 100mm effective projection, whichever is greater. Reducer and bend required for connecting HDPE 160mm dia pipe piece to lower size rain water uPVC pipe shall provide as per the grade of rain water pipe.

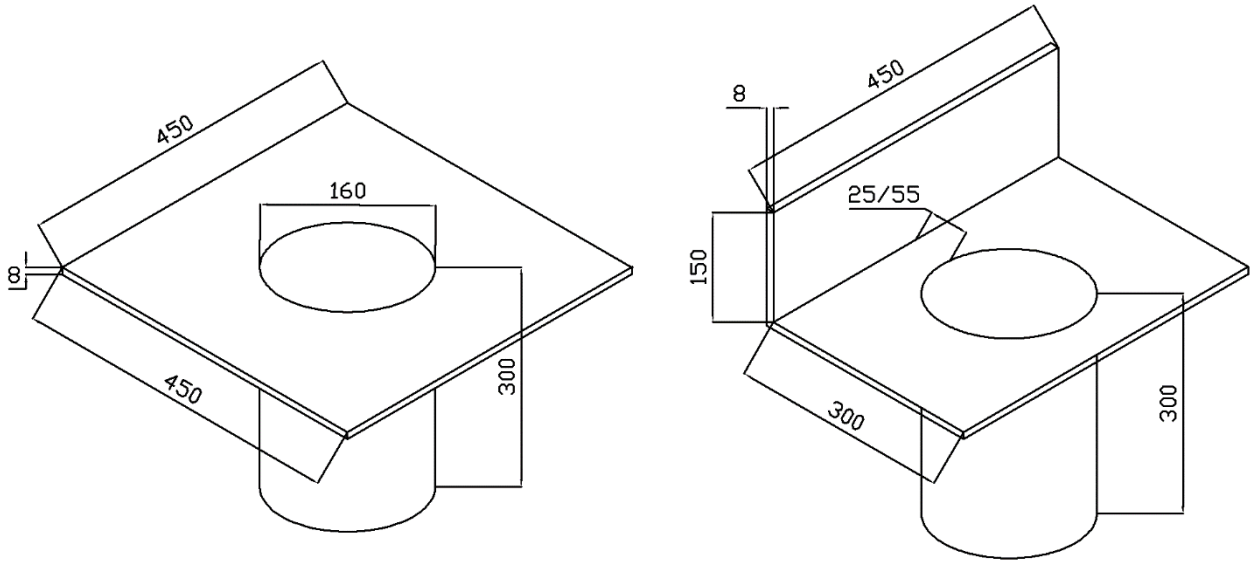
5.11.03 FIXING: HDPE sheet flashing shall be fixed with cement mortar 1:2 mixed with water proofing compound and forming the proper shape and grade and finishing with inlet mouth of rain water pipe, cutting RCC slab or wall if required

For fixing HDPE sheet on RCC / Cement Concrete, bottom surface of HDPE sheet shall be stick watertight by synthetic glue as per manufacturer's recommendation (Glue type as per manufacturer's recommendation). Top potion shall be spread with approved synthetic glue and fine 0.5 to 1.0 mm sand shall be sprinkled over it and allowed to be dried. After drying it is to be embedded using cement mortar 1:2 as per required shape and form.

5.11.04 THE RATE INCLUDES FOR :

1. Fabricating and supplying HDPE sheet flashing. Supplying and fixing uPVC fittings such as Bend and Reducer. Bitumen, cement mortar etc fixing material, tools & plants.
2. Laying, jointing and fixing HDPE sheet flashing including welding, cutting pipes, wastage etc.
3. All necessary materials, labour and use of tools

5.11.05 MODE OF MEASUREMENT : The measurement shall be for each number.



HDPE Sheet Flashing

(Length of pipe piece = 400mm in lieu of 300mm as shown in above sketch)

5.12 **RAIN WATER G.I. SPOUT :**

5.12.01 GENERAL : The item include supplying of G.I. rain water spouts of specified diameter with or without fitting at outlet including fixing. Cutting and painting.

5.12.02 MATERIAL : The rain water spout shall be of heavy quality G.I. pipe of approximate 400 mm length or as specified in the schedule of work. The 'T' of same diameter shall be fixed at the out let of spout. G.I. Pipe and fitting shall be as per specifications under section IV.

5.12.03 FIXING : G.I. rain water spout shall be fixed in the position as shown in the drawing including breaking, cutting RCC pardi, brick wall, RCC floor etc. It shall be fixed with 1:1 cement mortar and 1:2:4 cement concrete.

5.12.04 PAINTING : The exposed part of spout shall be painted with two coats of approved flat oil paint over a coat of primer.

5.12.05 THE RATE INCLUDES FOR :

1. The G.I. rain water spout, cement concrete and cement mortar.
2. Fixing and painting the spout.
3. All necessary materials, labour and use of tools.

5.12.06 MODE OF MEASUREMENT : The measurement shall be for each unit of G.I. spout fixed.

5.13 **RAIN WATER C.I. SPOUT :**

5.13.01 GENERAL : The item include supplying of C.I. spouts of specified diameter including fixing, cutting, and painting,

5.13.02 MATERIAL : The spout shall be of heavy quality C.I. pipe of approximate 600 mm long or as specified in the schedule of work. Pipe shall be as per specifications of C.I. piping work under Section-V.

5.13.03 FIXING : C.I. rain water spout shall be fixed in the position including breaking, cutting RCC/ brick structure etc. It shall be fixed with 1:1 cement mortar and 1:2:4 cement concrete.

5.13.04 PAINTING : The exposed part of spout shall be painted with two coasts of anticorrosive black bitumastic paint over a cost of primer.

5.13.05 THE RATE INCLUDES FOR :

1. The C.I. Spout, cement concrete and cement mortar.
2. Fixing and painting the spout.
3. All necessary materials, labour and use of tools.

5.13.06 MODE OF MEASUREMENT : The measurement shall be for each unit of C.I. spout fixed.

5.14 RAIN WATER uPVC / CPVC SPOUT :

5.14.01 GENERAL : The item include supplying of rain water spouts of specified plastic material, diameter with or without fitting at outlet including fixing. Cutting and painting.

5.14.02 MATERIAL : The rain water spout shall be of heavy quality specified pipe of approximate 400 mm length or as specified in the schedule of work. The 'T' of same material and diameter shall be fixed at the outlet of spout. Pipe and fitting shall be as per specifications under section IV.

5.14.03 FIXING : Pipe portion to be embedded shall be spread with approved synthetic glue and fine 0.5 to 1.0 mm sand shall be sprinkled over it and allowed to be dried. After drying it is to be embedded using cement mortar 1:2 as required. Rain water spout shall be fixed in the position as shown in the drawing including breaking, cutting RCC pardi, brick wall, RCC floor etc. It shall be fixed with 1:1 cement mortar and 1:2:4 cement concrete.

5.14.04 PAINTING : The exposed part of spout shall be painted with two coats of approved water base distemper of approved shade.

5.14.05 THE RATE INCLUDES FOR :

1. The PVC rain water spout, synthetic glue, fine sand, cement concrete and cement mortar.
2. Fixing and painting the spout.
3. All necessary materials, labour and use of tools.

5.14.06 MODE OF MEASUREMENT : The measurement shall be for each unit of spout fixed.

5.15 GARBAGE CHUTE :

5.15.01 GENERAL : The item include supplying of A.C. garbage chute of specified diameter including fixing & cutting.

5.15.02 MATERIAL : Garbage chute shall be of asbestos cement of dimension as mentioned in the schedule. The refuse disposal system shall consist of A.C. pipes, A.C. refuse junction, A.C. adapter of suitable size and M.S. or Aluminium hopper of 18 gauge suitably capped with vent covers and providing the AC junction at terrace floor opening for periodical flushing / cleaning purpose. Inlet hopper which is to be located at each floor shall be closed with rubber seal along the shutter and shall be of 18 gauge aluminium / M.S. sheet and suitable for all diameter of shafts.

5.15.03 FIXING : A.C. refuse junction shall be fixed at convenient height and it should not exceed 75 cms. From floor level or as directed by the Engineer-in-charge.

Square opening of refuse junctions shall be embedded in masonry or in cement concrete and M.S. Aluminium hoppers shall be fitted with nuts and bolts to the square junction opening and the frame shall flush with the wall.

The refuse disposal system shall be supported by M.S. flats not less than 20 mm x 3 mm thick encircling the pipe or junction below the socket and fixed to the wall with two screws of suitable length on each end of M.S. flats. The entire fixing of the garbage chute shall be carried out as directed by the Engineer-in-charge.

5.15.04 JOINTING : Joints of sockets and spigot shall be caulked to about 25 mm in depth with bitumastic jointing compound and remaining gap may be grouted with 1:2 cement mortar.

5.15.05 THE RATE INCLUDES FOR :

1. The A.C. garbage chute with all fittings
2. Fixing the garbage chute and joining with 1:1 cement mortar.
3. All necessary materials, labour and use of tools.

5.15.06 MODE OF MEASUREMENTS : The measurement shall be for per running meter length of garbage chute fixed.

5.16 INSPECTION CHAMBER :

5.16.01 GENERAL : The item includes provision of brick masonry Inspection Chamber of internal size as specified in the schedule.

5.16.02 MATERIAL : Concreting, Brick work, plastering etc., shall be as per specification as given in general specification under section II.

5.16.03 CONSTRUCTION :

1. Internal dimensions and initial depth shall be as specified in the schedule or as shown in the drawing.
2. Foundation of 1:2:4 concrete shall be 150 mm thick and shall have 150 mm offset.
3. The concrete 1:2:4 shall be laid to necessary shapes to form the channel for the pipe being received in the channel. It shall be of appropriate diameter and shall be half round. The sides shall be kept sloping towards the channel.
4. Brick masonry shall be 230 mm thick in cement mortar 1:2 or as specified in the schedule of work, making brick tapering for longitudinal wall 450 mm from top of cover of the chamber.
5. Brick masonry shall be rendered with 20 mm thick plaster in cement mortar 1:1 or as specified in the schedule of work inside and outside surfaces in two courses and inside surface finished smooth with neat cement punning.

5.16.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.16.05 THE RATE INCLUDES FOR :

1. Concreting in foundation, forming the channels, constructing brick masonry and plastering over the brick work, and finishing smooth in side surfaces.
2. Cutting existing stoneware/RCC Hume/uPVC pipe line to facilitate construction the Inspection chamber.
3. Dewatering the pit if found necessary till completion of work.
4. All necessary labour, materials and use of tools.

5.16.06 MODE OF MEASUREMENT : The measurement shall be for an Inspection chamber of specified finished internal size and initial depth measured vertically from top of the frame and cover to the invert of chamber. Extra for additional depth or rebate for lesser depth shall be measured in R.M.

5.17 CIRCULAR MANHOLE :

5.17.01 GENERAL : The item includes provision of brick masonry Circular manhole of internal size as specified in the schedule.

5.17.02 MATERIAL : Concreting, Brick work, plastering etc. shall be as per specification as given in general specification under section II.

5.17.03 CONSTRUCTION :

1. Internal dimensions and initial depth shall be as specified in the schedule of work or as shown in the drawing.
2. Foundation of 1:2:4 concrete shall be 300 mm thick and shall have 300 mm offset.
3. The concrete 1:2:4 shall be laid to necessary shapes to form the channel for the pipe being received in the channel. It shall be of appropriate diameter and shall be half round. The sides shall be kept sloping towards the channel.
4. Brick masonry shall be in cement mortar 1:2 or as specified in the schedule of work. Conical height from top shall be as shown in the drawing. Thickness of Brick masonry varies with depth and shall be as specified in the schedule of work or as shown in the drawing.
5. For chamber having depth more than 3m; RCC bands of 250mm thickness as shown in drawing with reinforcement of 12mm tor steel rings and 8mm stirrups at 250mm spacing shall be provided. For 1 brick wide band 4 steel rings of 12mm tor steel shall be provided similarly for 1½ brick wide band 6 steel rings, for 2 brick wide band 8 steel rings, for 2½ brick wide band 10 steel rings shall be provided.
6. Brick masonry shall be rendered with 20 mm thick plaster in cement mortar 1:1 or as specified in the schedule of work inside and outside surfaces in two courses and inside surface finished smooth with neat cement punning.

5.17.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.17.05 THE RATE INCLUDES FOR :

1. Concreting in foundation, forming the channels and RCC bands with reinforcement steel, constructing brick masonry and plastering over the brick work and finishing smooth inside surfaces.
2. Cutting existing stoneware / RCC hume / uPVC pipe line to facilitate construction of new manhole.
3. Dewatering the pit if found necessary till completion of work.

4. All necessary labour, materials, scaffoldings and use of tools.

5.17.06 MODE OF MEASUREMENT : The measurement shall be for one circular manhole of specified finished internal size and initial depth measured vertically from top of the frame and cover to the invert of manhole. Extra over for additional depth or rebate for lesser depth shall be measured in R.M.

5.18 EXTRA DEPTH FOR INSPECTION CHAMBER AND MANHOLE :

5.18.01 GENERAL : The item includes provision for extra depth of Inspection Chamber and manholes of brick masonry.

5.18.02 MATERIAL : Concreting, Brick work, plastering etc. shall be as per specification as given in general specification under section II.

5.18.03 CONSTRUCTION : Extra depth for inspection chamber and manhole shall be constructed under the 5.12 & 5.13 of the Section - 5.

5.18.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.18.05 THE RATE INCLUDES FOR :

1. Constructing brick masonry and plastering over the brick work.
2. Dewatering the pit if found necessary till completion of work.
3. All necessary labour, materials, scaffoldings and use of tools.

5.18.06 MODE OF MEASUREMENT : The measurement shall be for unit meter depth or part thereof for inspection chamber / circular manhole constructed. Depth of manhole or chamber shall be measured from top of the frame and cover to the invert level of manhole deducting the initial depth of a manhole/ chamber. Extra for additional depth or rebate for lessor depth shall be measured in R.M.

5.19 DROP CONNECTION (for depth more than 600mm):

5.19.01 GENERAL : The item includes provision of drop connection of salt glazed, uPVC or HDPE (as per the sewer line pipe material) of nominal diameters as specified in schedule of quantities including 1:2:4 cement concrete encased to pipe all round.

5.19.02 MATERIAL : Concreting, Jointing material as per as per the sewer line pipe material, pipes and specials like bends, tees, crosses (double tees), plugs caps etc. of specified diameter shall be as per the sewer line pipe material class and conforming to respective IS code. All the pipes and fitting shall be free from all type of defects and imperfections. Necessary formwork shall be provided for encasing the pipes.

5.19.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work and contractor has to replace the same from the site at his own cost and charges.

5.19.04 LAYING, FIXING, JOINTING, CLEANING, TESTING : Above shall be done as specified for laying of sewer pipes.

5.19.05 ENCASING THE PIPE LINE : After the joints and pipes have been proved to be water tight then pipe line shall be embedded in cement concrete as specified in the schedule of quantities and as shown in drawings including necessary form work.

5.19.06 DEWATERING : The contractor rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.19.07 THE RATE INCLUDES FOR :

1. Sewer pipe with specials viz. bends, tees, crosses (double tees), plugs, caps etc. with jointing material.
2. Laying, jointing and testing the pipe line including cutting & wastage
3. Concreting and formwork for encasing
4. Dewatering if found necessary till completion of work.
5. All necessary labour, materials, scaffoldings and use of tools.

5.19.08 MODE OF MEASUREMENT : The measurement shall be for one drop connections of specified nominal dia. of pipe & depth of drop connection shall be measured vertically from the bed level of drop pipe cleaning chamber (i.e. finished top of bed concrete) to the invert level of manhole or chamber. Extra/Rebate for additional/lesser than the initial depth respectively shall be measured in RM.

5.20 DROP CONNECTION (for depth upto 600mm):

5.20.01 GENERAL : The item includes provision of drop connection to sewer line in inspection chamber or manhole by constructing inclined / Sloping U channel of width equal to the greater size of sewer pipelines connected to chamber for through chamber and shall be equal to incoming pipe for junction chambers.

5.20.02 MATERIAL : Concreting.

5.20.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work and

contractor has to replace the same from the site at his own cost and charges.

5.20.04 LAYING, FIXING, JOINTING, CLEANING, TESTING : Above shall be done as specified in laying of sewer pipes.

5.20.05 DEWATERING : The contractor rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.20.07 THE RATE INCLUDES FOR :

1. Concreting and formwork for constructing U channel and slope profile.
4. Dewatering if found necessary till completion of work.
5. All necessary labour, materials, scaffoldings and use of tools.

5.20.08 MODE OF MEASUREMENT : The work shall be measured under relevant item in the schedule of quantities.

5.21 DROP PIPE CLEANING CHAMBER :

5.21.01 GENERAL : The item includes construction of brick masonry cleaning chamber of size as specified in the schedule including providing frame and cover of loading class, size and material as specified in the schedule.

5.21.02 MATERIAL : Brick work, plastering, concreting etc. shall be as per general specification under section II. Frame and cover of loading class, size and material all as specified in the schedule.

5.21.03 CONSTRUCTION :

a) Foundation concrete of mix 1:2:4 shall be of 150 mm thick with 150 mm offset around or as specified in the schedule.

b) Brick masonry in cement mortar 1:2 as specified.

c)Plastering inside and outside surfaces of walls in two courses using cement mortar 1:1 of thickness as specified mixed with water proofing compound of specified Quality including inner surfaces finished smooth with neat cement punning.

5.21.04 FRAME AND COVER : Frame and covers of Precast RCC, M.S., C.I., D.I. or FRP Composite shall be as specified. Frame and cover of loading class, size and material specified in the schedule shall be fixed with the cement concrete 1:2:4 at the top of drop pipe cleaning chamber. Metal frame and covers shall be painted with two coasts of black bitumastic paint.

5.21.05 DEWATERING : The water accumulated in the pit due to rain, seepage, springs or any other cause during the progress of work shall be pumped/bailed out till the completion of work.

5.21.06 THE RATE INCLUDES FOR :

1. Bed concrete, Brick masonry, cement plaster, frame and cover etc.
2. Dewatering the trench or pit if necessary.
3. All necessary labour, materials and use of tools.

5.21.07 MODE OF MEASUREMENT : The measurement shall be for each unit of chamber of specified internal size and depth constructed.

5.22 C.I. FRAME AND COVER FOR MANHOLES :

5.22.01 GENERAL : The item includes supply LD/MD/HD/EHD/C.I. frame and cover as specified in schedule including fixing and painting.

5.22.02 MATERIAL : C.I. Frame and cover shall conform to IS 1720 and shall have IS certification mark with grade LD/MD/HD/EHD and the weight of frame and cover shall not be less than as specified in the schedule.

5.22.03 FIXING : Frame shall be fixed in the cement concrete 1:2:4 for bearing course and capping on the brick masonry wall of the chamber of manhole and finishing shall be done in 1:2 cement plaster finished smooth with neat cement.

5.22.04 PAINTING : The frame and cover shall be painted with two coats of approved black bitumastic anticorrosive paint over a coat of primer.

5.22.05 THE RATE INCLUDES FOR :

1. C.I. frame and cover, cement concrete, cement plaster, painting etc.
2. All necessary labour, material and use of tools.

5.22.06 MODE OF MEASUREMENT : The measurement shall be for C.I. Frame & cover on actual unit weight basis.

5.23 PRECAST CONCRETE FRAME AND COVER FOR MANHOLES :

5.23.01 GENERAL : The item includes supply LD/ MD/ HD/ EHD factory made precast steel fibre reinforced concrete (SFRC) frame and cover as specified in schedule including fixing and placing.

5.23.02 MATERIAL : The precast frame and cover shall be of steel fibre reinforced concrete (SFRC) conforming to IS 12592 and shall be of approved make. The frame and cover shall be of LD/ MD/ HD/ EHD grade, size and thickness as mentioned in the description of the item. The defective Frame and cover shall be replaced by the contractor at his own cost and charges.

5.23.03 FIXING : Frame shall be fixed in cement concrete 1:2:4 for bearing course & capping on the top of masonry wall of chamber or manhole and finishing shall be done in 1:2 cement plaster finished smooth with neat cement.

5.23.04 THE RATE INCLUDES FOR :

1. Precast S.F.R.C. Frame and cover, cement concrete, cement plaster etc.
2. All necessary labour, material and use of tools.

5.23.05 MODE OF MEASUREMENT : The measurement shall be for unit set of Precast S.F.R.C. Frame and cover fixed.

5.24 FRP COMPOSITE FRAME AND COVER FOR MANHOLES:

5.24.01 GENERAL: The item includes supply LD/MD/HD/EHD FRP composite frame and cover as specified in schedule including fixing.

5.24.02 MATERIAL: FRP composite Frame and cover shall conform to the loading as per IS 1726 and shall have Manufacturers &/or departments mark, date with grade LD/MD/HD/EHD engraved / embossed. Frame and cover shall be approved by MCGM and/or relevant statutory authority.

5.24.03 FIXING : Frame shall be fixed in the cement concrete 1:2:4 for bearing course and capping on the brick masonry wall of the chamber of manhole and finishing shall be done in 1:2 cement plaster finished smooth with neat cement.

5.24.04 THE RATE INCLUDES FOR:

5.24.04.1 FRP composite frame and cover, cement concrete, cement plaster etc.

5.24.04.2 All necessary labour, material and use of tools.

5.24.05 MODE OF MEASUREMENT: The measurement shall be for FRP Frame & cover each number basis as per grade.

5.25 D.I. FRAME AND COVER FOR MANHOLES:

5.25.01 GENERAL: The item includes supply LD/MD/HD/EHD D.I. frame and cover as specified in schedule including fixing.

5.25.02 MATERIAL: D.I. Frame and cover shall conform to the loading as per IS 1726 and shall have Manufacturers &/or departments mark, date with grade LD/MD/HD/EHD engraved / embossed. Frame and cover shall be approved by MCGM and/or relevant statutory authority.

5.25.03 FIXING : Frame shall be fixed in the cement concrete 1:2:4 for bearing course and capping on the brick masonry wall of the chamber of manhole and finishing shall be done in 1:2 cement plaster finished smooth with neat cement.

5.25.04 PAINTING : The frame and cover shall be painted with two coats of approved black bitumastic anticorrosive paint over a coat of primer.

5.25.05 THE RATE INCLUDES FOR:

5.25.05.1 D.I. frame and cover, cement concrete, cement plaster etc.

5.25.05.2 All necessary labour, material and use of tools.

5.25.05 MODE OF MEASUREMENT: The measurement shall be for D.I. Frame & cover on actual unit weight basis.

5.26 CAST IRON STEPS / RUNGS :

5.26.01 GENERAL : The item includes supplying of cast iron steps including fixing and painting.

5.26.02 MATERIAL : The steps shall be of cast iron as per IS:5455 latest revision.

5.26.03 FIXING : The steps shall be fixed in brick masonry wall with 1:2:4 cement concrete with 75 mm cement concrete cover at all around the step. The first step shall be 450 mm below from top surface of structure and next shall be fixed 300 mm centre to centre in two rows at 300 mm distance or as shown in the drawing.

5.26.04 PAINTING : The projected portion of the cast iron step shall be painted with two coats of approved black bitumastic anti corrosive paint over a coat of primer.

5.26.05 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.26.06 THE RATE INCLUDES FOR :

1. C.I. Steps cement concrete and painting etc.

2. Dewatering if found necessary till completion of work.
3. All necessary labour, material and use of tools.

5.26.07 MODE OF MEASUREMENT : The measurement for C.I. steps shall be on actual unit weight basis or unit C.I. step fixed as specified in the schedule.

5.27 COPOLYMER POLYPROPYLENE PLASTIC FOOT-RESTS / STEPS / RUNGS :

5.27.01 GENERAL : The item includes supplying of copolymer polypropylene steel reinforced plastic Foot-rests / Steps /rungs including fixing.

5.27.02 MATERIAL : The steps shall be copolymer polypropylene steel reinforced plastic Foot-rests / Steps of approved brand or eq. as per ASTM D - 4101 specification and moulded above 12 mm dia. IS - 1786 grade Fe - 415 steel reinforcing bar and in "U" shape having dimensions 263 x 168 mm.

5.27.03 FIXING : The steps shall be fixed in brick masonry wall with 1:2:4 cement concrete with 75 mm cement concrete cover at all around the step. The first step shall be 450 mm below from top surface of structure and next shall be fixed 300 mm centre to centre in two rows at 300 mm distance or as shown in the drawing.

5.27.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.27.05 THE RATE INCLUDES FOR :

5.27.05.1 Copolymer polypropylene steel reinforced plastic Steps and cement concrete etc.

5.27.05.2 Dewatering if found necessary till completion of work.

5.27.05.3 All necessary labour, material and use of tools.

5.27.06 MODE OF MEASUREMENT : The measurement for copolymer polypropylene steel reinforced plastic steps shall be on unit step fixed as specified in the schedule.

5.28 SALT GLAZED STONE WARE PIPING WORK :

5.28.01 GENERAL : The item includes supplying, laying and fixing the salt glazed Stone ware pipes with necessary fittings of specified diameter including laying, jointing etc.

5.28.02 MATERIAL : Salt glazed stoneware pipes and specials of specified diameter shall be of grade "A" or "AA" conforming to IS 651. All the pipes and fitting shall be free from pin holes, cracks and other imperfections and should have the glossy finish of salt glazing.

5.28.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work contractor has to replace the same from the site at his own cost and charge.

5.28.04 TRENCHES : The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under road way, a minimum cover of 900 mm is recommended for adoption, but it may be modified to suit local conditions.

Unless otherwise specified by the Engineer-in-Charge, the width at bottom of trenches for different diameters of pipe laid at different depth s shall be as given below:-

a) For all diameters, upto an average depth of 1200 mm, width of trench in mm shall be equal to diameter of pipe plus 300 mm.
b) For all diameters for depths above of 1200 mm , width of trench in mm shall be equal to the diameter of pipe plus 400 mm
c) Notwithstanding (a) & (b) above, the total width of trench shall not be less than 750 mm for depths exceeding 900 mm.

The width of trench in the upper reaches shall be increased as described in sub head under “Earth Work.”

5.28.05 LAYING AND FIXING : Pipes shall be laid carefully to the correct alignment, levels and gradient and care shall be taken to prevent for entering the sand, earth or other foreign material into the pipes during laying. The pipes between manholes shall be laid truly in straight line, without vertical or horizontal undulations.

All inverts shall be laid from sight rails fixed at the true levels, with proper boning rods, the pipes shall be laid sockets facing up the gradient, alignment at the lower end and with the socket resting in the concrete bed if specified. Each pipes shall be laid singly and no pipe shall be laid until the trench has been excavated up to the required depth for a distance of 5meter in front of the pipes to be laid.

5.28.06 JOINTING : Spun yarn soaked in cement wash shall be passed round the spigot and spigot inserted in the socket, the spun yarn shall then be caulked with 1:1 cement mortar with a little water, pressed into the joint with hand and finished at 45 degree the mortar shall be cured for seven days.

The following table shows the details of materials used for jointing the S.W. pipe.

Internal dia of pipe (mm)	Depth of socket in mm	Depth of yarn in mm	Depth of C.M. paste in mm
100	50	20	33

150	56	30	30
230	65	30	35

5.28.07 CLEANING : Interior surface of the pipes and fittings shall be cleaned off from all dirt, cement mortar and superfluous materials.

5.28.08 TESTING : The joints of S.W. Pipe line shall be tested for a minimum 600 mm water head over the crown of the highest pipe between the two manholes. The lower end shall be plugged water tight. Water shall then be filled in the inspection chamber or manhole at the upper end of the line with 600 mm depth of water over the crown. If it is found the certain pipe joints are leaking, the water shall be drained off and joints shall be recaulked.

5.28.09 ENCASING THE PIPE LINE : After the joints and pipes have been proved to be water tight then pipe line shall be embedded in cement concrete if specified to the extent of one half of external diameter of the pipes as directed, the concrete being made to slope away towards the sides of the foundations bed. Refilling shall be done with fine selected materials and shall be done in layers not exceeding 150mm thick, watered, consolidated and rammed properly, as specified.

5.28.10 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.28.11 THE RATE INCLUDES FOR :

5.28.11.1 S.W. Pipes with specials, cement mortar 1:1 and spun yarn.

5.28.11.2 Laying, jointing and testing the pipe line including cutting and wastage.

5.28.11.3 Dewatering if found necessary till completion of work.

5.28.11.4 All necessary labour, materials and use of tools.

5.28.12 MODE OF MEASUREMENT : The measurement shall be for unit meter length of pipe line laid. The pipe shall be measured along the center line over all fittings. The measurement does not include for encasement of the pipe, which will be paid the relevant item.

5.29 UPVC UNDERGROUND DRAINAGE PIPING WORK :

5.29.01 GENERAL : The item includes supplying, laying and fixing the UPVC underground drainage pipes with necessary fittings of specified diameter including laying, jointing etc.

5.29.02 MATERIAL : UPVC underground drainage pipes, fittings and specials of specified diameter shall be of ring stiffness class SN8 or SN4 conforming to IS 15328. All the pipes and fitting shall be free from all defects, other imperfections and should have the smooth finish. For rubber ring jointing SBR or EPDM gasket / rubber ring shall be used.

5.29.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work contractor has to replace the same from the site at his own cost and charge.

5.29.04 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.29.05 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside surfaces.

5.29.06 TRENCHES : The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under road way, a minimum cover of 900 mm is recommended for adoption, but it may be modified to suit local conditions.

Unless otherwise specified by the Engineer-in-Charge, the width at bottom of trenches for different diameters of pipe laid at different depth s shall be as given below:-

a) For all diameters, upto an average depth of 1200 mm, width of trench in mm shall be equal to diameter of pipe plus 300 mm.

b) For all diameters for depths above of 1200 mm , width of trench in mm shall be equal to the diameter of pipe plus 400 mm

c) Notwithstanding (a) & (b) above, the total width of trench shall not be less than 750 mm for depths exceeding 900 mm.

The width of trench in the upper reaches shall be increased as described in sub head under “Earth Work.”

5.29.07 LAYING AND FIXING : Pipes shall be laid carefully to the correct alignment, levels and gradient and care shall be taken to prevent for entering the sand, earth or other foreign material into the pipes during laying. The pipes between manholes shall be laid truly in straight line, without vertical or horizontal undulations.

All inverts shall be laid from sight rails fixed at the true levels, with proper boning rods, the pipes shall be laid sockets facing up the gradient, alignment at the lower end and with the socket resting in the concrete bed if specified. Each pipes shall be laid singly and no pipe shall be laid until the trench has been excavated up to the required depth for a distance of 5meter in front of the pipes to be laid.

5.29.08 JOINTING : Solvent cement joint or rubber ring joint shall be provided and jointing process in accordance with IS:7634(Part3) latest revision shall be adopted.

5.29.09 CLEANING : Interior surface of the pipes and fittings shall be cleaned off from all dirt, cement mortar and superfluous materials.

5.29.10 TESTING : The joints of sewer pipe line shall be tested for a minimum 600 mm water head over the crown of the highest pipe between the two manholes. The lower end shall be plugged water tight. Water shall then be filled in the inspection chamber or manhole at the upper end of the line with 600 mm depth of water over the crown. If it is found the certain pipe joints are leaking, the water shall be drained off and joints shall be rectified.

5.29.11 ENCASING THE PIPE LINE : After the joints and pipes have been proved to be water tight then pipe line shall be embedded in cement concrete if specified to the extent of one half of external diameter of the pipes as directed, the concrete being made to slope away towards the sides of the foundations bed. If specified sewer pipe shall be encased full with minimum 150mm side clearance between outer surface of pipe and outer surface of encasing. Refilling shall be done with fine selected materials and shall be done in layers not exceeding 150mm thick, watered, consolidated and rammed properly, as specified.

5.29.12 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.29.13 THE RATE INCLUDES FOR :

5.29.13.1 UPVC pipes for use in underground drainage and sewerage systems with specials, solvent cement and rubber gaskets.

5.29.13.2 Laying, jointing and testing the pipe line including cutting and wastage.

5.29.13.3 Dewatering if found necessary till completion of work.

5.29.13.4 All necessary labour, materials and use of tools.

5.29.14 MODE OF MEASUREMENT : The measurement shall be for unit meter length of pipe line laid. The pipe shall be measured along the center line over all fittings. The measurement does not include for encasement of the pipe, which will be paid the relevant item.

5.30 SEWER TRAP (S.W.):

5.30.01 GENERAL : The item includes supplying, laying and fixing the Stone ware sewer trap of specified diameter including fixing, jointing and embedding.

5.30.02 MATERIAL : Sewer trap shall be salt glazed of stoneware of specified diameter and shall be of grade "A" or "AA" conforming to IS 651. Sewer trap should be free from pin holes, cracks and other imperfections and should have the glossy finish of salt glazing.

5.30.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work and contractor has to replace the same from the site at his own cost and charge.

5.30.04 FIXING : Sewer trap shall be laid carefully to the correct alignment, levels and gradient and care shall be taken to prevent for entering the sand, earth or other free material into the trap during laying. The trap shall be on bedded in CC 1:2:4 including necessary form work.

5.30.05 TESTING : The testing shall be done along the testing of server line with the same specification.

5.30.06 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.30.07 THE RATE INCLUDES FOR :

5.30.07.1 S.W. sewer trap, cement mortar 1:1 and spun yarn.

5.30.07.2 Laying, jointing on bedding in CC 1:2:4

5.30.07.3 Dewatering if found necessary till completion of work.

5.30.07.4 All necessary labour, materials and use of tools.

5.30.08 MODE OF MEASUREMENT : The measurement shall be for each unit of sewer trap fixed.

5.31 SEWER TRAP (uPVC):

5.31.01 GENERAL : The item includes supplying, laying and fixing the uPVC sewer trap of specified diameter including fixing, jointing and embedding.

5.31.02 MATERIAL : Sewer trap shall be of uPVC of specified diameter. If for specified diameter readymade uPVC sewer trap is not available then sewer trap shall be fabricated from uPVC pipe and uPVC fittings as per drawing. uPVC Sewer trap should be free from all defects, other imperfections and should have the smooth inside finish.

5.31.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work and contractor has to replace the same from the site at his own cost and charge.

5.31.04 FIXING : Sewer trap shall be laid carefully to the correct alignment, levels and gradient and care shall be taken to prevent for entering the sand, earth or other free material into the trap during laying. The trap shall be

on bedded in CC 1:2:4 including necessary form work.

5.31.05 TESTING : The testing shall be done along the testing of server line with the same specification.

5.31.06 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.31.07 THE RATE INCLUDES FOR :

5.31.07 uPVC sewer trap, solvent cement, cement mortar 1:1 and rubber gasket as per requirement.

5.31.07 Laying, jointing on bedding in CC 1:2:4

5.31.07 Dewatering if found necessary till completion of work.

5.31.07 All necessary labour, materials and use of tools.

5.31.08 MODE OF MEASUREMENT : The measurement shall be for each unit of sewer trap fixed.

5.32 CONNNECTION WITH DOMESTIC SEWER :

5.32.01 GENERAL : The item includes the provisions of connecting sewer line with existing sewer line chamber or manhole including cutting, breaking of masonry, road surface and making good to the original condition of the damages.

5.32.02 MATERIAL : Concreting, Brick work, plastering etc. shall be as per specification as given in general specification of section II.

5.32.03 MAKING CONNECTION :

5.32.03.1 Breaking or cutting the road surface for server connection.

5.32.03.2 Restoring all the excavated items in proper manner as directed by the Engineer-in-charge.

5.32.03.3 Cutting the brick masonry wall to required size of existing manhole or inspection chamber.

5.32.03.4 Connecting the sewer line to the chamber or manhole.

5.32.03.5 Making good to the original condition all the damages after completion of sewer connection.

5.32.03.6 Disposing off all the superfluous material as directed.

5.32.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.32.05 THE RATE INCLUDES FOR :

5.32.05.1 Cutting the road surface as required and making good.

5.32.05.2 Restoring all the excavated materials and disposal of superfluous materials.

5.32.05.3 Cutting the manhole masonry, making good masonry and other damages to the original condition according to the bye-laws.

5.32.05.4 Dewatering if found necessary till completion of work.

5.32.05.5 All the necessary labour, materials and use of tools.

5.32.06 MODE OF MEASUREMENT : The measurement shall be for one job.

5.33 CONNECTION WITH MUNICIPAL SEWER LINE :

5.33.01 GENERAL : The item includes the provisions of connecting sewer line with existing municipal sewer line chamber or manhole including cutting, breaking of masonry, road surface and making good to the original condition of the damages.

5.33.02 MATERIAL : Concreting, brick work, plastering etc. shall be as per specification as given in general specification under section II.

5.33.03 MAKING CONNECTION :

5.33.03.1 Breaking or cutting the road surface for sewer connection.

5.33.03.2 Restoring all the excavated items in proper manner as directed by the Engineer-in-charge.

5.33.03.3 Cutting the brick masonry wall to required size of municipal manhole or inspection chamber.

5.33.03.4 Connecting the sewer line to the chamber or manhole of Municipal sewer line.

5.33.03.5 Making good to the original condition all the damages after completion of sewer connection.

5.33.03.6 Disposing off all the superfluous materials as directed.

5.33.03.7 All necessary labour, materials and use of tools.

5.33.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.33.05 MUNICIPAL CHARGES : The contractor shall obtain the necessary permission for connecting the sewer line to the municipal sewer from the concerned authorities. He shall pay all necessary charges towards the connection given by the municipality.

5.33.06 THE RATE INCLUDES FOR :

5.33.06.1 Cutting the road surface as required and making good.

5.33.06.2 Restoring all the excavated materials and disposal of superfluous materials.

5.33.06.3 Cutting the manhole masonry, making good masonry and other damages to the original condition according to the bye-laws.

5.33.06.4 All the municipal charges towards connection.

5.33.06.5 Dewatering if found necessary till completion of work.

5.33.06.6 All necessary labour, material and use of tools.

5.33.07 MODE OF MEASUREMENT : The measurement shall be for one job

5.34 DOUBLE WALL CORRUGATED (DWC) DRAINAGE PIPING WORK :

5.34.01 GENERAL : The item includes supplying, laying and fixing the DWC underground drainage pipes with necessary fittings of specified diameter including laying, jointing etc.

5.34.02 MATERIAL : DWC underground drainage pipes, fittings and specials of specified diameter shall be of ring stiffness class SN8 or SN4 conforming to IS 16098 Part 2. All the pipes and fitting shall be free from all defects, other imperfections and should have the smooth finish. For rubber ring jointing SBR or EPDM gasket / rubber ring shall be used.

5.34.03 DAMAGED MATERIAL : Any material found damaged or cracked shall not be used in the work contractor has to replace the same from the site at his own cost and charge.

5.34.04 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

5.34.05 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside surfaces.

5.34.06 TRENCHES : The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under road way, a minimum cover of 900 mm is recommended for pipe dia upto 400 for adoption, but it may be modified to suit local conditions.

Minimum width of trenches shall be as per IS:16098 Part 2 for reference which is given in table below:

Minimum Trench Widths

Sl.No. (1)	Pipe Diameter (mm) (2)	Trench Width (m) (3)
i)	75 to 200	0.6
ii)	250	0.7
iii)	300	0.8
iv)	400	0.9
v)	600	1.2
vi)	800	1.3
vii)	900	1.6
viii)	1000	1.8
ix)	1200	2.0

Precautions are to be taken to arrest floating of installed sewer segments against buoyant forces in case of sudden accumulation of water in the trench. The diameter wise minimum cover necessary to counteract the buoyant forces is given in IS:16098 for reference which is given in table below. For exceptional cases of higher level of ground water, additional anchoring at equal intervals would be necessary.

Required Minimum Cover to Prevent Floatation

Sl.No. (1)	Pipe Diameter (mm) (2)	Minimum Cover (mm) (3)
i)	75	65
ii)	100	77
iii)	150	102
iv)	200	127
v)	250	178
vi)	300	368
vii)	400	505
viii)	600	711
ix)	900	1067
x)	1050	1219
xi)	1200	1372

The width of trench in the upper reaches shall be increased as described in sub head under “Earth Work.”

5.34.07 LAYING AND FIXING : Pipes shall be laid carefully to the correct alignment, levels and gradient and care shall be taken to prevent for entering the sand, earth or other foreign material into the pipes during laying. The pipes between manholes shall be laid truly in straight line, without vertical or horizontal undulations.

All inverts shall be laid from sight rails fixed at the true levels, with proper boning rods, the pipes shall be laid sockets facing up the gradient, alignment at the lower end and with the socket resting in the concrete bed if specified. Each pipes shall be laid singly and no pipe shall be laid until the trench has been excavated up to the required depth for a distance of 5meter in front of the pipes to be laid.

5.34.08 JOINTING : Solvent cement joint or rubber ring joint shall be provided and jointing process in accordance with IS:16098 latest revision shall be adopted.

5.34.09 CLEANING : Interior surface of the pipes and fittings shall be cleaned off from all dirt, cement mortar and superfluous materials.

5.34.10 TESTING : The joints of sewer pipe line shall be tested for a minimum 600 mm water head over the crown of the highest pipe between the two manholes. The lower end shall be plugged water tight. Water shall then be filled in the inspection chamber or manhole at the upper end of the line with 600 mm depth of water over the crown. If it is found the certain pipe joints are leaking, the water shall be drained off and joints shall be rectified.

5.34.11 ENCASING THE PIPE LINE : After the joints and pipes have been proved to be water tight then pipe line shall be embedded in cement concrete if specified as per drawing and as directed by EIC. Refilling shall be done with fine selected materials and shall be done in layers not exceeding 150mm thick, watered, consolidated and rammed properly, as specified.

5.34.12 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

5.34.13 THE RATE INCLUDES FOR :

5.34.13.1 DWC underground drainage pipes, fittings and specials sewerage systems with specials, solvent cement and rubber gaskets.

5.34.13.2 Laying, jointing and testing the pipe line including cutting and wastage.

5.34.13.3 Dewatering if found necessary till completion of work.

5.34.13.4 All necessary labour, materials and use of tools.

5.34.14 MODE OF MEASUREMENT : The measurement shall be for unit meter length of pipe line laid. The pipe shall be measured along the center line over all fittings. The measurement does not include for encasement of the pipe, which will be paid the relevant item.

6.0 WATER TANK, SEPTIC TANK, UPFLOW FILTER, & SOAK PIT & STP

6.1 FRAME AND COVER (M.S. or C.I.):

6.1.01 GENERAL : The item includes supplying of M.S. or C.I. frame with cover of size as specified in the schedule including fixing and painting. The frame and cover shall be of mosquito proof condition and approved by the Municipality

6.1.02 MATERIAL : The frame and cover shall be of mild steel or cast iron as specified in the schedule. The weight of frame and cover shall not be less than 50 kilogram's. They should have locking arrangement.

6.1.03 FIXING : The frame shall be fixed in the roof slab of tank or built with hold fast to R.C.C. slab by chasing or cutting slab and grouting with 1:2 cement mortar.

6.1.04 PAINTING : The frame and cover shall be painted with two coats of approved anti corrosive black bitumastic paint over a coat of approved quality primer.

6.1.05 THE RATE INCLUDES FOR :

6.1.05.1 Supplying and fixing frame and cover with locking arrangement.

6.1.05.2 All necessary materials, labour, painting and use of tools.

6.1.06 MODE OF MEASUREMENT : The measurement shall be on actual unit weight basis.

6.2 FRAME AND COVER D.I.:

6.2.01 GENERAL : The item includes supplying of D.I. frame with cover of size as specified in the schedule including fixing and painting. The frame and cover shall be of mosquito proof condition and approved by the Municipality

6.2.02 MATERIAL : The frame and cover shall be of Ductile iron of size and loading capacity as specified in the schedule. They should have locking arrangement.

6.2.03 FIXING : The frame shall be fixed in the roof slab of tank or built with hold fast to R.C.C. slab by chasing or cutting slab and grouting with 1:2 cement mortar.

6.2.04 PAINTING : The frame and cover shall be painted with two coats of approved anti corrosive black bitumastic paint over a coat of approved quality primer.

6.2.05 THE RATE INCLUDES FOR :

6.2.05.1 Supplying and fixing frame and cover with locking arrangement.

6.2.05.2 All necessary materials, labour, painting and use of tools.

6.2.06 MODE OF MEASUREMENT : The measurement shall be on actual unit weight basis.

6.3 FRAME AND COVER FRP COMPOSITE:

6.3.01 GENERAL : The item includes supplying of FRP composite frame with cover of size as specified in the schedule including fixing. The frame and cover shall be of mosquito proof condition and approved by the Municipality.

6.3.02 MATERIAL : The frame and cover shall be of FRP composite of size and loading capacity as specified in the schedule. They should have locking arrangement.

6.3.03 FIXING : The frame shall be fixed in the roof slab of tank or built with hold fast to R.C.C. slab by chasing or cutting slab and grouting with 1:2 cement mortar.

6.3.04 THE RATE INCLUDES FOR :

6.3.04.1 Supplying and fixing frame and cover with locking arrangement.

6.3.04.2 All necessary materials, labour, painting and use of tools.

6.3.06 MODE OF MEASUREMENT : The measurement shall be taken for each frame and cover as unit of specified size and loading capacity fixed.

6.4 SPOOL PIECE :

6.4A MILD STEEL / CAST IRON :

6.4A.01 GENERAL : The item includes supplying of M.S. Spool piece with end coupling or C.I. Spool piece with end flanges of size as specified in the schedule including fixing and painting.

6.4A.02 MATERIAL : Spool piece shall be in length 400 mm of G.I. pipe with end coupling or to 600 mm of C.I. spun pipe with end flanges, as specified in the schedule, A mild steel plate of size 3D x 3D or 200 mm x 200 mm whichever is more (where 'D' is the outer diameter of pipe) and shall be welded on the pipe such a way that it can be placed in the center of the RCC wall/ floor. The plate shall not be less than 4 mm thick.

6.4A.03 FIXING : The Spool piece shall be fixed in position as shown in the drawing or as directed by the Engineering in charge. The spool piece in RCC wall / floor of water tank / septic tank shall be fixed by making hole in the shuttering and tying it with reinforcement with M.S. wire, all as directed by the Engineer-in-charge.

6.4A.04 PAINTING : Projected length of Spool piece shall be painted with two coats of oil paint or anticorrosive black bitumastic paint as specified.

6.4A.05 THE RATE INCLUDES FOR :

6.4A.05.1 Supplying and fixing of spool piece.

6.4A.05.2 All necessary materials, labour, painting and use of tools.

6.4A.06 MODE OF MEASUREMENT : The measurement shall be taken for each spool piece of specified diameter fixed.

6.4B <u>STAINLESS STEEL :</u>

6.4B.01 GENERAL : The item includes supplying of stainless steel Spool piece with end flanges with required number of bolt holes of size as specified in the schedule & drawings including fixing.

6.4B.02 MATERIAL : Spool piece shall be of approximate 600 mm long or standard available length of stainless steel pipe conforming to ASTM A312, TP304/TP304L with end flanges as specified in the schedule. A stainless steel plate of size 3D x 3D or 200 mm x 200 mm, whichever is more (where 'D' is the outer diameter of pipe) and shall be welded on the pipe such a way that it can be placed in the center of the RCC wall/ floor. The plate shall not be less than 4 mm thick. The stainless steel pipe shall be seamless and scheduled / classified / graded as per actual system requirement and as per ANSI B36.19

6.4B.03 FIXING : The spool piece shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. The spool piece in RCC wall and floor of water tank shall be fixed by making hole in the shuttering and tying it with reinforcement using M.S. wire, all as directed by the Engineer-in-charge.

6.4B.04 THE RATE INCLUDES FOR :

6.4B.04.1 Supplying and fixing of spool piece.

6.4B.04.2 All necessary materials, labour and use of tools.

6.4B.05 MODE OF MEASUREMENT : The measurement shall be on total weight / mass basis of pipe pieces, flanges and puddle plate fixed as one unit.

6.5 <u>OVER FLOW COUPLING :</u>

6.5.01 GENERAL : The item includes supplying of C.P. Brass over flow coupling with mosquito proof jalli of size as specified in the schedule including fixing and painting.

6.5.02 MATERIAL : The overflow coupling shall be of heavy quality. Over flow coupling and Mosquito proof Jalli shall be of C.P. brass.

6.5.03 FIXING : The over flow coupling & jalli shall be fixed in position as shown in the drawing with leak proof joints.

6.5.04 THE RATE INCLUDES FOR :

6.5.04.1 Supplying & fixing Overflow coupling with mosquito proof jalli.

6.5.04.2 All necessary materials, labour, painting and use of tools.

6.5.05 MODE OF MEASUREMENT : The measurement shall be for each overflow coupling fixed with mosquito proof jalli.

6.6 <u>FLOAT VALVE :</u>

6.6.01 GENERAL : The item includes providing horizontal type float valve with PVC or copper float of size as mentioned in the schedule including fixing.

6.6.02 MATERIAL : Horizontal plunger type float valve with PVC or copper float shall be conforming to IS 1703. The lever shall be of brass and may be made in one piece and the diameter of the lever rod shall not be less than the diameter of the thread for boss of ball. Float shall be watertight and non-absorbent and shall not contaminate water. Adhesives for joining the part shall not be used. The minimum thickness for copper sheet of copper float shall be 0.45 mm up to 115 mm diameter and 0.55 mm for ball over 115 mm diameter. Valve shall be tested in closed position to the hydraulic pressure of 2 MPa for a minimum period of 2 minutes without leakage and sweating.

6.6.03 MINIMUM MASS : The minimum mass of finished float valve and float of different size and class shall be as per Table No. 8 of IS 1703.

6.6.04 FIXING : Valve shall be fixed in position as indicated in the drawing with necessary socket, union nuts etc. as per site requirements. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tight joint. Leaking joint if any shall be rectified to make it leak proof.

6.6.05 TESTING : Testing shall be done along with the testing of pipe line, separate testing if required shall be done as per ISI norms.

6.6.06 THE RATE INCLUDES FOR :

6.6.06.1 Supply of specified diameter float valve with copper or PVC float & brass lever arm, hemp yarn,

linseed oil, zinc etc.

6.6.06.2 All necessary materials, labour and use of tools.

6.6.07 MODE OF MEASUREMENT : The measurement shall be for each float valve fixed.

6.7 POLYETHYLENE WATER TANK :

6.7.01 GENERAL : The item includes providing polyethylene plastic water tank with cover of capacity as mentioned in the schedule including fixing and making connections such as inlet, outlet, scour, overflow etc.

6.7.02 MATERIAL : The water tank shall be made out of best moulded Polyethylene plastic. It shall be vertical or horizontal type as specified, watertight and non-absorbent and shall not contaminate water. Adhesives shall not be used in joints. The cover shall be of polyethylene / M.S. / C.I. / D.I./FRP as approved.

6.7.03 FIXING : The plastic water tank with cover shall be installed and fixed as per the manufacturer's specification. The connections such as inlet, outlets, over flow, scour etc. of specified diameter shall be made as mentioned in the schedule including the cost of fittings, fixtures and pipe of approximate 400 mm long.

6.7.04 THE RATE INCLUDES FOR :

6.7.04.1 Supply of polyethylene plastic tank, cover, pipe, fittings etc.

6.7.04.2 Installation of tank and making connections.

6.7.04.3 All necessary materials, labour and use of tools.

6.7.05 MODE OF MEASUREMENT : The measurement shall be for each polyethylene water tank of specified capacity installed or per litre capacity of water tank.

6.8 MEDIA FOR UP-FLOW FILTER :

6.8.01 GENERAL : The item pertains to the provision of Stone aggregate as filter media of specified size for upflow filter as mentioned in the schedule including laying and filling.

6.8.02 MATERIAL : The media of stone aggregate shall be irregular or cubical in shape. They shall be free from thin, elongated and flat pieces. They should have high specific surface area, high percentage void, space, resistance to abrasion or disintegration during placement, insolubility in sewage or other waste water and resistance to spelling and flaking.

6.8.03 LAYING : The filter media made up of stone aggregate ranging from 40 mm to 75 mm in sizes as shown in the drawing and the same shall be placed in different layers starting from bigger sizes to smaller sizes from bottom.

6.8.04 DEWATERING : The contract rate includes bailing or pumping out all the water if accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

6.8.05 THE RATE INCLUDES FOR :

6.8.05.1 Supplying and laying stone aggregate.

6.8.05.2 Dewatering, if necessary till completion of work.

6.8.05.3 All necessary materials, labour and use of tools.

6.8.06 MODE OF MEASUREMENT : The measurement shall be for unit cubic meter aggregate filled.

6.9 GENERAL SPECIFICATIONS FOR WATER TANK AND SEPTIC TANK :

6.9.01 GENERAL : Construction of water tank, septic tank and up flow filter is required to be done very carefully with good quality materials. Dense, well compacted concrete of required strength has to be achieved in order to make water tight compartment. The slope in the bed of tank, invert levels of insert, and also the levels of partition and baffle walls should be properly maintained for proper flow of liquid.

6.9.02 TESTING OF WATER TANK AND SEPTIC TANK : After construction of tank, it shall be tested for leak proof ness. The tank shall be first filled with water up to the top of wall. The water level should not drop more than 50 mm within 48 hours. If the drop of water level is found more than 50 mm the defective and leakage point shall be rectified to the full satisfaction of the Engineer-in-charge.

6.9.03 COMMISSIONING OF SEPTIC TANK : Before commissioning the septic tank, a little quantity of digested sludge, horse or cow dung may be added as a seed sludge to start functioning of bacterial activity in sewage.

6.9.04 BACK FILLING : The back filling shall be done as per specification after satisfactory testing of the tanks. Back filling shall be done in layers all around the tank and above the roof slab of the tank up to the height / depth as directed by the Engineer-in-charge.

6.9.05 CLEANING OF WATER TANK : The cleaning of the tank shall be done by manually or by Hydro dynamic mechanism with low or high pressure as directed. Potable water, approved disinfectant etc. shall be used for cleaning of water tank before use.

6.9.06 DEWATERING : The contract rate shall include bailing or pumping out all the water if any accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

6.9.07 MODE OF MEASUREMENT : The work shall be measured under relevant item in the schedule of quantities and paid for. Quoted rates are deemed to include for dewatering, back filling testing and commissioning of water tank, septic tank and up-flow filter.

6.10 HUME PIPE SEPTIC TANK :

6.10.01 GENERAL : The item pertains to providing Hume pipe septic tank of specified diameter with vent pipe and cap including laying, fixing and making connections.

6.10.02 MATERIAL : The Hume pipe septic tank of specified diameter and capacity with vent pipe and cap. The Hume-pipe septic tank shall be in good condition without any damage and cracks.

6.10.03 LAYING AND FIXING : Hume pipe septic tank shall be fixed in position and level as indicated in the drawing as per the manufacturer's specifications. The pipe joints for connection shall be made in cement mortar 1:1 the vent pipe with cap shall be fixed to the septic tank. Septic tank shall be completely filled with water just before putting into use.

6.10.04 DEWATERING : The contract rate includes bailing or pumping out all the water if accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

6.10.05 THE RATE INCLUDES FOR :

6.10.05.1 Hume pipe septic tank, vent pipe with cap, cement mortar etc.

6.10.05.2 Laying Hume pipe septic tank, fixing vent pipe, making inlet pipe connection and filling the tank with water.

6.10.05.3 Dewatering the pit, if necessary till completion of work.

6.10.05.4 All necessary labour, material and use of tools.

6.10.06 MODE OF MEASUREMENT : The measurement shall be for each unit of Hume pipe septic tank for specified capacity provided.

6.11 SOAK PIT :

6.11.01 GENERAL : The item pertains to providing Soak pit of specified size as mentioned in the schedule of quantities including filling with brick bats and coarse sand filling around the honey comb brick wall.

6.11.02 MATERIAL : The brick bats shall be from properly burnt bricks and not from over burnt bricks, Coarse sand filling. Brick work and plastering shall be as per general specifications under section II.

6.11.03 CONSTRUCTION : Brick masonry shall be in cement mortar and its size and type shall be as specified in the schedule. The pit shall be filled with loosely packed brick bats. The coarse sand shall be filled around the honey comb brick wall of specified thickness.

6.11.04 DEWATERING : The contract rate includes bailing or pumping out all the water. If accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

6.11.05 THE RATE INCLUDES FOR :

6.11.05.1 Providing all materials required for the construction of soak pit.

6.11.05 Dewatering the pit, if necessary till completion of work.

6.11.05 All necessary labour, materials and use of tools.

6.11.06 MODE OF MEASUREMENT : All the items shall be measured separately under the relevant items or as specified in the schedule of work.

6.12 RCC SPUN PIPE FOR DRAIN WORK :

6.12.01 GENERAL : The item includes supplying. Laying and fixing the RCC spun pipe of specified diameter and class including all necessary fittings, laying, jointing etc.

6.12.02 MATERIAL : NP3 / NP2 class pipe and collar shall comply with IS 458.

6.12.03 LAYING : The pipe shall be laid to lines, level and slope as indicated in the drawing. The pipe drain shall rest on the bed throughout its length. To ensure this the space between under side of the pipe and the invert of the cradle shall be carefully grouted with cement slurry consisting of one part of cement to three parts of clean washed sand in a manner to avoid the voids during grouting. The contractor shall take precautions to see that dirt, earth or other foreign matter is not allowed on the surface of the cradle or of the pipe resting there on. No pipe shall be laid / placed / jointed till the alignment of the pipe drain and its levels and gradient have been carefully checked and found correct.

6.12.04 CONCRETE CRADLE : The cradle of concrete shall be allowed to set at least for three days before any pipe is placed on it and the contractor shall take due care in setting the pipe on the cradle so that no damage to the cradle shall occur. If any damage to the cradle occur, it shall be remade or rectified. In case the damage to the cradle is beyond repair, contractor shall cut out the damaged section of the cradle and replace the same at his own cost to the complete satisfaction of the E-in-Ch.

6.12.05 JOINTING : The joints of pipe shall be made by loose collars and the connecting space shall be as

minimum as possible. The collars shall be specially roughened inside to provide a better grip. The two adjacent pipe ends will be so designed and manufactured that when butted together concentrically, a dowel shall be left between the two ends. In this dowel, Cement mortar of 1:1 proportion or as specified in the schedule shall be filled. The remaining space between the pipe ends and the collar shall then be caulked with cement mortar 1:1 around the external diameter of the pipes. Every joint shall be finished off smooth at an angle of 45 degree with the longitudinal axis of the pipe of the collars.

6.12.06 CLEANING : The interior of the pipe drains shall be cleaned off from all dirt, cement mortar & superfluous materials

6.12.07 TESTING : The joints of R.C.C. spun pipe line shall be tested for 1.80 meter water head over the crown of the highest pipe between the two manholes. The lower end shall be plugged water tight. Water shall than be filled in the manhole at the upper end of the line with 1800 mm depth of water over the crown.

The test shall be for an hour or longer as directed by the Engineer-in-charge. If the water level does not fall more than 12 mm in a length of 92 mtr. The test may be considered satisfactory. If it is found that certain pipe joints are leaking, the water shall be drained off and joints shall be remade/recaulked.

6.12.08 ENCASING THE PIPE LINE : After the joints and pipes have been proved to be water tight then pipe line shall be embedded in cement concrete if specified to the extent of one half of external diameter of the pipes as directed, the concrete being made to slope away towards the sides of the foundation bed, Refilling shall be done with fine selected materials in layers not exceeding 150mm thick, watered, consolidated and rammed properly, as specified.

6.12.09 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage or any other cause till completion of the work.

6.12.10 THE RATE INCLUDES FOR :

6.12.10.1 RCC Spun pipe with collar, cement mortar 1:2 and spun yarn.

6.12.10.2 Laying, jointing and testing the pipe line including cutting and wastage.

6.12.10.3 Dewatering if found necessary till completion of work.

6.12.10.4 All necessary labour, materials and use of tools.

6.12.11 MODE OF MEASUREMENT : The measurement shall be for length in running meter of pipe line laid and shall be measured along the center line.

6.13 GREASE TRAP CHAMBER :

6.13.01 GENERAL : The item includes provision of brick masonry Grease Trap Chamber of internal size as specified in schedule of work.

6.13.02 MATERIAL : Concreting, Brick work, plastering etc. shall be as per specifications given in general specification under section-II.

6.13.03 CONSTRUCTION :

6.13.03.1 Internal dimensions and depth shall be as specified in the schedule of work.

6.13.03.2 150 mm thick foundation shall be in 1:4:8 cement concrete and shall have 150 mm offset from outer surface of brick wall.

6.13.03.3 Brick masonry shall be in cement mortar 1:2 or as specified in the schedule of work.

6.13.03.4 Brick masonry shall be plastered with 20 mm thick cement mortar 1:3 inside and outside surfaces in two courses, inside surface finished smooth with neat cement punning.

6.13.04 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

6.13.05 THE RATE INCLUDES FOR :

6.13.05.1 Concreting in foundation, constructing brick masonry and plastering over the brick work.

6.13.05.2 Dewatering the trench or pit if found necessary till completion of work.

6.13.05.3 All necessary labour, materials and use of tools.

6.13.06 MODE OF MEASUREMENT : The measurement shall be for each unit of grease trap chamber of specified internal size and depth constructed.

6.14 SEWAGE TREATMENT PLANT :

6.14.1 GENERAL : The item includes provision of Sewage treatment plant of capacity specified in schedule.

6.14.2 MATERIAL : STP (readymade / fabricated / constructed on site) shall consisted of all components as specified in schedule and required for functioning of STP as whole system to provide intended specified treatment level. STP technology such as Moving Bed Bio Reactor (MBBR), Rotating Bio Contactor (RBC), Membrane Bio Reactor (MBR), Hybrid Granular Sequential Batch Reactor (HGSBR) etc. shall be as specified in schedule.

6.14.3 CONSTRUCTION :

6.14.3.1 Civil part of construction shall comply with civil specification.

6.14.3.2 Electro mechanical and plant piping part of construction shall comply with mechanical specification.

6.14.3.3 Electrical part of construction shall comply with electrical specification.

6.14.3.4 PHE part of construction shall comply with PHE specification.

6.14.3.5 All part of construction shall comply with Local statutory requirement.

6.14.3.6 All component of STP system require for Local/State/central statutory norms compliance shall be provided.

6.14.3.7 STP system shall be constructed considering raw sewage parameters, treated sewage and treated water parameters.

6.14.3.8 During and after construction / erection / commissioning of STP there shall be no contamination of surrounding Soil, Water and Air.

6.14.4 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

6.14.5 RATE INCLUDES :

6.14.5.1 All components of STP specified in schedule and to make the system working to provide intended specified treatment level to satisfy EIC and Local/State/central statutory norms.

6.14.5.2 Obtaining all statutory permissions required from Local/State/central statutory authorities to construct and commission the STP system.

6.14.6 MODE OF MEASUREMENT : The measurement shall be as a whole system or as components and items as specified in schedule.

6.15 EFFLUENT TREATMENT PLANT :

6.15.1 GENERAL : The item includes provision of Effluent treatment plant of capacity specified in schedule.

6.15.2 MATERIAL : ETP (readymade / fabricated / constructed on site) shall consisted of all components as specified in schedule and required for functioning of ETP as whole system to provide intended specified treatment level. ETP technology and process shall be as specified in schedule.

6.15.3 CONSTRUCTION :

6.15.3.1 Civil part of construction shall comply with civil specification.

6.15.3.2 Electro mechanical and plant piping part of construction shall comply with mechanical specification.

6.15.3.3 Electrical part of construction shall comply with electrical specification.

6.15.3.4 PHE part of construction shall comply with PHE specification.

6.15.3.5 All part of construction shall comply with Local statutory requirement.

6.15.3.6 All component of ETP system require for Local/State/central statutory norms compliance shall be provided.

6.15.3.7 ETP system shall be constructed considering raw effluent parameters, treated effluent and treated water parameters.

6.15.3.8 During and after construction / erection / commissioning of ETP there shall be no contamination of surrounding Soil, Water and Air.

6.15.4 DEWATERING : The contract rate shall include bailing or pumping out all the water if accumulated during the progress of the work either from rain, seepage, springs or any other cause.

6.15.5 RATE INCLUDES :

6.14.5.1 All components of ETP specified in schedule and to make the system working to provide intended specified treatment level to satisfy EIC and Local/State/central statutory norms.

6.14.5.2 Obtaining all statutory permissions required from Local/State/central statutory authorities to construct and commission the ETP system.

6.15.6 MODE OF MEASUREMENT : The measurement shall be as a whole system or as components and items as specified in schedule.

7.0 RAIN WATER HARVESTING SYSTEM

7.1 FILTER MEDIA FOR PERCOLATION TRENCH / PIT:

7.1.01 GENERAL : The item pertains to the provision of Sand/Gravel/Stone aggregate as filter media of specified size for filter in Rain Harvesting percolation Trench / pit / bore as mentioned in the schedule including laying and filling.

7.1.02 MATERIAL : Sand/Gravel/The media of stone aggregate of specified size as per schedule shall be irregular, cubical or near spherical in shape. They shall be free from thin, elongated and flat pieces. They should have uniformly graded and shall have filter void formation, resistance to abrasion or disintegration during placement, insolubility in rain water and resistance to spelling and flaking. Filter media shall be washed with water before placing, laying and filling.

7.1.03 LAYING : The filter media made up of Sand/Gravel/stone aggregate of sizes as specified in schedule and as shown in the drawing, shall be placed in different layers starting from bigger sizes to smaller sizes from bottom. Filter layer of maximum 150mm thickness shall be laid at a time.

7.1.04 DEWATERING : The contract rate includes bailing or pumping out all the water if accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

7.1.05 THE RATE INCLUDES FOR :

7.1.05.1 Supplying and laying washed Sand/Gravel/stone aggregate.

7.1.05.2 Dewatering, if necessary till completion of work.

7.1.05.3 All necessary materials, labour and use of tools.

7.1.06 MODE OF MEASUREMENT : The measurement shall be for unit cubic meter aggregate filled.

7.2 FILTER GRADE GEOSYNTETIC FABRIC / GEOTEXTILE:

7.2.01 GENERAL : The item pertains to the provision of geosystemic fabric / geotextile as separator and filter media of specified size for Rain Water Harvesting percolation Trench / pit / bore as mentioned in the schedule including laying.

7.2.02 MATERIAL : Providing and placing Filter Grade synthetic Geotext, needle punched nonwoven material, minimum 200GSM, thermal bounded Geotextile with apparent opening about 70microns and water permeability about 100 L/Sqm/sec or as specified in schedule and as directed by EIC. Geosystemic fabric shall conform to relevant IS code or ASTM.

7.2.03 LAYING : The filter geosystemic fabric / geotextile shall be spread, laid at the location shown in drawing or as directed by EIC. Wherever required overlaps not less than 150mm shall be provided with suitable stitching as per manufacturer's recommendation.

7.2.04 DEWATERING : The contract rate includes bailing or pumping out all the water if accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

7.2.05 THE RATE INCLUDES FOR :

7.2.05.1 Supplying and laying geosystemic fabric / geotextile including stitching.

7.2.05.2 Dewatering, if necessary till completion of work.

7.2.05.3 All necessary materials, labour and use of tools.

7.2.06 MODE OF MEASUREMENT : The measurement shall be for unit square meter area fabric laid. Overlap shall not be measured additionally.

7.3 ONLINE RAIN WATER FILTER:

7.3.01 GENERAL : The item pertains to the provision of online rain water filter to be fixed on rain water down take pipes.

7.3.02 MATERIAL : Material of construction of filter shall be corrosion and UV resistant. Filter assembly shall be fixed on wall or in shaft. Filter assembly shall have arrangement to divert first rain fall flow. Effective screen size shall be less than or equal to 300micron. During non-rainy period water shall not be stagnated in filter. Construction of filter shall be such that dirt shall be automatically removed without any external energy. Size of filter shall be as specified in schedule.

7.3.03 FIXING : The online rain water filter shall be fixed on rain water down take pipe as per manufacturer's recommendation in shaft or on wall using suitable anchor bolts, brackets, nuts etc. Arrangement to divert first rain fall flow shall be provided. Fixed online rain water filter shall be tested for proper working.

7.3.04 DEWATERING : The contract rate includes bailing or pumping out all the water if accumulated during the progress of work either from rain, seepage, springs or any other cause till completion of the work.

7.3.05 THE RATE INCLUDES FOR :

7.3.05.1 Supplying and fixing online rain water filter including accessories.

7.3.05.2 All necessary materials, labour and use of tools.

7.3.06 MODE OF MEASUREMENT : The measurement shall be each unit of online rain water filter fixed.

7.4 V WIRE SCREEN:

7.4.01 GENERAL : The item pertains to the provision of V Wire Screen of specified shape, size and material.

7.4.02 MATERIAL : V Wire Screen is also known as non-clogging Screen. Material of construction for screen shall be noncorrosive metal or preferably SS-304 or better. Shape of screen shall be as specified in schedule e.g. flat for using as bar screen, cylindrical shaped for using over percolation pipe or two cylindrical screens fitted concentric to each other and annular spaces filled with graded gravel.

7.4.03 FIXING : V Wire Screen shall be fixed as per location, shape and as instructed by EIC or as per manufacturer's recommendations including all fixing accessories.

7.4.05 THE RATE INCLUDES FOR :

7.4.05.1 Supplying and fixing V Wire Screen of shape and size as specified in schedule including accessories and fixing.

7.4.05.2 Dewatering, if necessary till completion of work.

7.4.05.3 All necessary materials, labour and use of tools.

7.4.06 MODE OF MEASUREMENT : The measurement shall be each unit of specified shape & size screen fixed.

7.5 SLOTTED PIPE FOR PERCOLATION BORE:

7.5.01 GENERAL : The item pertains to the provision of slotted pipe of specified diameter(size), slot/perforation, class and material.

7.5.02 MATERIAL : Slotted pipe shall be as per IS:12818 (uPVC bore well casing pipe) or IS:8110 (Well Screens and Slotted Pipes) or shall be as per IS:4985 (uPVC pressure pipe) with slot dimensions as specified. Material of slotted pipe shall be as specified in schedule.

7.5.03 FIXING : Slotted pipe with end cap shall be lowered in percolation bore at equidistance from all sides of bore with or without vent pipe. Upto 5m meters of bore depth, slotted pipe shall rest at 0.5m above from the bottom of bore. For bore depth more than 5m, slotted pipe shall rest at 1m above from the bottom of bore. Annular space between slotted pipe and bore wall shall be filled with specified filter media. Slotted pipe jointing shall be as per manufacturer's recommendations and/or as instructed by EIC including all fixing accessories.

7.5.05 THE RATE INCLUDES FOR :

7.5.05.1 Supplying slotted pipe of specified diameter(size), slot/perforation, class and material as specified in schedule including accessories and fixing. Vent pipe and filter media shall be paid under relevant item.

7.5.05.2 Dewatering, if necessary till completion of work.

7.5.05.3 All necessary materials, labour and use of tools.

7.5.06 MODE OF MEASUREMENT : The measurement shall be each unit length of specified slotted pipe fixed.

8.0 CEMENT CONSUMPTION COEFFICIENTS *(derived on the basis of CPWD AOR)*

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	Part-I-SANITARY INSTALLATIONS			
1	Fixing I.W.C. or European or pedestal type w.c.with flushing cistern and brackets, slush pipe with fittings and clamp including making good the walls and floors.	Each	5.0	0.10
2	Fixing 32 mm ϕ flush pipe	Each	1.0	0.02
3	Fixing w.c. pan only + a pair of foot rests.	Each	2.5+0.5	0.06
4	**Fixing flat back or wall type, lipped front, urinal basin :-**			
	a) One urinal with 5 litre cistern	Each	2.5	0.05
	b) Two urinal with 10 litre cistern	Each	4.0	0.08
	c) Three urinal with 10 litre cistern	Each	6.7	0.13
	d) Four urinal with 15 litre cistern	Each	9.5	0.19
	e) Urinal basin only	Each	1.0	0.02
5	**Fixing stall urinals**			
	a) Single stall urinal with 5 litre cistern	Each	5.1	0.10
	b) Two stall urinal with 10 litre cistern	Each	10.2	0.20
	c) Three stall urinal with 10 ltr. Cistern	Each	15.3	0.31
	d) Four stall urinal with 15 ltr. cistern	Each	20.3	0.41
	e) Stall urinal only	Each	2.0	0.04
6	Fixing lavatory basin/ sink with brackets & making good the walls	Each	2.5	0.05
7	Fixing wash basin/ kitchen sink	Each	1.5	0.03
8	Fixing T.W.draining board with brackets and making good the walls	Each	1.4	0.03
9	Fixing M.S. holder bat clamp in C.C. 1:2:4 block/ M.S. stay and clamp for C.I. pipe	Each	0.5	0.01
10	Fixing S.C.I trap with grating including making good the walls and floors	Each	2.5	0.05
11	**Cutting chase in B.W. for fixing S.C.I. pipe & making good the B.W. in In C.M. 1:3**			
	a) 100 mm dia	Each	5.0	0.10
	b) 50 mm dia	Each	3.33	0.07
12	Fixing square mouth S.W. gully trap with C.I. grating and B.M. Chamber	Each	23.0	0.46
13	Providing and fixing M.S. foot rests with 200 x 200 x 100 mm C.C. 1:3:6 block	Each	0.88	0.018
14	Fixing C.I. Steps (Rungs)	Each	1.0	0.02
	Part-II- WATER SUPPLY SYSTEM			
1	Constn.of BM valve chambers 1.0 M depth ,230 mm thick b.m. in cm 1:4 over 150 mm thick CC 1:2:4 bed also for capping and bearing Course on the top of masonry wall, 150 mm offset cp in cm1:3 mixed With w.p.comp.@ 2% by wt. Of cement , 20 mm thick both on int.& ext.surfaces, int. surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float , providing 100 mm thick RCC slab casted in G. M.S.angle box frame.			
a	Chamber 1 M. x 1 M. clear int.dim. without s.b.	Each	493.00	9.86
b	Chamber 1 M. x 1 M. clear int.dim. with s.b.	Each	493.00	9.86
c	Extra depth for V.C.over item No: (a&b).	RM	236.50	4.73
d	Chamber 1.2 M. x 1.2 M. clear int.dim. without s.b.	Each	592.00	11.84
e	Chamber 1.2 M. x 1.2 M. clear int.dim. with s.b.	Each	592.00	11.84
f	Extra depth for V.C.over item No: (d&e).	RM	274.00	5.48

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
2	Prov.Valve chamber(suitable for C.I. Frame & cover) of following int.dim.,230 mm b.m.in CM 1:4, over a 150 mm th. CC1:4:8 bed with 150 mm offset from all finished faces also for capping and bearing course on the top of masonry wall, 15 mm thick c.p.in cm1:3 with w.p.comp.@ 2% by wt.of cement on int.& ext.surfaces, all int.surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float.			
A	**Valve chamber of internal dimension 300x300 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	76.00	1.52
b	Valve chamber of 450mm depth.	Each	90.00	1.80
B	**Valve chamber of internal dimension 450x450 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	98.50	1.97
b	Valve chamber of 450mm depth.	Each	116.00	2.32
c	Valve chamber of 600mm depth.	Each	133.50	2.67
C	**Valve chamber of internal dimension 600x600 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	121.50	2.43
b	Valve chamber of 450mm depth.	Each	143.00	2.86
c	Valve chamber of 600mm depth.	Each	164.50	3.29
3	Prov. Valve chamber (suitable for SFRC cover) of following int.dim.,230 mm b.m. in CM 1:4, over a 150 mm th. CC1:4:8 bed with 150 mm offset from all finished faces also for capping and bearing course on the top of masonry wall, 15 mm thick c.p.in cm1:3 with w.p.comp.@ 2% by wt.of cement on int.& ext. surfaces, all int.surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float, supplying & placing SFRC cover.			
A	**Valve chamber of internal dimension 300x300 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	76.00	1.52
b	Valve chamber of 450mm depth.	Each	90.00	1.80
B	**Valve chamber of internal dimension 450x450 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	98.50	1.97
b	Valve chamber of 450mm depth.	Each	116.00	2.32
c	Valve chamber of 600mm depth.	Each	133.50	2.67
C	**Valve chamber of internal dimension 600x600 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	121.50	2.43
b	Valve chamber of 450mm depth.	Each	143.00	2.86
c	Valve chamber of 600mm depth.	Each	164.50	3.29
4	**Fixing G.I. pipe on wall including making good the walls (Note: 1 HaM = 100 M)**			
	a) 15 mm ϕ	HaM	5.0	0.10
	b) 20 mm ϕ	HaM	6.0	0.12
	c) 25 mm ϕ	HaM	7.0	0.14
	d) 32 mm ϕ	HaM	7.5	0.15
	e) 40 mm ϕ	HaM	8.0	0.16
	f) 50 mm ϕ	HaM	8.0	0.16
	g) 80 mm ϕ	HaM	9.0	0.18
	h) 100 mm ϕ	HaM	10.0	0.20
	i) 150 mm ϕ	HaM	12.50	0.25

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	Part-III- SEWERAGE SYSTEM			
1a	Const.of rect.inspect.chambers of int.size 900 mm x 600 mm at bottom and int.size 900x450mm at top for depth upto 600mm & brick masonry in cm 1:2 , 230 mm th.wall incl.making brick tapering for log.walls for 450mm depth meas.from top of frame & cover, over 150mm thick CC1:2:4 with 150mm offset from all outer fini.wall surfaces,also for benching ,20mm th.c.p.in cm 1:1 with w.p.comp. @2% by wt.of cem.on int.& ext. surfaces, int.surfaces and channel finished smooth with floating coat of neat cement and ext.surfaces finished rough with wooden float.	Each	312.50	6.25
1b	Extra over item 4(a) for depth beyond 600 mm initial depth upto a depth of 1500 mm. all as per specification and as directed.	RM	357.50	7.15
2a	Const.of circular manhole of 1200 mm int.dia.at bottom and 540/600 mm at top for 1500 mm ini.depth & b.m.in cm 1:2, 230 mm th.wall for 1400 mm depth meas.from top of frame & cover of M.H.in conical shape and remaining ht. Const.345mm th.in cyl.shape over a 300 mm th.CC 1:2:4 bed with 300mm offset from outer finished wall surface,also for bench., 20mm th.plaster in cm1:1 with w.p.comp.@2% by wt.of cem.on int.&ext.surfaces,int.surfaces and channel finished smooth with floating coat of neat cement and ext.surfaces finished rough with wooden float.			
(i)	Top internal dia 540mm to suit MD & HD frame & cover.	Each	1063.50	21.27
(ii)	Top internal dia 600mm to suit EHD frame & cover.	Each	1074.00	21.48
2b	Extra over item 5(a) for a depth beyond 1500 mm initial depth & upto a depth of 2300 mm.	RM	534.00	10.68
3a	Const.of circular manhole of 1500 mm int.dia.at bottom and 540/600 mm at top for 2300 mm ini.depth & b.m.in cm 1:2, 230 mm th.wall for 2000 mm depth meas.from top of frame & cover of M.H.in conical shape and remaining ht. Const.345mm th.in cyl.shape over a 300 mm th.CC 1:2:4 bed with 300mm offset from outer finished wall surface,also for bench., 20mm th.plaster in cm1:1 with w.p.comp.@2% by wt.of cem.on int.&ext.surfaces,int.surfaces and channel finished smooth with floating coat of neat cement and ext.surfaces finished rough with wooden float.			
(i)	Top internal dia 540mm to suit MD & HD frame & cover.	Each	1685.50	33.71
(ii)	Top internal dia 600mm to suit EHD frame & cover.	Each	1702.00	34.04
3b	Extra over item 6(a) for a depth beyond 2300 mm initial depth.	RM	635.00	12.70
4	Constn.of b.m.drop pipe cleaning chamber of intl.size 300x300 mm for depth of 300 mm from top of cover & frame above S.W. drop pipe in b.m., in c.m.1:2 and 230mm thk.wall over 150mm offset from all outer finished wall surfaces of the chamber, p.& f. suitable MD precast SFRC cover of “Pratibha” or equi. Make 100 mm thk.CC 1:2:4 coping at top of b.m., 20mm cem.plastering in cm1:1, mixed with w.p.comp.@ 2% by wt.of cem.intl.& extl.surfaces of the chamber, all inside surfaces finishing smooth with floating coat of neat cement and extl. Surfaces finishing rough with wooden float.	Each	138.50	2.77

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
5	P.& f.drop connect.for ini.depth of 600mm including p.&l. followiing dia. S.W. pipe & specials including p.& f.bends, tees, crosses (double tees) plugs, caps etc., including jointing the joints with hemp yarn and C.M. 1:1,including encasing the pipes with CC 1:2:4 such that shape of the cross sect.through encased pipe shall be square of side length equal to o.d.of pipe plus 300mm.			
	a) 150mm nom. dia.	Each	76.00	1.52
	b) Extra depth over item 8(a) beyond 0.60 M initial depth	RM	69.50	1.39
	c) 230mm nom.dia.	Each	88.50	1.77
	d) extra depth over item 8© beyond 0.60 M initial depth	RM	91.50	1.83
	e) 300mm nom.dia.	Each	95.00	1.90
	f) extra depth over item 8(e) beyond 0.60 M initial depth	RM	112.50	2.25
6	P.& f.precast (SFRC) MH frame & covers conf.to IS 12592 of following sizes approved by PMC/CIDCO/E-I-C, Pratibha or equi.make tested as per IS 1726 (Part-I)1974 incl.cost of necessary steel reinf.,CC1:2:4 for fixing frame, for bed block (bearing course) and capping including necessary form work and cm1:2 for fixing the frame & for plast.expsosed surf.of CC surf.of bed block (b.c.) & capping fini. Smooth with floating coat of neat cement.			
	a) SFRC rect.frame for IC of size o/s 1130mm x 680mm, i/s clear opening 900mmx 450mm and RCC cover for IC of size 1000 mm x 550 mm			
	i) Medium Duty (Grade MD-10) frame sect.size 110mm wide x105 mm deep and cover thick. 50mm	Each	80.40	1.608
	ii)Heavy Duty (Grade HD-20) frame sect.size 115mm wide x150 mm deep and cover thick. 95mm	Each	72.00	1.44
	b) SFRC circular frame& cover			
	i) Medium Duty (Grade MD-10) SFRC frame of out. Dia. 840mm, clear intl.dia. 530mm, frame sect.size 155mm wide x115mm deep, SFRC manhole cover of 630mm dia. And 65 mm thick.	Each	47.80	0.956
	ii) Heavy duty (Grade HD-20)SFRC frame of out.dia. 940mm, clear intl.dia. 540mm deep, frame sect.size 200 mm wide x150mm deep, SFRC manhole cover of 630mm dia. And 95 mm thickn.	Each	32.70	0.654
	iii) Extra Heavy duty (Grade EHD-35) SFRC frame of out.dia. 940mm, clear intl.dia. 540mm deep, frame sect.size 200 mm wide x175 mm deep, SFRC manhole cover of 780mm dia. And 120 mm thick.	Each	30.00	0.60
7	P.&F.air tight C.I. frame & cover of size and number as specified in schedule, for M.H. & I.C. each weighing ranging from 100 to 300 Kgs. Including cost of CC 1:2:4 for bed block (bearing course) and capping, fixing frame including necessary form work, 1:2 cement mortar for fixing frame and smooth cement finished plaster over exposed concrete surfaces of bed block (bearing course) and capping.			
	a) C.I. rect.frame & cover for IC of int.size 900 x450mm			
	i) Medium Duty (Grade MD-10)	Each	89.35	1.787
	ii)Heavy Duty (Grade HD-20)	Each	87.10	1.742
	b) SFRC circular frame& cover of int. 560mm dia.			
	i) Medium Duty (Grade MD-10)	Each	48.75	0.975
	ii)Heavy Duty (Grade HD-20)	Each	44.85	0.897

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
8	P.& f.approved quality S.W. sewer trap of following sizes including placing the trap in position inside the manhole,embedding in C.C. 1:2:4, finishing the joints and rectifying the leakages.			
	a) 100mm dia	Each	6.50	0.13
	b) 150mm dia	Each	11.00	0.22
	c) 200mm dia	Each	16.50	0.33
	d) 230mm dia	Each	19.50	0.39
	e) 250mm dia	Each	24.00	0.48
	f) 300mm dia	Each	31.00	0.62
9	Making connections with the existing chamber or manhole incuding breaking the brick masonry wall re-doing the same to the original condition after the connection by adding approved w.p.comp.to the mortar.			
	a) 100mm dia	Each	3.70	0.074
	b) 150mm dia	Each	5.30	0.106
	c) 200mm dia	Each	7.00	0.14
	d) 230mm dia	Each	8.00	0.16
	e) 250mm dia	Each	11.50	0.23
	f) 300mm dia	Each	14.50	0.29
	g) 350 mm dia.	Each	17.50	0.35
	h) 400 mm dia.	Each	20.50	0.41
	i) 450 mm dia.	Each	23.50	0.47
	NOTE FOR S.W. PIPES:-			
	1. To arrive the cement consumption of different proportion of cement mortar,consider 2/3rd consumption for cm1:2 & 1/2 consumption for cm1:3 of the given consumption of cm 1:1.			
10	P.&L. following dia.best quality s.g.S.W.pipe conf.to IS 651-1980 with ISI mark and approved make, lowering and laying the pipe line in trenches for all depth including aligning & jointing with hemp yarn and finishing with cm 1:1 mixed with w.p. comp., curing, testing the line.			
	a) 100mm dia. ---------- 0.6m length	RM	2.00	0.040
	b) 150mm dia . ---------- " ----------	RM	3.00	0.060
	c) 200mm dia. ---------- " ----------	RM	4.35	0.087
	d) 230mm dia. ---------- " ----------	RM	4.85	0.097
	e) 250mm dia. ---------- " ----------	RM	5.50	0.110
	f) 300mm dia. ---------- " ----------	RM	6.50	0.130
	g) 350 mm dia. ---------- " ----------	RM	7.80	0.156
	h) 400 mm dia. ---------- " ----------	RM	9.15	0.183
	i) 450 mm dia. ---------- " ----------	RM	9.75	0.195
	j) 500 mm dia. ---------- " ----------	RM	13.50	0.270
	k) 600 mm dia. ---------- " ----------	RM	16.80	0.336

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	NOTE FOR RCC / CC SPUN PIPES:-			
	1. To arrive the cement consumption of different proportion of cement mortar,consider 2/3rd consumption for cm1:2 & 1/2 consumption for cm1:3 of the given consumption of cm 1:1.			
	2. Pipes of 300mm dia.and above 3.0m,3.5m,4.0m in length may also be available except "NP1"class pipes.			
	3. The cement consumption for "P1" class pipe (which is available in the range of 80mm to 1200mm dia.) can be taken similar to "NP2" class pipe			
11	Supplying, lowering, laying, CC class "NP1" spun pipes of following class conforming to IS-458 with necessary collars or spigot socket, laid to correct grade and levels at all depth, including cutting to lengths, jointing with rubber ring or with hemp yarn and cement mortar 1:1, caulking the joints, and finishing, curing, testing etc. complete as per specifications.			
	a) 80 mm dia. ---------- 1.0 m Length	RM	0.62	0.012
	b) 100 mm dia.---------- "	RM	0.71	0.014
	c) 150 mm dia.---------- "	RM	0.86	0.017
	d) 200 mm dia.---------- "	RM	1.06	0.021
	e) 225 mm dia.---------- "	RM	1.17	0.023
	f) 250 mm dia.---------- "	RM	1.26	0.025
	g) 300 mm dia.---------- "	RM	1.96	0.039
	h) 350 mm dia.---------- "	RM	2.65	0.053
	i) 400 mm dia.---------- "	RM	3.34	0.067
	j) 450 mm dia.---------- "	RM	4.03	0.081
12	Supplying, lowering, laying, RCC spun pipes of following class conforming to IS-458 with necessary collars or spigot socket, laid to correct grade and levels at all depth, including cutting to lengths, jointing with rubber ring or with hemp yarn and cement mortar 1:1, caulking the joints, and finishing, curing, testing etc. complete as per specifications.			
A	**class-NP2 RCC**			
	a) 80 mm dia. ---------- 2.0 m Length	RM	0.55	0.011
	b) 100 mm dia.---------- "	RM	0.75	0.015
	c) 150 mm dia.---------- "	RM	0.90	0.018
	d) 200 mm dia.---------- "	RM	1.15	0.023
	e) 225 mm dia.---------- "	RM	1.18	0.024
	f) 250 mm dia.---------- "	RM	1.35	0.027
	g) 300 mm dia.---------- 2.5 m length	RM	1.50	0.030
	h) 350 mm dia.---------- "	RM	2.20	0.044
	i) 400 mm dia.---------- "	RM	2.80	0.056
	j) 450 mm dia.---------- "	RM	3.60	0.072
	k) 500 mm dia.---------- "	RM	3.90	0.078
	l) 600 mm dia.---------- "	RM	4.80	0.096

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	m) 700 mm dia.---------- "	RM	5.55	0.111
	n) 800 mm dia.---------- "	RM	6.30	0.126
	o) 900 mm dia.---------- "	RM	7.35	0.147
	p) 1000 mm dia.---------- "	RM	8.25	0.165
	q) 1100 mm dia.---------- "	RM	9.15	0.183
	r) 1200 mm dia.---------- "	RM	10.20	0.204
	s) 1400 mm dia.---------- "	RM	11.30	0.226
	t) 1600 mm dia.---------- "	RM	12.80	0.256
	u) 1800 mm dia.---------- "	RM	14.40	0.288
	v) 2000 mm dia.---------- "	RM	16.00	0.320
	w) 2200 mm dia.---------- "	RM	17.60	0.352
B	**class-NP3 RCC**			
	a) 80 mm dia. ---------- 2.0 m Length	RM	0.55	0.011
	b) 100 mm dia.---------- "	RM	0.70	0.014
	c) 150 mm dia.---------- "	RM	0.85	0.017
	d) 200 mm dia.---------- "	RM	1.15	0.023
	e) 225 mm dia.---------- "	RM	1.20	0.024
	f) 250 mm dia.---------- "	RM	1.74	0.0347
	g) 300 mm dia.---------- 2.5 m length	RM	1.74	0.0348
	h) 350 mm dia.---------- "	RM	2.85	0.057
	i) 400 mm dia.---------- "	RM	3.80	0.076
	j) 450 mm dia.---------- "	RM	4.15	0.083
	k) 500 mm dia.---------- "	RM	4.45	0.089
	l) 600 mm dia.---------- "	RM	5.26	0.105
	m) 700 mm dia.---------- "	RM	5.95	0.119
	n) 800 mm dia.---------- "	RM	6.75	0.135
	o) 900 mm dia.---------- "	RM	7.45	0.149
	p) 1000 mm dia.---------- "	RM	8.65	0.173
	q) 1100 mm dia.---------- "	RM	9.35	0.187
	r) 1200 mm dia.---------- "	RM	10.10	0.202
	s) 1400 mm dia.---------- "	RM	11.70	0.234
	t) 1600 mm dia.---------- "	RM	13.20	0.264
	u) 1800 mm dia.---------- "	RM	14.70	0.294
	v) 2000 mm dia.---------- "	RM	16.35	0.327
	w) 2200 mm dia.---------- "	RM	17.95	0.359
	x) 2400 mm dia.---------- "	RM	19.55	0.391
	y) 2600 mm dia.---------- "	RM	21.15	0.423

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
C	**class-P2 RCC**			
	a) 80 mm dia. ---------- 2.0 m Length	RM	0.55	0.0110
	b) 100 mm dia.---------- "	RM	0.75	0.0150
	c) 150 mm dia.---------- "	RM	0.90	0.0180
	d) 200 mm dia.---------- "	RM	1.15	0.0230
	e) 225 mm dia.---------- "	RM	1.20	0.0240
	f) 250 mm dia.---------- "	RM	1.74	0.0347
	g) 300 mm dia.---------- 2.5 m length	RM	1.74	0.0348
	h) 350 mm dia.---------- "	RM	2.44	0.0488
	i) 400 mm dia.---------- "	RM	3.15	0.0630
	j) 450 mm dia.---------- "	RM	3.85	0.0770
	k) 500 mm dia.---------- "	RM	4.37	0.0873
	l) 600 mm dia.---------- "	RM	5.39	0.1077
	m) 700 mm dia.---------- "	RM	5.95	0.1190
	n) 800 mm dia.---------- "	RM	6.78	0.1355
	o) 900 mm dia.---------- "	RM	7.63	0.1526
	p) 1000 mm dia.---------- "	RM	8.45	0.1689
D	**class-P3 RCC**			
	a) 80 mm dia. ---------- 2.0 m Length	RM	0.28	0.0055
	b) 100 mm dia.---------- "	RM	0.75	0.0150
	c) 150 mm dia.---------- "	RM	0.90	0.0180
	d) 200 mm dia.---------- "	RM	1.21	0.0242
	e) 225 mm dia.---------- "	RM	1.32	0.0263
	f) 250 mm dia.---------- "	RM	1.43	0.0286
	g) 300 mm dia.---------- 2.5 m length	RM	1.83	0.0365
	h) 350 mm dia.---------- "	RM	2.50	0.0500
	i) 400 mm dia.---------- "	RM	3.18	0.0636
	j) 450 mm dia.---------- "	RM	4.20	0.0840
	k) 500 mm dia.---------- "	RM	4.65	0.0930
	l) 600 mm dia.---------- "	RM	5.55	0.1110
	m) 700 mm dia.---------- "	RM	6.45	0.1289
	n) 800 mm dia.---------- "	RM	7.35	0.1469

I. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	Part-IV – STORM WATER DRAINS & CHAMBERS			
1a	*Construction of storm water chambers of internal sizes 600 mm x 600mm x* x 600mm initial depth, 450 thk. Wall in R.R.masonry in CM 1:6, 150mm thick bedding in CC1:4:8,50mm thk benching, 80mm high haunching in CC1:2:4, also for100mm thick capping & bearing course plastering in cm 1:4,20mm thick on sides of drain, 12mmthick ontop & base in cm1:4,finished smooth with neat cement ,supplying & placing medium duty (MD) RCC precast perforated cover 750mm x 600mm x75mm .etc complete and as directed by engineer in charge.	Each	269.00	5.38
b	Extra over item (a) over 0.6 m initial depth.	RM	181.00	3.62
2a	**Constn.of storm water chambers of internal sizes 600mm x1050mm** x 900mm initial depth, 450 thk. Wall up to 700mm depth from top of chamber & remaining hight 600mm thk.in R.R.masonry in CM 1:6, 150mm thick bedding in CC1:4:8,50mm thk. Benching, 80mm high haunching,100mm thick capping & bearing course in CC1:2:4, plastering in cm 1:4,20mm thick on sides of drain, 12mmthick on top & base in cm1:4,finished smooth with neat cement ,supplying and placing medium duty (MD) RCC precast perforated cover 750mm x 600mm x75mm .etc complete and as directed by engineer in charge.	Each	432.65	8.65
b	Extra over item (a) over 0.9 m initial depth.	RM	316.80	6.34

* * *

9.0 RECOMMENDED MANUFACTURERS FOR SOME OF THE FACTORY MADE MATERIALS

9.1 GENERAL INSTRUCTIONS :

1. Products with relevant IS Markings from the IS Licensed manufacturers, who are in the market for the last three years with valid IS License, shall be considered for approval.

2. In case of items where IS marked material is not available, the contractor shall procure the same from the following list, subject to prior approval of engineer-in-charge. Periodic tests shall be carried out as per contract / specifications at contractor's own cost.

3. In case of any new brand other than ISI certified or from departmental list of manufacturer is proposed, adequate information about the product and manufacturer, shall be provided at the tender stage.

4. Department reserves the right to accept / reject any new brand(s) proposed by the tenderer.

5. The contractor shall make his own arrangement to procure reinforcement steel bars. The same shall be either plain mild steel bars grade-1 as per is-432 (part-1) or high yield strength deformed bars as per is 1786, or as shown and specified in the drawing. Steel shall be procured from agencies meeting with following criteria:

A) They shall have valid is license or certification of tor-allis engineer services pvt. Ltd.

B) Steel shall be rolled directly from billets as per the process of is 1786 / 432 as appropriate.

C) It shall conform to mechanical and chemical properties as per relevant is standards.

The contractor shall submit the test certificate of manufacturer. Regular test on steel supplied by the contractor shall be performed by the contractor at the approved lab in the presence of departmental engineer, as per relevant is. Recommended manufacturer of steel are : SAIL, ISCO, TISCO, RINL.

6. Samples of materials, fittings etc. Shall be submitted by the contractor and got approved from the Engineer-in-Charge, before supply in bulk at site of work. The bulk supply shall strictly conform to the samples approved. The approved samples shall be kept in custody of the Engineer-in-Charge, till completion of the work.

9.2 : LIST OF RECOMMENDED MANUFACTURERS / AGENCIES :

In addition to the materials specified below, the manufacturers / agencies included in the list of approved products by Central Products Evaluation Committee of CPWD, as per Appendix – 'B' in CPWD specifications, shall also be considered for approval by the Department, subject to conformity with DCSEM specifications

SN	Description of items	Recommended manufacturers
1	Sanitarywares:-Vitreous Chinaware Water Closet, Flush tank, Wash Basin, Urinals, Shower Tray, Sink, Cisterns	Hindware, Cera, Parryware, Neycer, Roca, Toto, Kohler
	Seat & cover for EWC	Hindware, Cera, Parryware, Neycer, Roca, Toto Commander, Hindustan, Capri, Supreme
	PVC flushing Cistern	Hindware, Cera, Parryware, Neycer, Roca, Toto Commander, Hindustan, Duralite
2	CP brass fittings & fixtures such as Bib tap, Stop cock, Pillar tap, flush valve, Pressmatic Tap, Health Faucet, Wall Mixer, Shower, waste coupling, Bottle Trap, Toilet paper roll holder, Soap Dish Holder, Towel Rail, Soap Dispenser, braided hose, etc.	Jaquar, Roca, Toto,GEM, Techno, Kingston, Metro, Plato, JAL, Kohler
3	CP brass Jet Spray Set (butterfly spray)	ESSCO- Jaquar, Plumber, Plato
4	Glass Mirror	Modi Guard, Saint Gobain Float Glass India Ltd., Eagle, Asahi(IAG)
5	Stainless steel Sink	Nirali, Neelkanth, AMC, Jayna , Diamond, Parryware
6	G.I / M.S Pipes	TATA, Zenith, Ambika, Surya, Khandelwal, Jindal, Hissar
7	G.I Malleable fittings	MJM, Unik, Zoloto, 'R' brand
8	PP-R pipes, Fittings, PP-R Ball Valves	M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd., Kisan
9	cPVC pipes, Fittings, cPVC Ball Valves	M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd., M/s.Astral (Astral Poly Technik Ltd.), M/s. Ashirvad pipes (P) Ltd., M/s. Ajay Industrial Corporation Ltd., M/s. Jain Irrigation,

		Finolex.
10	ASTM non-treaded UPVC solvent welded pipes fittings & ball valve	AquaGold of M/s. Supreme Industries Ltd., EASYFIT of M/s Prince Pipes & Fittings Pvt. Ltd., M/s. Jain Irrigation Systems Ltd., M/s. Kisan, M/s. Astral (Astral Poly Technik Ltd.),M/s. Ashirvad pipes (P) Ltd., M/s. Ajay Industrial Corporation Ltd.
11	SWR-UPVC pipe & fittings (including low noise drainage pipe system), uPVC Gully trap	M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd., B-Sure of M/s. Jain Irrigation Systems Ltd., Finolex, M/s.Astral(Astral Poly Technik Ltd.),M/s. Ashirvad pipes (P) Ltd., M/s. Ajay Industrial Corporation Ltd.
12	uPVC pipes conforming to IS:4985 & Fittings conforming to IS	Premium, M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd., M/s. Jain Irrigation Systems Ltd., Finolex ,M/s.Astral (Astral Poly Technik Ltd.), M/s. Ashirvad pipes (P) Ltd., M/s. Ajay Industrial Corporation Ltd.
13	uPVC Bore Well casing pipe conforming to IS:12818	M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd., M/s. Jain Irrigation Systems Ltd., Finolex ,M/s.Astral (Astral Poly Technik Ltd.), M/s. Ashirvad pipes (P) Ltd., M/s. Ajay Industrial Corporation Ltd.
14	PVC Column pipe and Accessories	M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd., M/s. Jain Irrigation Systems Ltd., Finolex ,M/s.Astral (Astral Poly Technik Ltd.), M/s. Ashirvad pipes (P) Ltd., M/s. Ajay Industrial Corporation Ltd.
15	HDPE sheet flashing	M/s. SANGIR Plastics Ltd., M/s. Jain Irrigation Systems Ltd., M/s. Supreme Industries Ltd. or approved eq.
16	UPVC underground drainage pipes & Fittings conforming to IS:15328	M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd., M/s. Jain Irrigation Systems Ltd., Finolex ,M/s.Astral (Astral Poly Technik Ltd.), M/s. Ashirvad pipes (P) Ltd., M/s. Ajay Industrial Corporation Ltd.
17	uPVC / PE Inspection / Manhole Chambers & Accessories	M/s. Supreme Industries Ltd. M/s.Astral (Astral Poly Technik Ltd.), M/s. Ashirvad pipes (P) Ltd., or as approved equivalent.
18	uPVC Spiral Suction Hose Pipes	M/s. Kisan, or as approved equivalent.
19	Polyethylene water storage tank	Sintex, Caveri, Supreme, Raunaq, Patton.
20	GM or Copper alloy Gate / Peet / Globe / Check valve	Neta, Sant, Kingston, Leader, Zoloto, GG., Hawa
21	Ball Valve	Techno, MBM, Sant, Zoloto.
22	CI/DI Air Valve / Kinetic Air Valve	IVC, Durga, Mayur, Leader, Sant, Hawa, Kirloskar, Kartar, Upadhyay.
23	Filters, Sand Separator (Hydrocyclone filter), Plastic Air Valve, Plastic Valve Box	M/s. Jain Irrigation Systems Ltd. or as approved equivalent.
24	Bobbin Wound filter including filter media,	M/s. Astralpool. or as approved equivalent.
25	GRP/ FRP composite Manhole Covers and Gratings, FRP Mesh Gratings	M/s. Everlast Composites Pvt. Ltd. M/s. HP Adhesives Limited- HP International, Thermodrain of M/s. Thermoset Poly Products(I) Pvt. Ltd.
26	copolymer polypropylene steel reinforced plastic Foot-rests	M/s. Patel brand, M/s. Shree Vinayak Enterprise or as approved equivalent.
27	CI/DI Sluice valve, NRV, Butterfly Valve	Upadhyay, IVC, Durga, Mayur, Minoti, Kejrival Castings., Leader, Sant, Hawa, Kirloskar, Kartar
28	CI/DI Foot valve (swing & lift type)	Mayur, Upadhyay, Minoti, Kartar, KPM, IVC, Leader, Durga, Kartar

29	C.I Water quality pipes	Electrosteel, KDUL, Truform
30	C.I Soil quality pipes	Neco, KDUL, SKF by Singhal Iron Foundary (P) Ltd,
31	CI/DI Frame & Cover	Neco, Kajeco, Kejriwal Castings Ltd. or as approved equivalent.
32	S.W Pipe & Gully Trap	Perfect or as approved equivalent.
33	RCC Hume pipe	The Indian Hume Pipe, M/s Pranali, M/s West Bengal Concrete Industries, Kolkata, M/s Sur Industries, Kolkata.
34	SFRC frame & cover & Gratings.	SS, KK or as approved equivalent.
35	HDPE Pipe & fittings	Goutam, M/s. SANGIR Plastics Ltd., M/s. Jain Irrigation Systems Ltd., M/s. Supreme Industries Ltd., M/s Prince Pipes & Fittings Pvt. Ltd
36	uPVC Foot Valve	M/s. Jain Irrigation Systems Ltd. or as approved equivalent.
37	SBR / EPDM Gaskets	Prabhat, Orient or as approved equivalent.
38	C.I fittings / Specials	Kejriwal, Orient, Durga, Upadyay
39	Float Valve	Leader, Sant, Zoloto or as approved equivalent.
40	Anticorrosive tape for pipe protection	Pypekote, or as approved equivalent.
41	Garden irrigation system	M/s. Jain Irrigation Systems Ltd., M/s. Supreme Industries Ltd. M/s. Kisan Mouldings Limited, M/s. Kisan Irrigations Limited.
42	Cockroach trap	Chilly, Nirali or as approved equivalent.
43	Pumps & Pump sets	Grundfos, KSB, Kirloskar, Mather & Platt, Becon, Crompton Greaves, Calama, sehra
44	Dosing Pumps	Grundfos, Astralpool, KSB, Kirloskar
45	Suction Strainer	Leader, Sant, Zoloto or as approved equivalent.
46	Ductile iron Pipe	Electrosteel, JindalSAW, Electrotherm, TATA
47	Ductile iron Specials / Fittings	Electrosteel, Kejriwal, Truform, JindalSAW,
48	RCC frame, covers	Pratibha, Bharat, Vikrant, Supertile, Basant Beaton
49	Precast RCC SWD, Manholes	M/s Godrej Construction, M/s Siddhivinayak Precast Pipes pvt ltd., M/s Fuji Silvertech concrete pvt ltd
50	Rainy Filter	M/s. Farmland Rainwater Harvesting System or as approved equivalent.
51	V-wire screen	M/s. Johnson Screens (India) Private Limited. M/s. Apollo Screens Private Limited. M/s. Farmland Rainwater Harvesting System or as approved equivalent.
52	Filter Grade Geosyntetic Fabric / Geotextile	M/s. Techfab India Industries limited, M/s. Garware Technical Fibers Ltd. or as approved equivalent.
53	Pig Lead	Hindustan Zinc or as approved equivalent.

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GOVERNMENT OF INDIA
परमाणु ऊर्जा विभाग
DEPARTMENT OF ATOMIC ENERGY
निर्माण, सेवा एवं संपदा प्रबंध निदेशालय
DIRECTORATE OF CONSTRUCTION, SERVICES AND ESTATE MANAGEMENT
तीसरा माला, विक्रम साराभाई भवन, अणुशक्तिनगर, मुंबई ४०० ०९४