



**RAJKOT MUNICIPAL CORPORATION  
RAJKOT**

**: Name of Work :**

Providing, Lowering, Laying, Jointing, Testing and Commissioning of D.I./M.S. Pipe Line for Transmission Main from Gondal Road to NarayanNagar & Swati Park Head-works for water supply system of Kotharia area of Rajkot.

**e-TENDER No. RMC/WW/CZ/KTL-1**

**:: Milestone dates of e-Tendering ::**

1 Downloading of e-TENDER documents	Dt. 07/02/2019 to Dt. 28/02/2019 up to 17:00 Hrs.
2. Pre-bid Meeting	Dt. 11/02/2019 at 12:00 Hrs. at Central Zone Office- RMC.
3. Online submission of e-TENDER	Dt. 28/02/2019 up to 18:00 Hrs.
4. Physical Submission of EMD, Tender fee, Documents required for pre-qualification and other necessary documents.	Dt. 01/03/2019 to Dt.02./03/2019 up to 18:00 Hrs.
5. Verification of submitted documents (EMD, Tender fee, Documents required for pre-qualification and other necessary documents.)	Dt. 05/03/2019 Onwards.
6. Opening of online Primary Bid (Technical bid)	Dt. 05/03/2019 at 10:30 Hrs. Onwards
7. Agency to remain present along with original documents for verification	Dt. 07/03/2019 between 16:00 to 18:00 Hrs.
8. Opening of online Commercial Bid (Price Bid) for Technically qualified bidders only	Dt. 08/03/2019 at 11:00 Hrs. Onwards
9. Bid Validity	One Eighty (180) calendar days

**FEBRUARY-2019**

**VOLUME – II (TECHNICAL - BID)  
DETAILED TECHNICAL SPECIFICATIONS**

**Authority :  
Executive Engineer  
Water Works Department, Central Zone,  
Second floor, Room no.-06,  
Rajkot Municipal Corporation  
Dr. Ambedkar Bhavan Dhebar Road,  
RAJKOT - 360 001.**

Providing, Lowering, Laying, Jointing, Testing and Commissioning of D.I./M.S. Pipe Line for Transmission Main from Gondal Road to NarayanNagar & Swati Park Head-works for water supply system of Kotharia area of Rajkot.

**VOLUME – II**  
**Detailed Technical Specifications**

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## GENERAL TECHNICAL SPECIFICATIONS

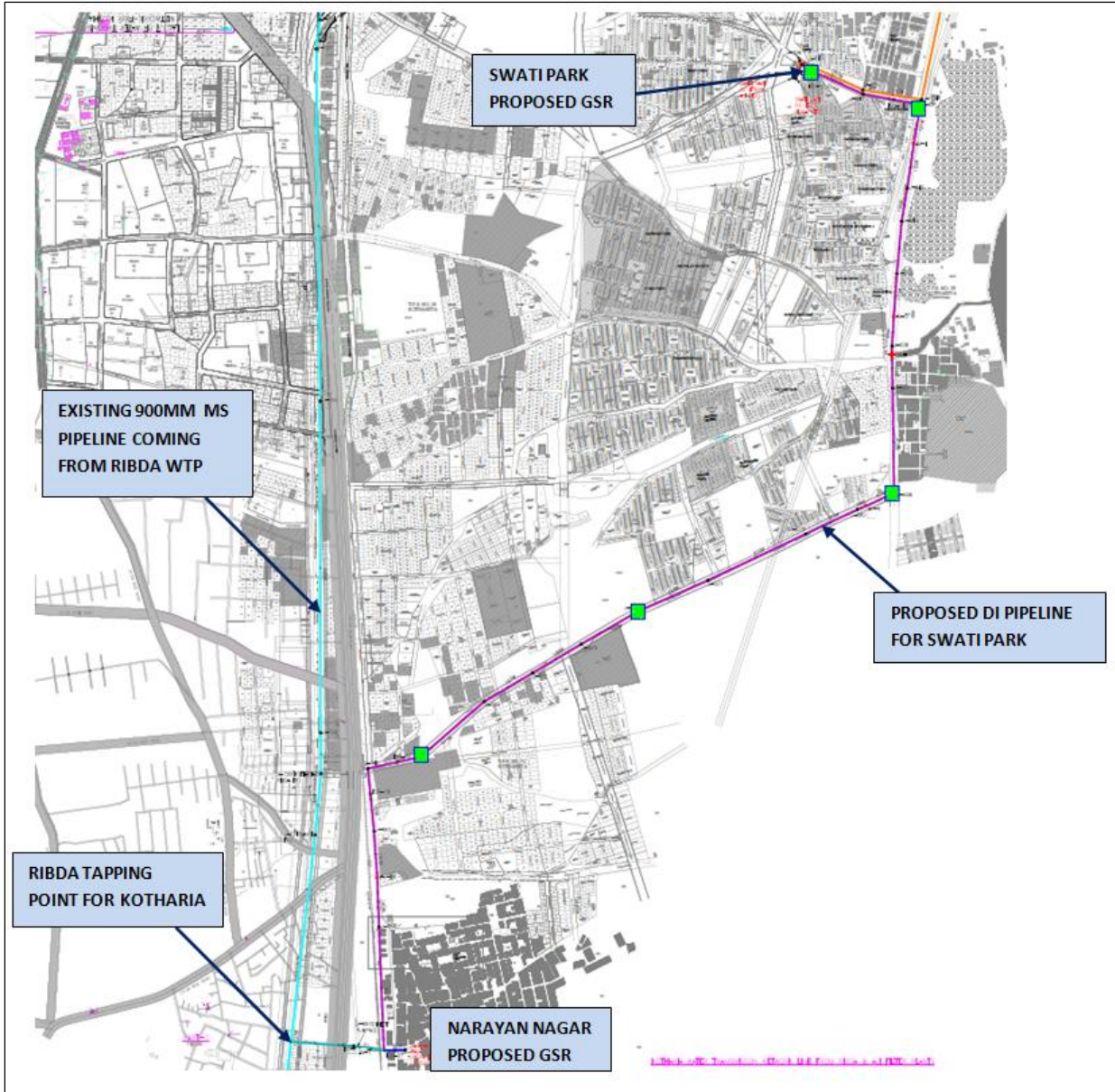
### 1. Scope of Contract:

The work entitled “Providing, Lowering, Laying, Jointing, Testing and Commissioning of D.I./M.S. Pipe Line for Transmission Main from Gondal Road to NarayanNagar & Swati Park Head-works for water supply system of Kotharia area of Rajkot”.

The scope of works comprises the following:

- Detailed design of the water supply transmission line
- Carrying out necessary topographical survey and geotechnical investigations
- Excavation of pipe trenches in soil, soft rock, hard rock, WBM and concrete roads, including dewatering.
- Supplying and Laying of DI pipes with all specials along the route as per the network map
- Jointing of pipes with existing pipes (wherever required) with all required accessories
- Obtaining statutory approval from railway and other government bodies if required.
- Contractor shall plan and accordingly phase the supply of items according to his requirement to best utilize the available storage space at site.
- Providing and fixing sluice valves, Scour valves and Air Valves on the existing as well as new pipeline, as specified in relevant datasheets, detailed technical specifications, particular technical specifications and BOQ.
- Providing pipe bedding as per the requirements.
- Backfilling of pipe trench with selected soil immediately after erection of pipe excluding pipe joints.
- Encasing of underground pipelines as per specifications.
- Hydro testing of pipeline in segments.
- Backfilling of pipe trench at pipe joints.
- Detailed Designing and Construction of RCC Sluice/ Butterfly Valve Chambers/RCC Thrust blocks/ Saddles/ Anchor blocks. The typical drawings for various structures are enclosed in Bid drawings for reference.
- Reinstatement of WBM, Tar and Concrete Roads after laying and testing of pipeline.
- Demolishing old structures in the route of pipeline, if required.
- Flushing of entire pipeline with clean water at least for 24 hours.
- Testing and commissioning.
- Preparation of as-built drawings.

The site of tendered pipeline work is DI and MS pipelines with their fittings is for water supply system for Transmission Main for Kotharia Area only as shown in the pipeline network drawing at Rajkot, (Location map is shown in the tender drawings). A tapping will be taken from an existing MS pipeline of 900mm coming from Ribda Filter Plant for NarayanNagar & Swati Park Head-works for Kotharia Area water supply system.



### **1.1. Delivery Schedule:**

The contract time shall be **as prescribed in tender document, from the notice to proceed**. The contractor shall submit his delivery schedule and the programme of works together with his tender in conformity with delivery schedule given in the documents.

### **1.2. Packing and Handling:**

- a. Necessary care shall be taken and required packing shall be provided to avoid damage to pipe barrels and the edges of the pipe ends in transit.
- b. Where the goods are required to be dispatched at Railway risk, special packing as per IRCA rules are absolutely necessary, which would be payable by the contractor himself.
- c. The contractor shall use proper handling equipment or follow suitable standard handling method for DI pipes & DI Specials as approved by the Engineer-in-charge to unload the materials at the delivery site to prevent damage to the goods.
- d. The contractor shall take all care for Transportation & supply of HC connections items to be supplied with its standard handling process, stored at site under his store / the delivery site to prevent damage to the goods.

### **2.0 General Specifications:**

All the items occurring in the work and as found necessary during actual execution shall be carried out in the best workman like manner as per specifications and as per instructions of the Engineer-in-charge. All material should be from approved vendor for that material

Extra claim in respect of extra work shall be allowed only if such work is ordered to be carried out in writing by the Engineer-in-charge and the same is made in a fortnight after its occurrence.

The contractor shall engage a qualified Engineer for the execution of work who will remain present for all the time on site and will receive instructions and orders from the Engineer-in-charge or his authorized representative. The instructions and orders given to the contractor's representative on site shall be considered as if given to the contractor himself.

A work order book as prescribed shall be maintained on the site of the work by the contractor and contractor shall sign the orders given by the inspecting officers and shall carry out them promptly.

Quantities specified in the tender may vary at the time of actual execution and the contractor shall have no claim for compensation on account of such variation.

Diversion of road, if necessary, shall be provided and maintained during the currency of the contract by the contractor at his cost.

Figured dimensions of drawings shall supersede measurements by scale. Special dimensions or directions in the specifications shall supersede all other dimensions.

All levels are given in drawings and the contractor shall be responsible to take regular levels on the approved alignment before actually starting the work. The levels shall be connected to the G.T.S. levels and shall be got approved from the Engineer-in-charge.

If the arrangement for temporary drainage is required to be made during any work of this contract, this shall be made by the contractor without claiming any extra cost.

### **3. Classification of Strata:**

All materials encountered in excavation will be classified in the following groups irrespective of made of excavating the materials and the decision of the Engineer-in-charge in this regard shall be final and binding to the contractor.

#### **3.1. Soils & Hard Murrum:**

Soils of all sorts, silt, sand, gravel, soft murrum, stiff clay, kunkar and other soft excavation not covered in the items mentioned hereunder. Hard materials comprising of all kinds of disintegrated rock or shale or Indurate conglomerate interspersed with boulders of size between 0.02M3 and 0.75M3, weathered and decomposed rock, which could be removed with, pick, bar, shovel wedges and hammers, thought not without some difficulties.

#### **3.2. Soft-Rock & Hard-rock:**

This shall include all materials which is rock but which does not need blasting and can be removed with a pick, bar, wedges, pavement breakers, pneumatic etc. This shall include rock occurring in mass or boulders bigger than 0.75 M3 each which need blasting. This will also include rock to be removed by chiseling or any other method where blasting is not permissible.

The contractor will have to arrange for land, power and water for manufacture of pipes. However, if requested by the contractor, the Engineer-in-charge after due verification of facts will recommend to appropriate authority for obtaining land and power for manufacture of pipes under this contract.

## TECHNICAL SPECIFICATIONS

### ITEM NO.1: EXCAVATION WORK

**Excavation in Trench for pipe in all types of strata (incl. all safety provision) including lifting and laying in 90 mtr. Lead area as instructed etc comp.**

**0.0 to 1.50M depth.**

**1.51 to 3.00M depth.**

Excavation for pipe line trenches with shoring, strutting, bailing or pumping out watered from trenches whenever necessary of required length, width and depth including extra excavations for sockets and all safety measures and provisions such as site rails fencing, lighting, watching including refilling the trenches in layers including ramming and removing the excavated staff with 90m lead and clearing the site etc. as stipulated in the tender specification complete before starting work and after completion of work for all lifts and soil strata as specified.

- a) In all sorts of soil soft murmur, hard murrum, boulders, macadam and asphalt roads including breaking of lime and cement masonry and lime concrete.
- b) In soft rock, cement concrete, hard rock, and cutting of cement concrete and R.C.C. of any proportion, etc. with controlled blasting and or chiseling whichever is necessary and feasible as required by site conditions.
- c) In hard rock,

#### **1.1 Clearing of sites :**

- 1.1.1 The site at which the pipe line is to laid and the area required for setting out and other operations shall be cleared of all obstructions, loose stones, and rubbish of all kinds; stumps of trees, brushwood as well as all trees shall be removed as directed. The roots shall be entirely grubbed up.
- 1.1.2 The products of the clearings to be stacked in such a place and in such a manner, As directed by the Engineer-in-charge.
- 1.1.3 In site clearing, all trees not specially marked for preservation, bamboos jungle wood and brush wood shall be cut down and their roots grubbed up. All wood and materials from the clearing shall be the property of corporation and shall be arranged as directed by the Engineer-in-charge or his authorized agent. The materials found to be useful by the Engineer-in-charge shall be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.
- 1.1.4 All holes or hollows, whether originally existing or produced by digging up

roots, shall be carefully filled up with earth, well rammed and leveled off, as may be directed shall not be paid for. The contractor shall get approval of design of shoring. The shoring shall be of sufficient strength to resist side pressure and ensure safety from slips and blows and to prevent damage to work and property and injury to persons. It shall be removed as directed after all the items of work for which it is required are completed.

#### 1.1.5 Protection :

1.1.5.1 The foundation pits and trenches, etc shall be strongly fenced and red light Signals shall be kept at night in charge of watch-man to prevent accidents. Sufficient care and protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structures. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, the contractor at his own cost shall provide caution boards etc.

#### 1.6 Classification of Strata :

1.6.1 The decision regarding classification of strata shall rest with the Engineer-in-Charge and his decision shall be final and binding to the contractor.

1.6.2 All the materials encountered in the excavation shall be classified as described in 2.0 of general specifications.

#### 1.7 Dewatering :

1.7.1 Unless specially provided for as a separate item in the contract, the rate of excavation would include bailing or pumping out all water met with in excavation or which may accumulate in the excavation during the progress of the work either, by percolation, seepage, springs, rain or any other cause and diverting surface flow if any, by earthen bunds or by other means. The bunds shall be removed as soon as the work is completed.

1.7.2 Unless specially provided as a separate item of contract, pumping of water from foundation pit, trenches etc shall be carried out by the contractor at his won cost and he shall arrange for required numbers of dewatering pumping sets for the above work. He shall take precaution to prevent any damage to the foundation trenches, concrete or masonry or any adjacent structure. The excavation shall be kept free from water by the contractor (1) during inspection and measurement (2) When concrete and/or masonry work are in progress and till the construction work reaches above the natural water level and (3) till the Engineer – in – charge considers that the mortar is sufficiently set. The rate shall be paid for cum. of excavation.

#### 1.8 Excavation in Rock :



### 1.8.1 Blasting with Gun Power:

Blasting operations shall be carried out with the prior permission and in the presence of the Engineer – in – charge or his authorized representative and during fixed time hours of the day. All safety precautions such as providing safety nylon netting etc. shall be carried out as per instructions of the Engineer – in – charge.

Red danger flags shall be prominently displayed and all the people, except those who have actually to light the fuse must be away to a safe distance, not less than 200 meters.

All fuses shall be cut to the length required before being inserted into the holes.

The number of charges to be fired and the actual number of shots heard shall be compared and the person responsible must satisfy himself by examination that all the charges have exploded before work people are permitted to approach the scene. The withdrawal of a charge which has not exploded shall under no circumstances be permitted, but the tamping and charge shall be flooded with water and the hole marked in a distinguishing manner. The next hole to be fired shall be at a distance of about 500mm from the old hole and fired in the usual way.

The contractor or any of his competent authorized person shall be in charge of the blasting operations and shall be held responsible for strictly observing the safety rules, particularly applicable to blasting operations, in addition to other safety rules.

In blasting rocks with dynamite, the following general principles shall be observed.

In general, the following diameter of drills shall be used for different depth of boreholes:

From 1 – 2 metres	25 mm diameter
From 2 – 3 metres	37 – 50 mm diameter
From 3 – 4.75 metres	50 – 60 mm diameter

The borehole should generally be not more than 1.3m deep and the distance apart should be from one and half to twice the depth.

Cracks and fissures in the rock to be blasted shall be carefully studied to ascertain the best portion for the boreholes. Charge shall always be placed in a round piece of rock, if possible not nearer than 30mm from the crack.

## Rules for blasting with dynamite and other high explosives

The person - in- charge must show that he is thoroughly acquainted with all blasting operations and that he understands the rules herewith laid down. He will be held responsible for any accident that may occur.

Boreholes must be of such sizes that the cartridge can easily pass down them. The position of all holes to be drilled must be marked out with white paint and the person – in – charge must take particular note of these positions.

The drilling operation being finished, the person – in – charge must make a second inspection and satisfy himself that the boreholes marked out by him have been drilled. The person – in – charge must prepare all charges necessary for boreholes.

Only ten holes may be loaded and fixed at one time and the charges should be fixed simultaneously as far as practicable. Boreholes must be thoroughly cleared before a cartridge is inserted.

The loading is to be done by the person – in – charge himself and the position of the charge holes carefully noted by him. Wooden tamping rods only to be used in charging holes (not pointed but cylindrical throughout, one cartridge at a time must be inserted and gently pressed with the tamping rod.

Immediately before firing blast, due warning must be given and the person – in – charge must see that all the labourers have retired to safety.

The safety fuse of the charged holes are to be lighted in the presence of the person – in – charge, who must see that the fuses of the holes charged have properly ignited. After the blast, the person – in – charge must carefully inspect the work and satisfy himself that all the charges have exploded.

### 1.8.2 Misfires:

Misfires are a source of great danger, if it is suspected that part of the blast failed to fire or is delayed, allow sufficient time to elapse before entering the danger zone. When fuse and blasting caps are used, a safe time, at least of an hour should be allowed.

None of the drillers are to work near this hole until the two following separations have been done by the person – in – charge.

(a) The person – in – charge should very carefully extract the tamping with a wooden scrapper and withdraw the fuse with the primer and detonator attached, after which a fresh primer and detonator with fuse should be placed in this hole and fired or.

The hole may be cleared of 300mm of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 150mm away and parallel to it, the hole to be then charged and fired. The person – in – charge shall also at once report to the Engineer – in charge all cases of misfire, that cause of the same and what steps have been taken in connection herewith.

#### 1.8.2.1 Precautions against misfire:

The safety fuse should be cut in an oblique direction with a knife.

All saw dust must be cleared from the inside of the detonator this can be done by blowing down the detonator and tapping the open end. No instrument shall be inserted into the detonator for this purpose.

After inserting the fuse in the detonator, it shall be fixed by means of nippers.

If there is water present, or if the boreholes be damp, the junction of the fuse and detonator must be made water tight by means of grease, white or lead.

The detonator should be inserted into the cartridge, so that about one third of the copper tube is left exposed outside the explosives. The safety fuse outside the detonator, should be necessarily tied in position in the cartridge. Water proof fuse only to be used in the damp boreholes, or when water is present in the bore-holes.

If a misfire has been found to be due to defective fuse detonator or dynamite, the whole quantity or box from which the defective article was used shall be rejected.

Storage of materials for blasting shall be as per regulations/stipulations of the concerned authorities.

It shall be the contractor's responsibilities to arrange proper storage of explosives and obtain required permission from concerned authorities. No separate payment will be made for the above.

The refilling will generally refer to refilling of trenches up to ground level with excavated stuff.

Filling materials shall be from excavated stuff.

Excavated stuff to be used shall be cleared of all rubbish, large size stones, brick bats etc. Big clods shall be broken down to a size of 50 mm or less.

#### 1.9 Refilling :

After the pipes have been laid and jointed and the chambers are constructed and as soon as the joints have been inspected and passed by the Engineer-in-charge, the pipe line has

been tested for water tightness, and after all concrete work thoroughly set the trenches shall be fulfilled with the materials taken there from. In refilling the trenches, the utmost care shall be exercised so as not to disturb, break or damage the jointed pipes. Over and around every pipe, the finest selected material shall be put. No lumps of rock earth or other material around the pipe or be thrown into the trenches until the same has been broken to specified size and pipes covered by the fine material above referred to. The selected fine material shall be carefully placed next to the permanent work and well packed and well rammed in layers of 150mm for a depth of at least 300mm over the top of the pipe. The remaining of the excavation shall be filled in with the best and most suitable portions of the excavated material in layers of not more than 600 mm deep, each layer shall be thoroughly rammed before the next layer is placed. One man shall be employed for hand ramming for every 30m of refilling up to the level of 300mm over the top of the pipe. Surplus soil shall be piled on top of the filling to the extent possible for expected subsidence. All road materials to form a compact neat surface. The surface of the filled in trench shall be hand rolled by a hand roller weighing not less the ½ tones as directed by the Engineer-in-charge.

The contractor shall maintain all refilling and surfaces until reinstated. The contractor shall be responsible for claims arising from accidents due to subsidence or inadequate maintenance or improperly refilling work.

The contractor shall be responsible for any settlement during the defects liability period including monsoon and the same shall be refilled with stuff brought from outside, if necessary.

Where excavated material is not considered suitable for refilling by the Engineer-in-charge, the Contractor will be required to cart selected surplus excavated materials in place of unsuitable materials. The contractor may also be instructed to supply suitable granular or other hard filling material for use in refilling. Such imported filling material shall be paid for at the rates given in the Bill of quantities.

No payment shall be made for carting away surplus material arising either because of rejection of excavated material for refilling or because of surplus material.

#### Measurement:

The contractor's shall be for the unit of one cubic meter of the quantity excavated limited to the dimensions and provisions specified in the specifications or as directed by the Engineer-in-charge. The extra excavation to provide for jointing pipes, shoring etc. will not be paid for. The rates shall include cleaning and clearing the trench site by cutting grass, shrubs and trees of girth (circumference) not exceeding 10 feet and removing their obstructing roots in the trench cleaning the site, setting out works as per sanctioned plans, provide shoring, excavation and removal of all material from trenches, backfilling the trenches up to natural ground level and all other operations described above. The wood obtained during site clearance shall be the property of the department concerned.

The excavated quantity divided into two sub groups

Excavations up to depth of 1.5mt & 1.51 to 3.00mt

The trench section is to be provided with Max. width OD of pipe + 250mm to 300mm either sides. Depth of trench shall be minimum Bedding + OD of pipe + 0.60mt. cover above the top of pipe. (For 100mm dia pipe). Depth of trench shall be minimum Bedding + OD of pipe + 1.0mt. cover above the top of pipe. (For Other dia pipe).

**Mode Of Measurement And Payment:**

The rate shall be per Cubic Meter of excavation.

## **ITEM NO.2: SEND BEDDING**

### **Supply & Laying of Bhogavo Sand with all required material and labour for pipe Bedding etc comp.**

Pipe bedding of minimum 150 mm thickness and level shall be provided below pipe, prior to laying the pipe in trenches. It shall be compacted with a light hand rammer. Any reduction in thickness due to compaction shall be made up by adding sand during ramming. For the purpose of the bedding under this item only screened fine sand of grain size not larger than 2mm shall be used. The sand shall be clean, uncoated and free from clay lumps, injurious amounts of dust, soft particles, organic matter, loam or other deleterious substances.

If the sand supplied is unclean it shall be washed. In no case shall sand containing more than 3.5 % by dry volume or 5% by wet volume of clay, loam or silt be accepted. Tests specified for determining silt in sand and organic impurities as described in IS: 383 shall apply. Sieved and washed sand shall be stored on the works in such a manner as to prevent intrusion of any foreign matter, including coarser particles of sand or any clay or metal or chips. Tests as indicated above shall be performed if called for by the Engineer at the expense of the Contractor.

During the work of providing sand bedding and laying the pipeline over it, loose material from the sides or edges of the trench shall be prevented from falling inside the trench, by providing shoring and taking other measures. Also where necessary, trench shall be kept dry by pumping out seepage water continuously.

## **ITEM NO.3: EARTH FILLING(Selected Excavated Stuff) FOR BEDDING**

Providing, bedding incl. Raming, watering consolidating etc.

### **3.1 ) Murum To Be Used From Selected Excavated Stuff.**

The selected excavated stuff shall be got proved from the engineer in charge before using the same for providing bedding on trenches bed. Big clods shall be broken into small pieces and tress roots, weeds and big stone and other objectionable material decay shall not be used in the work.

The bedding shall be placed uniformly with minimum thickness (as per instruction) Along the routes of excavated pipe trench as directed by the engineer-in-charge. The bedding shall be properly rammed watered and consolidated.

The mode of Measurement.

The quantity of the work shall be paid on cum. Of the completed bedding after Proper consolidation & watering.

**ITEM NO.4: REMOVING SURPLUS MATERIALS:**

After refilling all surplus excavated stuff shall have to cart by the contractor within RMC limit including loading, transporting, unloading, spreading etc complete as directed by the Engineer-in-Charge. without any extra cost

Mode Of Measurement And Payment:

The rate shall be per Cubic Meter of truck-body bases.

**ITEM NO.5: JOB WORK**

**Job work for 900 mm MS pipe taping: Pipeline repairing work (in existing network / connecting new network) for with excavation-filling in required length with traffic regulating, testing and all essential materials for repairing viz. Safedo, loose thread, Rubber Sheet, Nut-Bolt etc. for CI / DI / PVC / HDPE / AC Pressure / RCC / GI / MS / PS Pipe (excluding valve, joints, specials etc. materials, de-watering work, cutting & welding of DI / MS / CI pipes as required) with all required equipments, in case of PL chowk up, like Steel rod / Hard rubber pipe for line cleaning to be provided by Contractor for 900 mm dia PL**

There will be job work to joint existing MS pipe of 900mm diameter coming from Ribda WTP with the proposed 610mm MS transmission main for Kotharia area. Contractor need to execute job work without disturbing the traffic including cleaning of site immediately after completing the job work including necessary safety provisions..

**Mode Of Measurement And Payment:**

The rate shall be per number of job work.

## **ITEM NO.6: GAS CUTTING WORK**

**Providing Gas cutting work Either square cut or V cut for pipes, plates etc. having thickness 6 to 10 mm etc comp.**

Gas cutting if required for preparing on site distance pieces, straps etc. and cutting out holes in the pipe line shall have to be carried out by the contractor. After cutting, the edges shall be made smooth and even by using electrical or pneumatic grinder so as to remove all inequalities. Care shall be taken to see that the shape of the material cut does not defect in any way at the time of cutting.

## **ITEM NO.7: WELDING WORK**

**Providing Misc. Welding work for MS pipes, plates etc having thickness 6 to 10 mm etc comp.**

All components of a standard shell, either straight or bent etc. shall be welded, wherever possible by use of automatic arc welding machine by Submerged Arc welding process with alternating current. Generally hand welding shall not be permitted except specific cases, where it is absolutely necessary. This should be done in consent with clients representative. Hand welding shall also not be permitted except for sealing runs and such other minor works at the discretion of the Engineer-in-charge. The strength of the joint shall be atleast equal to that of the parent material.

The welding shall be of the best workmanship free from flaws, burns, etc. and the Contractor shall provide for his own electrodes and equipments, ovens to keep the electrodes at the desired temperatures and dry. In order to maintain a good standard in welding, welders shall be tested by the Contractor with prior intimation to the client before they are entrusted with the job. Qualification standard for welding procedures, welders and welding operation shall conform to the requirements of IS : 7307 and IS : 7310 (latest)

The welded joint after welding should not become brittle or sensitive to blows and there should be no loss of toughness due to welding or heat treatment. The material after welding and heat treatment is to be tougher than the base metal and is to retain its original ductility. No allowance will be made for thinning of weld and the weld should in no point be less than the nominal thickness of plate.

The item includes following operations:

- i) Carting of pipes from departmental store to site of work
- ii) Lowering and laying pipes and specials in trenches.
- iii) Welding of pipes and specials as per IS 5822: 1994
- iv) Testing of welded joint as specified in the IS 5822: 1994 para 6.2. & Tensile test for minimum one joint out of forty joints.
- v) Hydraulic testing of the pipes



M.S. pipe/specials shall be lowered, laid and jointed by welding including preparation of ends wherever required, grinding as per relevant IS code of welding, testing etc. complete with hydraulic testing complete as per IS: 5822-1994.

**SPECIFICATIONS FOR WELDING:**

These specifications cover shop welding as well as site welding for requirement of M.S. pipe in particular length and M.S. specials. Following types of joints are considered for connecting the two pipes or pipe and specials.

Fillet weld with swaging of one end of pipe OR Butt weld without swaging of one end of pipe.

- **WELDING UNDER RAIN AND STRONG WIND:**

If welding is to be done during rain or strong wind, suitable protection shall be provided for the parts to be welded and the welder. Pre-heating of electrodes shall be done so as to remove any moisture. Where this is not practicable, no welding shall be done on piping under such conditions.

All the types of bends, scour tees, air valve tees, tail pieces of valves and water meters etc. shall be fabricated as per standard practice from M.S. pipe to be supplied by Contractor. The contractor shall have to provide M.S. pipe pieces and 18 to 20 mm thick flanges of required diameter for branch of tees, reducers, enlargers, etc. and paid on m. basis in Item No.1 supply of M.S. pipe. Fillet or butt weld as may be required shall do joint. Holes of appropriate dia shall be drilled in flanges of specials at appropriate spacing to facilitate jointing of sluice valves, water meter, air valves and other types of valves.

The following does are applicable for welding:

IS 814 Code for covered electrode for metal Arc welding for mild steel.

IS 815 Classification And Coding Of Covered Electrodes For Metal Arc Welding Of Mild Steel And Low Alloy High Tensile Steel.

IS 1663 Part – I/ Part – II regarding method of tensile testing of steel sheets and stripes.

IS: 3600 codes of procedure for testing of fusion welding joints and weld metal in steel.

- **ELECTRODES:**

The contractor shall use preferably Advani Orelikon overcord S.S. Greecon (Blue) or other electrodes as approved by Engineer-in-Charge depending upon the thickness of the plate and type of joint. They shall use standard current and Arc

Voltage required for the machine in use as per manufacturer's directions. Welding electrode shall conform to test procedure of IS 814 and IS 815. The contractor shall submit manufacturer's test certificate for each batch of electrode use by him. Electrodes shall be stored unopened in original containers. Electrodes when used shall be free of rust, oil, grease and all other matter which could be harmful for the good quality of welding.

- **QUALIFICATION OF WELDERS:**

Only such welders who are experienced and whose workmanship is satisfactory shall be employed for the work. Welders will be individually tested for the welding skill before they are allowed to work.

- **WELDING PROCESS:**

All welds shall be made down – hand by manual or automatic shielded arc welding process. Welding shall be done so that there shall be thorough fusion and complete penetration. Sealing runs in the inside shall be done manually. The joints for seams and circular welding shall be square but as per standard practice as per of IS: 816 shall be accepted.

- **END PREPARATION:**

Ends to be welded will be preferably made by machining. However, preparation of ends may be made by flame cutting, provided all grooves and irregularities are ground off and all the oxidation is removed.

- **CLEANING:**

The ends to be welded shall be properly cleaned. All paint, oil, grease, rust and oxide as well as all earth, sand or any other material sticking which could be harmful to the welding should be removed. Ends shall be totally dry while welding. No dirt or debris will be permitted in the pipeline. Prior to alignment the inside of each joint shall be adequately scrapped by approved means to the satisfaction of the Engineer-in-charge.

- **ALIGNMENT AND SPACING:**

Pipes to be welded shall be aligned and fitted with external line up clamp and spaced in a suitable manner, so as to hold ends during welding at a distance to ensure full penetration. Root opening shall not be more than as specified. Internal off set shall not exceed 1.5 mm. The pipe piece to be butt-welded shall be coupled by means of pipe couplers or by yokes or bridge “c” clamps. Owner's inspector may check and approve the joint fit-up and alignment prior to the commencement of welding.

- **WELDING TECHNIQUE:**

- (i) **FOR BUTT JOINTS:**

The maximum electrode size shall be 3.15 mm (10 SWG) and the electrode holder shall be connected, having due regard for the polarity requirement of the electrode approved for the use for pipe in horizontal position. Upward technique shall be used with the recommended values of current.

The root pass of butt joints, regardless of the technique used, shall be such as to achieve full penetration. However, projection of weld metal in to the pipe bore shall not exceed more than 5 mm. Root grooves and defective restart of the welding shall be carefully avoided. For pipes having dia greater than 500 mm all circumferential joints shall be welded on both sides i.e. outside and inside.

At each interruption of welding and on completion of each run, craters, weld irregularities and slag shall be removed by grinding or chiseling. After the welding is started and until the joint has been completed displacements, shocks, vibration or stresses shall be avoided in order to prevent cracks or breaks in the weld.

- (ii) **FOR FILLET WELDS:**

The maximum electrode size shall be 4 mm (8 SWG). On completion of the root pass, any visual defect or irregularity shall be ground off to avoid defects or irregularities in the next pass.

- (iii) **JOINT COMPLETION:**

Electrode size of more than 8 SWG (4 mm) shall not be allowed for filling of the weld upward technique shall generally be used for pipe in horizontal and vertical position welding. At each interruption of welding and after each run of welding is completed, chipping and slag removal shall be done. When the welding is completed, butt joints shall have a cover pass. It shall be slightly convex and fuse into the surface of the base metal in such a manner as to have a gradual notch free finish and good fusion at the joint edges. Welds shall have a regular appearance and shall be free from defects. Welder number shall be stamped alongside each weld whenever required by the Engineer-in-Charge / consulting engineer.

- (iv) **WELDING EQUIPMENT, TOOLS AND SUPPLIES:**

All welding machines, line up clamps, beveling machines, cutting torches and other equipment, tools and supplies used in connection with the welding work shall be kept in good working condition so as to produce sound welds. The welding machines shall have adequate controls for obtaining current adjustment for all pipeline-welding requirements. Ground clamps shall be of such design as to be dependable and should not deflect the pipe and with as large a contact area as is practicable.

- (v) **PREPARATION OF PIPE FACE FOR WELDING:**

Before aligning, assembling and welding pipe faces shall be cleaned by scrapping by wire brushes or by any other method approved by Engineer-in-Charge. The

correctness of shape and bevel edge will be checked with templates and required corrections carried out before welding.

- **WELDED JOINTS:**

As required in the welding work following points shall be observe. The contractor shall use the standard electrode depending on thickness of the plate and type of joints. They shall also use standard current and arc voltage required for the machine in use as per the direction of the Engineer-in-Charge. Welding electrodes shall confirm to IS 814 of Indian or equivalent foreign make of required quality approved by Engineer-in-Charge shall be used wherever possible.

- **GAS CUTTING:**

Gas cutting if required for preparing on site distance pieces, straps etc. and cutting out holes in the pipe line shall have to be carried out by the contractor at his own cost. After cutting the edges shall be made smooth and even by using electrical or pneumatic grinder so as to remove all inequalities. Care shall be taken to see that the shape of the material cut does not defect in any way at the time of cutting.

- **BLANK FLANGES:**

Blank flanges shall be provided at all ends left unattached for temporary closure of work and also for commissioning a section of pipeline for testing the line laid. For temporary closure non pressure blank flanges consisting of M.S. plate tack welded at the pipe ends may be used. The blank flanges or domes designed as per requirement shall be provided. Separate payment will not be made for the flanges or domes.

- **STRAPS:**

Whenever pipe line is to be done from two faces and / or required to be done in broken stretches due to any difficulty met at site the final connection has to be done by introducing straps to cover the gap upto 30 cm length. Such straps shall be fabricated in field by cutting pipes splitting them longitudinally and tapping them over the ends connected in the form of collar. The collar shall be in two halves and shall have the inside diameter equal to the outside diameter of pipe to be connected. A minimum lap of 8 cm on either end of the pipe shall be kept and fillet welds shall be run for circumferential joint. The longitudinal joint of the collar shall be butt welded. The material for straps and labour for doing above work is included in the rate, and nothing extra shall be paid for material as well as labour. The joints shall be provided with Reinforced cement mortar coating outside and cement mortar lining inside.

**ITEM NO.8:****M.S. Special : Providing Plain and flanged ends M.S. Specials having 4 mm to 25 mm thickness for jointing work etc comp.**

The jointing material shall include:

- All types of flanges fabricated from MS plates/ flats of required thickness and confirming to IS 2062
- Pipe supports/ valve supports from structural steel angles/channels of required size and confirming to IS standards.
- Jointing material like nuts, bolts, washers, gaskets etc.

**TRANSPORTING OF PIPES, SPECIALS etc.**

- All pipes and specials fabricated in the site factory / workshop and temporarily stacked in the Contractor's yard shall be transported to the site of laying after cleaning them internally etc. The loading in the factory shall be carried out by means of either a crane, gantry or shear legs, so as not to cause any damage to the finished material. Similarly, while unloading and stacking, great care shall be taken to ensure that the material is not damaged or dented. The contrivances to be used for unloading will be different in different situations and in each case the one approved by the Engineer shall be adopted. The material stacked at site shall be jointly inspected by the Engineer and the Contractor and defect or damage noticed shall be repaired to the satisfaction of the Engineer before payment is admitted.
- Props of approved designs for maintaining circularity having M.S. Angle/Pipe at both ends to avoid metal to metal contact shall be fixed to the pipes during transit to avoid undue sagging and consequent distortion. After the pipes are carefully stacked, props should be retained till pipes are joined in trenches and then props are re-used for subsequent similar operations. The stacking ground, both in the Contractor's yard and at the site of laying shall be selected in such a way as not to get waterlogged during monsoon. If this cannot be done, the pipes shall be supported on sleepers to avoid contact with wet earth and subsequent rusting. In order to prevent sagging during transit, savings of steel Coils can be utilized by cutting to the required length and tacking the same to the pipe ends, in place of props, if approved by the Engineer.
- As explained in earlier paragraphs, materials such as pipes, tapers, etc. may be transported to the site of laying as soon as the material is finished in all respects with the permission of the Engineer to avoid congestion in the Contractor's yard. However, materials such as expansion joints, composite bends, 'T' branches and other complicated materials shall be stacked in the Contractor's yard until they are required for laying in the field. In view of this, the work of fabrication of such materials shall be properly synchronized as far as possible with the laying operations.

- Fabricated materials such as specials, appurtenances, bolts, nuts, distance pipes, flanges, saddles, collars bypass arrangements etc. shall be transported to the site of laying from the fabrication shop according to the needs of the laying operations only. In regards access roads, the Contractor shall note that access road may lead up to some points on the alignment the Contractor shall have to make his own arrangement for connecting approaches to transport the pipes cross country to the actual site of laying at his own cost. Whatever may be the mode of transport he uses it shall be incumbent on the Contractor to carry and stack the pipes and specials along the alignment as close as possible to the site of laying.

**Mode Of Measurement And Payment:**

The rate of MS Specials shall be per kg.

**ITEM NO.9:**

**Welding Machine Rent :**

**Supply of Electric Welding Machine for Welding work at site including welding machine rent, transportation, welding material etc. comp.**

There will be requirement of welding machine at site for miscellaneous welding work. Contractor has to arrange welding machine and required safety standards need to follow during welding work at site.

**Mode Of Measurement And Payment:**

The rate of welding machine rent shall be per hour.

**ITEM NO.10:**

**Generator Set Rent :**

**Supply of Generator set on site including required fuel, transportation, power supply connection etc. for Electric Welding Machine where electricity is not available etc comp.**

There will be requirement of generator set at site. Contractor has to arrange generator set as and when required.

**Mode Of Measurement And Payment:**

The rate of welding machine rent shall be per hour.

**ITEM NO.11 & 12:**

**ITEM NO. 11:**

CC Excavation Work :

**Excavation shall be in C.C. road may be carried out either with hand breaker for pipeline trenches including all safety Provision using the site rails and stacking excavated stuff up to a lead of 90 mts cleaning the site etc. complete for lifts and strata is specified. Classification is decided by engineer in charge. The rate includes the cost of labour, tools, machinery etc.**

**Payment shall be measure in Cubic meter basis.**

**ITEM NO. 12:**

Paver Excavation Work :

**Excavation shall be in macadam( paver) road may be carried out either with hand breaker for pipeline trenches including all safety Provision using the site rails and stacking excavated stuff up to a lead of 90 mts cleaning the site etc. complete for lifts and strata is specified. Classification is decided by engineer in charge. The rate includes the cost of labour, tools, machinery etc.**

**Payment shall be measure in square meter basis.**

**Item No.13:**

**Providing & Supplying Ductile Iron Pipes with internal cement mortar lining and external Zinc coating with finishing layer of Bitumen; manufactured, tested and duly marked in strict accordance with and confirming to IS: 8329/2000 (as per latest amendment); suitable for push-on Jointing, along-with one number Rubber Gaskets for each length of pipe (EPDM Gasket as per IS: 5382/1985). Class- K9 etc comp.**

**Item No.14:**

**Ductile Iron fittings like, bends, tees, reducers or any other specials as per IS-9523-2000 (as per latest amendment) use with D.I.Pipes manufactured as per IS:8329/1994 (With external bitumen & zink coating & internal cement mortar lining)(350 mm to 400 mm and above). etc comp.**

**Note:**

**The DI Pipe shall be of cement mortar lining inside and zinc coating outside, bitumen coating as per manufacturing and testing IS 8329-2000 with ISI Mark suitable for pushup joint. All pipes with necessary EPDM Rubber Gasket (Rubber gasket IS-5382-1985) with existing Excise duty.**

## **A] DUCTILE IRON PIPES & FITTINGS/ SPECIALS:**

**Note: Wherever International Standards or Indian standards / specifications are mentioned, their equivalent or higher standards / specifications are also acceptable**

Supply and Delivery of **Ductile Iron Pipe as per IS: 8329-2000 & IS 9523/2000 DI fittings** or its latest revision or amendments if any including jointing material as EPDM ring as per IS 5382-1985 and ISO: 4633-1996 or its latest revision or amendments if any.

### **Standards**

The following standards, specifications and codes are part of this specification. In all cases, the latest revision of the including all applicable official amendments and revisions shall be referred to. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

- 1) ISO: 10803-1997 Design method for ductile iron pipes
- 2) IS:8329-2000 Centrifugally Cast (spun) ductile iron pressure pipes for water, gas and sewage & IS 9523 for DI Fittings/Specials.
- 3) ISO:2531-1991 Ductile iron pipes, fittings and accessories for pressure pipelines.
- 4) ISO:4179-1985 Ductile iron pipes for pressure and non pressure-Centrifugal cement mortar lining – General requirements.
- 5) IS:8112 Specification for 43 Grade ordinary Portland cement.
- 6) BS:3416 Bitumen based coatings for cold application, suitable for use in contact with potable water.
- 7) ISO:8179-1995 Ductile iron pipes-External coating-Part-1 Metallic Zinc with finishing layer.
- 8) IS:638 Sheet rubber jointing and rubber insertion jointing.
- 9) ISO:4633-1996 Rubber seals-Joint rings.
- 10) IS:5382-1985 Specification for Rubber sealing rings for gas mains, water mains and sewers.
- 11) AWWA C600 Installation of ductile iron water mains and their appurtenances.

### **1.0 Internal Diameter:**

The nominal values of the internal diameters of pipe, expressed in millimeters are approximately equal to the number indicating their nominal sizes DN.



**2.0 Length:**

The working length of socket and spigot pipes shall be 5 m ,5.5 m, or 6 metres.

**3.0 Thickness:**

The wall thickness of pipe 'e' in mm shall be calculated as a function of the nominal diameter by the following equation with minimum of 5 mm

$$e = K(0.5 + 0.001 \text{ DN})$$

where : e = wall thickness in mm, DN = the nominal diameter, K = the whole number coefficient

**4.0 EPDM Rubber Gasket:**

Rubber Gasket shall be suitably for Push-on-Joint.

The spigot ends shall be suitably chamfered or rounded off to facilitate smooth entry of pipe in the socket fitted with the rubber gasket

Rubber Gasket shall confirm to IS 5382-1985 and ISO : 4633-1996 its latest revision or amendments if any

**5.0 Sampling Criteria:**

Sampling criteria for various tests, unless specified in IS 8329-2000, shall be as laid down in IS 11606. Mechanical test, Brinell Hardness test, Hydrostatic test etc are shall be as per IS 8329-2000

**6.0 Tolerances on External Diameter:**

The nominal external diameter (DE) of the spigot end of socket and spigot pipes and when measured circumferentially using a diameter tape shall confirm to the requirements specified as follow. The positive tolerance is +1 mm and applies to all thickness classes of pipes. The maximum negative tolerance of the external diameter are specified as follow:

DN	Nominal	Positive Tolerance	Negative Tolerance
80	98	+1	-2.2
100	118	+1	-2.8
125	144	+1	-2.9
150	170	+1	-3.0
200	222	+1	-3.0
250	274	+1	-3.1
300	326	+1	-3.3
350	378	+1	-3.4
400	429	+1	-3.5
450	480	+1	-3.6
500	532	+1	-3.8
600	635	+1	-4.0

### 7.0 Tolerance on Ovality:

Pipes shall be as far as possible circular internally and externally. The tolerance for out-of-roundness of the socket and spigot ends is given below:

Nominal Diameter in mm	Allowable Difference Between Minor Axis and DE in mm
80 to 300	1.0
350 to 600	1.75
700	2.0
750 to 800	2.4
900 to 1000	3.5

### 8.0 Tolerance in thickness

The tolerance on wall thickness (e) and the flange thickness (b) of the pipes shall be as below:

Dimensions	Tolerance in mm
Wall thickness (e)	- (1.3 + 0.001 DN )1)
Flange thickness (b)	+ (2+0.05b) & - (2+0.05b)

### 9.0 Coating

Pipe shall be delivered internally and externally coated.

**External Coating:** Pipe shall be metallic zinc coated and after that it shall be given a finishing layer of bituminous paint as per IS - 8329-2000 Zinc coating shall comply with IS:8329/EN 545/ ISO 8179. Only molten zinc spray coating shall be acceptable. The average mass of sprayed metal shall not be less than 130 g/sqm with a local minimum of 110 g/sqm. Bitumen overcoat shall be of normal thickness of 70 microns unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II suitable for tropical climates factory applied preferably through an automatic process.

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

**Internal lining:** Internally pipe shall be Portland Cement mortar lined (as per IS - 8329-2000). The mortar shall contain by mass at least one part of cement to 3.5 part of sand. All pipes and fittings shall be internally lined with cement mortar using high speed centrifugal process in accordance with IWO 4179/IS 8329. Cement mortar lining shall be applied at the pipe manufacturing shop in conformity with the aforesaid standards. No admixtures in the mortar shall be used without the approval of the Engineer. The sand to cement proportion of sand if justified by the sieve analysis. Pipe lining shall be inspected on site and any damage or defective areas shall be made good to the satisfaction of the Engineer. Lining shall be uniform in thickness all along the pipe. The minimum thickness

of factory applied cement mortar lining shall be as per IS: 8329 Annex-B or ISO 4179. This is given below.

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

### **10.0 Joint**

Jointing of DI pipes and fittings shall be push-on type

#### **Push-on-joints**

The Contractor shall source the push-on-joint gaskets only from the pipe manufactures. In turn the pipe manufacturer shall supply at least 10% additional quantity of gaskets over and above the requirement to the Contractor at no extra cost. The gasket used for joints shall be suitable for natural and purified water conveyance. In jointing DI pipes and fittings, the Contractor shall take into account the manufacturer's recommendations as to the methods and equipments to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that once the rubber ring is correctly positioned before the joint is made, does not get damaged by friction or sharp edges of the spigot Chamfer. The rubber rings and the recommend lubricant shall be obtained only through the pipe manufacturer.

Rubber ring bundles form every lot shall carry with them manufacturers test certificate for the following mechanical properties.

1. Hardness
2. Tensile strength
3. Compression set
4. Accelerated again test
5. Water absorption test
6. Stress relaxation test

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint, the size of the pipe with which they are to be used, the manufacturer's name and trade mark, the month and year of manufacture and the shelf life.

### **11.0 Testing of Pipe:**

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

#### **[a] Mechanical Tests**

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

**[b] Brinell Hardness Test**

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

**[c] Re-tests**

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

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

**12.0 Quality Assurance**

The manufacturer shall have a laid down **Quality Assurance Plan** for the manufacture of the products offered which shall be submitted along with the tenders and successful tendered shall have to get its approval from RMC. All the materials, pipe, specials, valves etc. shall have to be inspected through Third Party Inspecting Agency.

**Mode of Payment : As per schedule B, R.M.C. will pay maximum 1000 meter un laid pipes supply payment restricted to 65 % of cost. 25 % will be released after on lowering, laying and jointing and 10% on satisfactory hydraulic test successful tests given after laying jointing.**

**ITEM NO.15: D. I. SPECIALS / FITTINGS :-**

**SPECIFICATION :**

**Supply of DI Specials, K-9 with ISI marked, conforming to IS 9523/2000 & BSEN:545/1995, suitable for jointing 150mm to 600mm dia. DI Pipes shall have the following :**

**A) EXTERNAL COATING :**

1. Metallic Zinc with finishing layer of bituminous as per Annexure 'A' of IS: 9523/2000.
2. Zinc rich paint with finishing layer of bituminous as per Annexure 'A' of IS: 9523/2000.
3. Bituminous paint as per Annexure 'C' of IS: 9523/2000.

**B) INTERNAL LINING :**

1. Portland Cement (with or without additives) mortar as per Annexure – 'B' of IS: 9523/2000.
2. Cement Mortar with Coal coat as per Annexure 'B' of IS 9523/2000.
3. Bituminous paint as per Annexure 'C' of IS: 9523/2000.

**C) METALURGY & MICRO STRUCTURE :**

The metal used for manufacture of D.I. fittings as per IS : 9523-2000 shall conform to the appropriate grade as specified in IS : 1865-2005.

D.I. Fittings shall contain a Stub (as cast), minimum length -15mm x dia.- 10 mm., which at the time of Inspection can be cut at random to carry out Metallographic test to ascertain minimum 80% Graphite Nodularity as per Clause – 9.1 of IS : 1865-2005, in the form - V or VI as per IS : 7754-2003.

**D) MANUFACTURING & VERIFICATION:**

All the DI fittings and specials shall conform to IS: 9523/2000 and shall be manufactured at well equipped foundries.

The QAP for the DI fittings shall include inspection of above two by Department's (/)senior technical representatives and shall necessarily require formal approval before manufacturing clearance.

**Mode of Payment: As per schedule B but supply payment restricted to 65% of cost. 25 % after laying jointing and 10 % will be released after successful hydraulic tests etc complete.**

**ITEM NO. 16, 17 & 18:**

**ITEM NO. 16 : Providing & Supplying M.S. Pipe -,I/S Solvent free Liquid Epoxy Lining (400 micron) + O/S 3 LPE Coated M.S. Pipe etc complete (610 mm dia. 6.3 mm thickness).**

**ITEM NO. 17: Lowering, laying & Jointing with approved Heat Shrink Sleeve in position to connect line & level M.S. Pipe with outside 3 LPE coating & inside solvent free liquid epoxy lining on pedestal or chairs upon prepared formation or prepared bedding in trenches the rates include conveyance from store to site of work loading, unloading, Jointing & hydrotesting etc.complete.**

**ITEM NO. 18: M.S. Pipe Specials : Providing MS Specials like bends, tees, angles, reducers, etc. With male female end if required.**

**MS PIPELINES, APPURTENANCES SPECIALS ETC.**

**Ñ SCOPE**

This specification covers the general requirements for supply, fabrication, delivery at site laying, jointing, testing and commissioning of all welded M.S pipeline, appurtenances, specials etc. above/below ground, including Civil works required for the same.

**Ñ APPLICABLE CODES & SPECIFICATIONS**

The following specifications, standards and codes are made a part of the specification. All standards, tentative specifications, specifications, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

<b>Sr. No.</b>	<b>Code Number</b>	<b>Description</b>
1	IS: 2062	Steel for general structural purposes.
2	IS : 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
3	IS : 814	Covered Electrodes for manual Metal Arc Welding of carbon and C-Mn steel.
4	IS : 3613	Acceptance Tests for Wire Flux combinations for Submerged - Arc Welding.
5	IS: 1367	Technical Supply Conditions for Threaded Fasteners (Parts 1 to 3).
6	IS: 2016	Plain Washers.

<b>Sr. No.</b>	<b>Code Number</b>	<b>Description</b>
7	IS: 2074	Ready Mixed Paint, Red Oxide Zinc Chrome and Priming.
8	IS: 102	Ready Mixed Paint, Brushing, Red Lead, no setting, Priming.
9	IS: 1786	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement
10	IS : 432	Specification for Mild Steel & (Part-I) Medium Tensile bars and hard drawn steel wire for concrete reinforcement : mild Steel & Medium tensile steel bars
11	IS.432	Specification for mild steel & (Part-II) Medium Tensile steel bars and hard drawn steel wires for concrete reinforcement : Hard drawn steel wire
12	IS : 269	Specification for Ordinary and Low heat Portland cement
13	IS : 8041	Specification for Rapid hardening Portland Cement
14	IS : 383	Specification for coarse and fine aggregate from natural source for concrete
15	IS :12330	Specification for Sulphate Resisting Portland Cement
16	IS : 456	Code of practice for plain and reinforced concrete
17	IS : 800	Code of practice for General Construction in Steel.
18	IS : 816	Code of practice for use of Metal Arc Welding for General Construction in mild steel.
19	IS : 4353	Submerged Arc Welding of Mild Steel & Low Alloy Steels – Recommendations.
20	IS: 817	Code of practice for Training and Testing of Metal Arc Welders.
21	IS: 1182	Recommended practice for Radiographic examination of Fusion - Welded Butt Joints in steel plants
22	IS: 2595	Code of Practice for Radiographic Testing.
23	IS: 3658	Code of Practice for Liquid Penetrate Flaw Detection
24	IS: 5334	Code of practice for Magnetic Particle Flaw Detection of welds.
25	IS: 3600	Methods of Testing Fusion Welded Joints and weld metal in steel (Parts 1 to 9)
26	IS: 4853	Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints in Steel Pipes.
27	IS: 1239	Seamless or Electrically welded steel pipes for Water Gas and Sewage (Up to 166.5 mm Outside Diameter)

<b>Sr. No.</b>	<b>Code Number</b>	<b>Description</b>
28	IS: 3589	Seamless or Electrically welded steel pipes for Water Gas and Sewage (168.3 to 2540 Outside Diameter)
29	IS: 6631	Steel pipes for Hydraulic Purposes
30	IS: 7343	Code of practice for ultrasonic Testing of Ferrous Welded Pipes and Tubular Products
31	IS: 2598	Safety Code for Industrial Radiographic Practice
32	IS: 5822	Code of Practice for Laying of Electrically Welded steel pipes for water supply
33	IS: 1608	Mechanical testing of Metals.
34	IS: 9595	Metal Arc welding of Carbon and Carbon-Manganese Steels.
35	IS: 2825	Code of unfired Pressure Vessels
36	IS: 5504	Code for Spiral Welded PIPES(457mm to 3250mm Outside Diameter)
37	IS: 10748	Requirements for Weld able Hot Rolled Carbon Steel Strip in Coils.
38	IS: 10234	Recommendation for radiography for general pipeline welding.
39	API-1104	Welding of pipeline & related facilities
40	ASTM E 94	Guide for Radiographic Testing
41	ASTM E 709	Guides for Magnetic Particle Examination.
42	ASTM E 165	Test Method for Liquid Penetrate Examination.
43	AWS: A-5.1	Specification for Mild Steel Covered Arc Welding Electrodes.
44	AWS: A-5.17	Specification for Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding
45	BS EN 499	Welding Consumables. Covered Electrodes for Manual Metal Arc Welding of Non Alloy and Fine Grain Steel. Classification

## Ñ MATERIALS

Steel Coils - The steel Coils for pipes, fittings, specials and stiffeners shall be of mild steel conforming to IS: 10748 grade III and shall bear ISI mark

Welding Consumables - such as electrodes, filler rods and wires shall conform to IS: 814, IS: 3613, IS: 6419 and IS: 7280 and shall be of GWSSB approved make (If any).

Before fabrication of pipes and specials/fittings is commenced, the copies of the mill sheets and the MANUFACTURER's test certificates for Coils and other materials required for the fabrication shall be submitted by the Contractor to the Engineer for his approval.



When requested by the Engineer, the Contractor shall supply free of charge to the Employer, for testing suitable samples of the materials to be used/used in the Works. The cost of such tests shall be borne by the Contractor and shall be included in his item rates.

## **Ñ INSPECTION**

All works and material under specification will be rigidly inspected during all phases of manufacture and testing and such inspection shall not relieve the Contractor of his responsibility to furnish materials and performed work in accordance with this specification.

The Contractor shall notify the Engineer, in advance of the production of materials and fabrication thereof, in order that the Employer may arrange for mill and shop inspection. The Engineer may reject any or all materials or works that do not meet with any of the requirements of this specification. The Contractor shall rectify or replace such rejected material/performed work at his own cost, to the satisfaction of the Engineer.

The Engineer shall have free access to those parts of all plants or any other premises and sites that are concerned with the furnishing of materials or the performance of work under this specification.

The Contractor shall furnish to the Employer's inspector reasonable facilities and space without charge for inspection, testing and obtaining of any information he desires in respect of the character of material used and the progress and manner of the work.

The Contractor shall supply free of cost required specimen of materials for testing by the Owner at any time during the progress of work and shall bear the cost of all such tests or retests to the satisfaction of Engineer.

The Contractor shall provide 2 (two) sets of accurate 'Go' and 'No Go' ring gauges to measure the diameter of pipes specials and fitting for the use of the Engineer at no extra cost.

## **Ñ FABRICATION OF PIPE**

### **1..1 GENERAL**

All Pipes (ISI Marked) and specials shall be manufactured as per IS: 1239 part 1/ IS: 3589 and IS: 5504 out of new mild steel HR Coils (IS: 10748 grade-III) which shall be free from any cracks, surface flaws, laminations, excessive fittings or any other defects. The pipes shall be truly cylindrical, and straight in axis. The ends shall be accurately cut and prepared for field welding. The external circumference of the pipe pieces which are to be fixed adjacent to flange adapter with fixed outer diameter shall not deviate from theoretical one by more than 1 mm. To obtain this accuracy the pipe shall be rolled several times, if necessary, as pipe pieces should be truly cylindrical. The external longitudinal welding of this pipe shall be ground smooth flush with surface to the satisfaction of the Engineer, for a length of 200 mm. No extra cost shall be charged by the Contractor for this grinding work. However, the pipe shall be manufactured as per tender specification.

Minor repair by welding or otherwise shall be permitted at the discretion of the Engineer, but such repairs shall be done only after obtaining the previous permission of

the Engineer. Any pipe or part thereof which develops injurious defects during shop welding or other operations shall be rejected.

## 1.2 PERMISSIBLE STRESS

The permissible stress in the pipe shell shall be related to yield stress ( $f_y$ ) of pipe material making due allowance for weld efficiency of the joint.

- a. working stress for combined bending and direct tensile stress shall not exceed 60% of yield stress of the material making due allowance for efficiency of welded joint (as per IWWA M-1).
- b. Working stress for combined bending and direct compressive stress shall not exceed 50% of yield stress making due allowance for weld efficiency (as per IWWA M-1).
- c. It is also necessary to check the shell thickness for adequate factor of safety against failure by buckling (as per IWWA M-11).

For field welded joint, efficiency factor of 80% is generally adopted, while for shop welding joint 90% efficiency is allowed (as per IS 5822).

## Ñ FABRICATION

The Contractor shall get the fabrication work done in a duly valid licensed factory of his own or that of an approved nominated sub-contractor. This factory meant for fabrication of pipes, specials etc. shall also be involved with testing etc., machining as well as painting. For completing the work under the present contract within the contract period, the factory shall be equipped with adequate number of various equipment and plant such as :

- a. Plate bending machines for rolling of pipe drums
- b. Automatic welding machines (suitable for circumferential welding)
- c. Hydraulic Testing Machines
- d. Travelling gantry or crane of capacity 10 Tones or above.
- e. Mobile cranes for loading/unloading of Coils, pipes etc. 15 tones capacity each
- f. Lathe for machining of the flanges rings, Coils etc.
- g. Equipment for sand blasting and applying paint by spray gun.
- h. Equipment for cold pressing of Coils up to 25 mm thick to the required curvature (specials, plug Coils etc.)
- i. Bending machine of adequate capacity for manufacturing ring girders and other necessary equipments.

The factory shall have adequate area, and shall also have stacking yard for the stacking of Coils, structural, fabricated pipes etc. and the scrap.

The Bidder may establish pipe fabrication factory within the project site for minimizing the transportation of pipes after fabrication to bring the pipes to the trench where pipes are to be laid. Contractor shall furnish with his bid the details of the factory where he intends to get the fabrication done, such as its location within the project site and the

equipment, plant and other facilities available in the factory for the manufacture of M.S. Pipes and special required under this contract. This shall be as per the MOU executed with the pipe MANUFACTURER.

#### **Ñ CUTTING OF COILS OR FROM COIL ROLLED AS PER REQUIRED SIZES**

The Coils shall be indented in such length as to have minimum wastage and so as to make the pipe as far as possible.

Before cutting, all the edges of the Coils shall be cleaned by brushing/grinding on both the sides.

After the Coils are cut, the edges shall be made smooth and even by polishing with an electrical or pneumatic grinder to remove all inequalities. Care shall be taken to see that the cut edges of the plate are perfectly straight. Jigs to be used for this purpose shall depend upon the types of cutting machine used. The Coils cut to the required shape shall be checked for correctness before they are rolled into pipe drums. If any corrections are required, the Contractor shall do the same by re-cutting, if necessary.

#### **Ñ ROLLING OF COILS**

The Coils prepared as mentioned above are cut to the exact size shall be put into a rolling machine to form a pipe of the required diameter as under :

The Contractor shall adjust the rolling machine so as to give a uniform curvature to the pipe throughout its circumference.

The curvature obtained shall be checked by the Contractor's foreman during the process of rolling and if proper curvature is not obtained at any place including the ends, the rolling operation shall be repeated at this stage

Heating of Coils to obtain the desired curvature shall not be permitted.

#### **Ñ WELDING**

All components of a standard shell, either straight or bent etc. shall be welded, wherever possible by use of automatic arc welding machine by Submerged Arc Welding Process with alternating current. Generally hand welding shall not be permitted except specific cases, where it is absolutely necessary. This should be done in consent with client's representative. Hand welding shall also not be permitted except for sealing runs and such other minor works at the discretion of the Engineer-in-charge. The strength of the joint shall be at least equal to that of the parent material.

The Contractor shall use electrodes of GWIL approved make and size, the size depending on the thickness of coil and the type of joint. It shall also be used with standard current and arc voltage required for the machine in use with such modifications as may be found necessary after experimental welding. For this purpose, samples of welded joints shall be prepared and tested in the presence of the Engineer. The values once determined shall be maintained throughout the work and if any modifications are to be made, a written permission of the Engineer shall be obtained. In the case of thin sheets, electric arc welding may not give satisfactory results and gas welding shall be resorted to. Gas welding shall be subject to the same specifications and tests as those for electric welds. Welding should be carried out inside as well as outside.

All the shop and field joints shall be welded, all welding shall conform to the requirements of IS 9595 and IS 4353.

All circumferential joints shall be double welded butt joints. Field joints shall be from outside, with a sealing weld from inside. End preparation for such welding shall conform to IS: 2825.

All circumferential welds involving Coils of unequal thickness shall be so kept that the inside surfaces of Coils match to provide stream lined joints without alteration in the internal diameter. As far as practicable, welding of dissimilar thickness of shells shall be carried out in the shops.

The welding shall be of the best workmanship free from flaws, burns, etc. and the Contractor shall provide for his own electrodes and equipments, ovens to keep the electrodes at the desired temperatures and dry. In order to maintain a good standard in welding, welders shall be tested by the Contractor with prior intimation to the client before they are entrusted with the job. Qualification standard for welding procedures, welders and welding operation shall conform to the requirements of IS: 7307 and IS: 7310 (latest). Periodical tests as regards their efficiency shall also be taken at intervals of about 6 months and those found inefficient shall be removed from the job. Only those who pass the test shall be posted on the job. If an incompetent welder has already welded some pipes, all welding done by him previously shall be fully checked by X-ray in addition to the regular X-ray inspections. The defects if any shall be set right to the satisfaction of the Engineer. All such check tests and rectification of defects shall be entirely at the cost of the Contractor. No pipes or steel sections shall be erected unless the work of the welder concerned has been proved to be satisfactory. Specially selected welders shall do site welds.

A record shall be maintained showing the names of welders and operators who have worked on each individual joint. Hand-welding shall preferably be carried out by a pair of welders (parallel welding putting two welders at a time both will be working in diametrically opposite side of the curvature. Welding shall be divided into 4 quadrants shall be welded simultaneously, so that by observing proper sequence, distortion can be avoided. A joint entrusted to a particular individual or a pair shall be as far as possible, completed by them in all respects, including sealing run. No helper or other unauthorized person shall be permitted to do any welding whatsoever. In case of infringement of above, the persons shall be punished as directed by the Engineer.

The welded joint after welding should not become brittle or sensitive to blows and there should be no loss of toughness due to welding or heat treatment. The material after welding and heat treatment is to be tougher than the base metal and is to retain its original ductility. No allowance will be made for thinning of weld and the weld should in no point be less than the nominal thickness of plate.

Upon receipt of the order and prior to the start of fabrication, the Contractor shall submit to the Engineer for his approval the "welding procedure" he intends to use in the shop work. Similarly, prior to the start of the field welding, procedure for the field welding must be submitted to the Engineer for his approval. Manual welding shall be adopted only when machine welding is not possible.

## **¶ ULTRASONIC & RADIOGRAPHIC TEST OF WELDED JOINTS**

### **1.1 MANUFACTURED IN SITE FACTORY/WORKSHOP**

For the mild steel pipes manufactured in site factory/workshop, fabricated from mild steel Coils, 100 % of weld length of each pipe shall be subjected to Ultrasonic Test either on-line or off-line. (As per API 5L)

For the mild steel pipes manufactured in site Factory/Workshop fabricated from mild steel coils, 15% of weld length of each pipe shall be subjected to Radiography Test by Digital Image/ X-Ray Film Method. (As per API 1104 or IS:10234)

## Ñ **FIELD WELDED JOINTS**

For Field welded joints, 100% of each welded joint shall be examined by Ultrasonic Test either online or offline and 15% weld length of each welded joint shall be examined by Radiography Test.

In case of failure of any of the joint during RT, the contractor is to carry out radiography of thrice the number of field joints which includes 1 Repair and 2 Penalty shots.

Subsequent to RT of thrice the number of field joints, if anyone of the joint fails the Contractor has to carry out RT of all field welded joints i.e. 100 % basis. All these testing's shall be carried out by the contractor at his own risk and cost.

The weld ripples or weld surface irregularities, on both inside and outside shall be removed by any suitable mechanical process to a degree such that resulting radiographic contact due to any remaining irregularities cannot mark or be confused with that of objectionable defect. The radiograph shall be made in strict accordance with the latest requirements and as per the latest and most efficient technique either with X-ray or gamma ray equipment.

The photographs are to be marked in such a way that the corresponding portion of the welded seam can be readily identified. All radiographs will be reviewed by the Engineer to identify the defect and determine those which must be removed. Defects that are not acceptable shall be removed by chipping, machining or flame gouging to sound metal and the resulting cavities shall be welded. After rectification, the joint is to be radiographed again to prove the quality of the repair. The Engineer based on the latest standards prescribed by Indian Standard specification will judge the radiographs as acceptable or unacceptable.

All X-ray shall be made with equipment and by personnel furnished by the Contractor. Films shall be developed within 24 hours of exposure and be readily accessible at all times for inspection by the Engineer. The Contractor shall provide for the use of the Engineer suitable X-ray viewing equipment. X-ray films shall be properly maintained by the Contractor and shall be handed over to the department on completion of the Contract. All films shall be identified by the No. and chart prepared indicating location of the joint each X-ray photo represents. In the event of additional radiographic inspections required of any work associated with the pipe erection, the Radiographer at the discretion of the Engineer shall perform such inspection.

## Ñ **RADIOGRAPHIC INSPECTION**

### 1..1 GENERAL

The Engineer shall assure himself that the welding procedure employed in the construction of pipes has been qualified. The Contractor shall submit evidence to the Engineer that the requirements have been met. The Contractor shall certify that the welding of pipes has been done only by qualified welders and welding operators and the Engineer shall ensure himself that only qualified welders and welding operators have been used.

The Contractor shall make available to the Engineer a certified copy of the records of the qualification tests of each welder and welding operator. The Engineer shall have the right at any time to call for and witness tests of welding procedure or of the ability of any welder and welding operator.

Radiographic Inspection of welded joints

All welded joints to be radiographed shall be examined in accordance with codes as specified below:

Sr. No.	Code Number	Description
1	IS : 2595	Code of Practice for Radiographic Testing
2	IS : 4853	Recommended Practice for Radiographic Inspection of Fusion Welded Butt joints in Steel Pipes.
3	IS :1182	Recommended Practice for Radiographic Examination of Fusion Welded Butt-Joints in steel Coils.

The reinforcement on each side of all butt welded joints shall not exceed 1.5 mm. A complete set of radiographs and records as described in IS: 2595 for each job shall be retained by the Contractor and kept on file for a period of at least five years.

Radiographers performing radiograph shall be qualified in accordance with SNT-TC-1A. Supplements and Appendices "Recommended Practice for Non-destructive Testing Personnel Qualification and Certification" published by the American Society for Non-destructive Testing as applicable for the technique and methods used.

Final acceptance of radiographs shall be based on the ability to see the prescribed pentameter image and the specified hole.

The acceptance criteria for radiography of the joint shall be as per IS-10234 or as per API -1104 standard.

∞ **THERMAL STRESS RELIEVING**

Not applicable

∞ **TOLERANCE**

The shell in the completed work shall be substantially round. The difference between maximum and minimum inside diameters at any cross section shall not exceed 1% of the nominal diameter of the cross section under consideration subject to a maximum of 10 mm.

Machined parts shall be within the limits specified by IS 3589.

Straight pipes shall have their faces perpendicular to the axis of the section with a maximum deviation of 2 mm on either side of the plane. Pipe ends shall be bevelled as per IS: 3589. The pipes shall be supplied in length of 10.5 m to 12.5 m.

For the shell thickness, no negative tolerances are acceptable.

#### Ñ **SHOP TESTING**

After fabrication, but before application of protective coatings all pipes and specials shall be subjected to a shop hydraulic test (100%). Standard lengths of pipes shall be directly subjected to test and non-standard pipe and elbows can be tested as standard pipe before being cut to size.

#### Ñ **FIELD HYDRAULIC TESTING**

The Pipeline after lying at site shall be subjected to 100% Hydro testing. The test pressure shall be 1.5 times working pressure or 6 kg/cm<sup>2</sup> whichever is higher. The pressure shall be maintained for a period of 24 hours. The length of pipe for hydro testing shall be generally 5 km as directed by Engineer-In-Charge.

Each pipe shall be filled with water and the pressure slowly and uniformly increased until the required test pressure is reached.

The pipe to be tested shall be given a serial no. which shall be painted on its inside together with details such as pipe No. Shell thickness, diameter, length etc. as directed. It shall be entered in the register to be maintained by the Contractor.

Prior to testing, the pipe shall be inspected thoroughly and all the apparent defects in welding such as jumps, porosity etc. shall be repaired by gouge and re-welding.

The hydraulic test shall be carried out under cover at the fabrication shop, in the presence of and to the satisfaction of the Engineer or the inspection agency appointed by the Employer.

For indicating the pressure inside the pipe an accurate pressure gauge of approved make duly tested and calibrated for the accuracy of readings shall be mounted on one of the closures which close the pipe ends.

The pressures shall be applied gradually by approved means and shall be maintained for a period of 24 hours. The pipe shall be hammered throughout its length with sharp blows, by means of a 1 kg. hand hammer.

The pipe shall withstand the test without showing any sign of weakness, leakage, oozing or sweating. If any leak or sweating is observed in the welded joints, the same shall be repaired by gouging and re-welding after dewatering the pipe. The repaired pipe shall be re-tested to conform to the specified pressure.

If any leak or sweating is observed in pipe shell the pipe under test shall be rejected temporarily. The Contractor shall stack such rejected pipes separately in his yard. The Engineer shall inspect the same and after taking cuts if necessary, shall determine the nature of repairs to be carried out thereon and shall then decide as to how and where they shall be used. No payment shall be made for handling or carrying out repairs, but, payment for the fabrication and hydraulic testing of the pipe shall be released only after acceptance of the pipe with necessary repairs and subsequent testing etc. are carried out by the Contractor to the satisfaction of the Engineer. The Engineer shall be supplied with two copies of the results of all the tests carried out.

The Mechanical Tests for Pipe material at Manufacturers work shall be carried as per approved Quality Assurance Plan( QAP) and tests shall be as per IS:1239/IS:3589/IS:5504.

### 1.1 Testing Of Site Welded Joints

The welded joints at site shall be tested for Tensile test, Bend test & Tre-panned plug in accordance with procedure laid down in as per the latest edition of IS No. 3600 “code of procedure for testing of fusion welded joints and weld metals in steel”.

Test pieces shall be taken by the contractors from the welded joints at the position on fabricated pipes pointed out by the Engineer in-charge.

The sample so taken shall then be cut to the exact shape and dimensions and machined as described below and handed over to the Engineer-in-charge for testing. All the work up to and including machining and arranging for test shall be done by the contractors.

### ¶ **SUBMISSION OF DAILY PROGRESS REPORT**

The Contractor shall submit to the Engineer a daily progress report in the proforma approved by the Engineer, wherein all the details of the work carried out in the factory shall be fully recorded. Similarly, works done in the various units in the factory shall be separately mentioned. The Contractor shall maintain a register of all the finished materials giving dates of carrying out important operations such as testing, transport, etc. The register shall be presented at least once a week to the Engineer who shall initial the entries after verification.

### ¶ **TRANSPORTING OF PIPES, SPECIALS etc.**

All pipes and specials fabricated in the site factory / workshop and temporarily stacked in the Contractor's yard shall be transported to the site of laying after cleaning them internally, etc. The loading in the factory shall be carried out by means of either a crane, gantry or shear legs, so as not to cause any damage to the finished material. Similarly, while unloading and stacking, great care shall be taken to ensure that the material is not damaged or dented. The contrivances to be used for unloading will be different in different situations and in each case the one approved by the Engineer shall be adopted. The material stacked at site shall be jointly inspected by the Engineer and the Contractor and defect or damage noticed shall be repaired to the satisfaction of the Engineer before payment is admitted.

Props of approved designs for maintaining circularity having M.S. Angle/Pipe at both ends to avoid metal to metal contact shall be fixed to the pipes during transit to avoid undue sagging and consequent distortion. After the pipes are carefully stacked, props should be retained till pipes are joined in trenches and then props are re-used for subsequent similar operations. The stacking ground, both in the Contractor's yard and at the site of laying shall be selected in such a way as not to get waterlogged during monsoon. If this cannot be done, the pipes shall be supported on sleepers to avoid contact with wet earth and subsequent rusting. In order to prevent sagging during transit, savings of steel Coils can be utilized by cutting to the required length and tacking the same to the pipe ends, in place of props, if approved by the Engineer.

As explained in earlier paragraphs, materials such as pipes, tapers, etc. may be transported to the site of laying as soon as the material is finished in all respects with the permission of the Engineer to avoid congestion in the Contractor's yard. However, materials such as expansion joints, composite bends, `T' branches and other complicated materials shall be stacked in the Contractor's yard until they are required for laying in



the field. In view of this, the work of fabrication of such materials shall be properly synchronized as far as possible with the laying operations.

Fabricated materials such as specials, appurtenances, bolts, nuts, distance pipes, flanges, saddles, collars bypass arrangements etc. shall be transported to the site of laying from the fabrication shop according to the needs of the laying operations only. In regards access roads, the Contractor shall note that access road may lead up to some points on the alignment the Contractor shall have to make his own arrangement for connecting approaches to transport the pipes cross country to the actual site of laying at his own cost. Whatever may be the mode of transport he uses it shall be incumbent on the Contractor to carry and stack the pipes and specials along the alignment as close as possible to the site of laying.

## Ñ **PROCEDURE FOR RECEIVING STEEL PIPES**

### 1..1 General

To ensure that the work of erecting pipes is not held up at any stage and place, the Contractor shall maintain an adequate stock of standard specials, flange rings, plug Coils, manhole covers, etc. and short length of smaller diameter pipelines, etc. at site in his field stores, in consultation with the Engineer. Wherever possible, the Contractor shall arrange one full month's requirement of pipes, specials, etc. stacked along the alignment.

### 1..2 Stacking of Pipes, etc. and Inspection

The Contractor shall keep in each section a responsible representative to take delivery of the pipes, specials and appurtenances, etc. transported from the fabricating stockyard or received from any other work site to the site of laying and to stack along the route on timber skids. Padding shall be provided between coated pipes and timber skids to avoid damage to the coating. Suitable gaps in the pipes stacked shall be left at intervals to permit access from one side to the other. The pipes, specials, appurtenances so received on site shall be jointly inspected and defects recorded, if any, such as protrusions, grooves, dents, notches, damage to the internal coating etc. shall be pointed out immediately to the Engineer at the site and in the acknowledgement challans. Such defects shall be rectified or repaired to the satisfaction of the Engineer entirely at the Contractor's risk and cost.

### 1..3 Handling of Pipes, Special Appurtenances etc.

It is essential to avoid damage to the pipes, fittings and specials, etc. or their coatings at all stages during handling. The pipes and specials shall be handled in such a manner as not to distort their circularity or cause any damage to their surface treatment. Pipes shall not be thrown down from the trucks nor shall they be dragged or rolled along hard surfaces. Slings of canvas or equally non-abrasive materials of suitable width of special attachment shaped to fit the pipe ends shall be used to lift and lower coated pipes to prevent damage to the coating.

Great care shall be taken in handling the pipe right from the first operation of manufacture until they are laid and jointed. The Contractor will provide temporary props as described earlier in order to prevent any sagging of the pipes while they are

stacked in their yard and while transporting to the site of delivery, i.e. laying. The props shall be retained until the pipes are laid and welded. If at any time these props are found to be dislodged or disturbed, the Contractor shall immediately reinstate them in such a way that the true shape of the pipe shell or specials is maintained to the satisfaction of the Engineer. No defective or damaged pipe or special shall be allowed to be used in the work without rectification to the satisfaction of the Engineer. Any damage to the coating shall be repaired by the Contractor at his own cost to the satisfaction of the Engineer.

#### 1.4 Dents

Whenever any dent, i.e. a significant alteration of the curvature of the pipe shell is noticed, the depth of the dent shall be measured between the lowest point of the dent and the pipe shell curvature line. All dents exceeding 2 percent of the outer diameter of the pipe shall be removed by cutting out a cylindrical portion of the pipe and replacing the same by an undamaged piece of the pipe. The Engineer may permit insert patching if the diameter of the patch is less than 25 percent of the nominal diameter of the pipe. Repairs by hammering with or without heating shall not be permitted. Any damage to the coating shall also be carefully examined and rectified.

#### 1.5 Marking

The component parts of the pipes shall be carefully marked for identification in the field. The marking shall be on the side which will be the inside of the pipe after bending.

The marking operation shall be conducted with full size rulers. Only blunt nose punches should be used.

The Coils used for fabrication of pipes shall be laid out in such a way that when the shells are completed one set of original identification markings for the material will be plainly visible. In case these markings are unavoidably cut out, they shall be accurately transferred by the Contractor to a location where these markings will be visible on the completed work.

After the hydraulic tests on the specials and other items, the number of the shell in the line as it will be erected and the direction of flow shall be stamped in a prominent manner on each piece.

A register shall be maintained in suitable Performa giving the following information for each shell tested:

Serial No.

Shell No.

Date of test

Thickness and specification of steel

Weight of shell tested

Maximum test pressure

Details of test performance

Details of radiographic examination of welds

Name of Engineer's representative witnessing tests

A copy of these details shall be furnished to the owner free of cost.

No separate payment will be made for these markings and the rates for the items concerned shall be deemed to include the cost of such markings.

## Ñ LAYING OF PIPELINE

### 1..1 General

Unless specified otherwise, the pipeline shall be buried with minimum cover at top, as shown on drawings. No material shall be erected unless it has been previously passed by the Engineer.

Pipe shall be protected from outside with rock shield mesh/soft murrum/Sand wherever required/as directed by Engineer-In-Charge. In such cases, the depth of soft murrum/sand shall be 300mm above top of pipe. The mesh shall be manufactured from HDPE material with weight per metre not less than 750 grams. The size of mesh shall be as per requirement of Engineer-in-Charge. The mesh shall be of such strength to protect the external coating from impact of rock during back filling. The height of falling of rock shall range from 3 to 5 m over top of pipe. The mesh shall be spirally wrapped over pipe with suitable overlap and properly tied with non metallic ties. The mesh shall be spirally wrapped over pipe with suitable over lap. After field joints and at all specials also shall be wrapped by rock shield protection mesh

Erection of fabricated shells shall be carried out by the Contractor who shall equip himself, at his cost, with all necessary tools, machinery, labour, etc. required for the purpose.

### 1..2 Welding

Except for routine welding of joints, no other work shall be done in the absence of Contractor's engineer, either during the day time or at night. Chipping shall not be kept in arrears for more than 15 joints.

### 1..3 Temperature

The components of the pipeline such as base Coils, top Coils and pedestals have been so designed that the centres of the Coils and pedestals shall coincide at the Mean Temperature (30°).

For this reason, all works such as fixing flanges, base plate etc. in true alignment and in correct position and tack welding pipes shall be done at the mean temperature.

For ascertaining the temperature, the Contractor shall provide mercury cups and fix them to the pipe shell from outside and shall also provide thermometers of the required type and range. No extra payment shall be made for this.

### 1..4 Saddle supports

Unless otherwise specified pipeline shall be underground. However at unavoidable reaches it shall be on R.C.C. saddles spaced at about 6 m centre to centre. The material and construction of R.C.C./Steel structures such as saddles, anchor blocks, crossings etc. associated with the work of pipe line shall conform with the relevant IS codes, good engineering practice and as directed by the Engineer. The pipes to be

laid on saddle supports shall be erected at mean temperature. Saddle supports shall either be sliding type or fixed type. For both the types of supports a 10mm thick double plate shall be welded to the part circumference of the pipeline that will make contact with the saddle and another similar plate shall also be embedded in the concrete saddle with necessary arrangement to facilitate welding it to the double plate welded to the pipe, in case of fixed support. In case of sliding support, the pipe shall be allowed to slide freely over the plate embedded in the saddle. Alternatively to achieve fixity, the pipe shall be anchored by providing suitable anchor block. The rate for laying the pipe on saddle support shall include for laying, aligning, tack welding, provision of rigging screws with screw eyes etc., complete.

In addition to above, the pipe shall be held in position on saddles with two numbers 50mm x 8mm thick holding down traps fixed to the saddles with holding down bolts and nuts.

### 1..5 Erection of Shells

The erection shall be true to position, lines and grade of the trench prepared or as modified by the Engineer. The Contractor shall provide at his cost necessary saddles, pads, spider etc., all necessary instruments and other materials and labour required for proper erection of shells in position and for the Engineer in checking the correctness of the erection.

Alignment of sections at edges to be butt welded shall be such that the maximum offset is not greater than the values given below:

Thickness 't' (mm)	Offset in Longitudinal joints (mm)	Offset in Girth joints (mm)
Up to 12	0.25 t	0.25 t
12 to 20	3 mm	0.25 t
20 to 40	3 mm	5 mm
40 to 50	3 mm	1/8 t
Over 50	<b>Lesser of 0.0625 t or 10 mm</b>	Lesser of 0.125 t or 20 mm

The best of welders as selected from their work in the Contractor's workshop shall be selected for in-situ welding of the shells. The relevant provision under welding such as qualification standard for welding procedures, tests on welder's work and removal of defects etc., shall also apply to in-situ welding.

### Ñ General Sequence of Operations

Before commencing the work of pipe laying, the Contractor shall study the L-section of the pipeline for the section concerned. He shall also study the details of laying i.e. underground or aboveground. The underground pipeline shall be laid on sand cushioning/ bedding as shown on the drawing. The difference in depth due to uneven excavations shall be made up by sand cushioning.

Pipe laying shall generally start from the fixity points on either side, the expansion joints if required for pipeline aboveground being provided last. Fixing points are at all

anchor blocks. Where such blocks are not required for long lengths, fixity shall be achieved by fixing the pipeline to the special type of R.C.C. or steel saddles as specified. The distance between successive fixity points shall not exceed 300 m.

Thrust and Anchor blocks shall be constructed before commencing the pipe laying work in any section. The construction of the blocks shall be carried out in 3 stages: in the first stage the lower part up to 150 mm below the invert of the pipeline including concrete chairs to support it shall be constructed; in the second stage the pipeline on this part of the block shall be laid; and lastly, the remaining block around and over the pipeline shall be constructed.

The fixity saddles and ordinary saddles if the pipeline is aboveground shall be cast at least 3 weeks before the pipeline is laid on them. After all saddles between successive fixity points have been cast, a line plan showing the actual position thereof shall be prepared, after taking levels and measuring distances. In case of any errors in casting the pedestals, corrections shall be applied. The pipe laying work shall then start from the fixity points and shall proceed towards the expansion joints. The method of jointing the pipes and erecting them on previously cast R.C.C. saddles shall be determined by the Contractor depending upon the type of plant equipment and personnel available with them.

The pipe strakes shall be assembled in position on the saddles either by the cranes, portable gantries, shear legs or any other equipment approved by the Engineer. Normally, not more than two pipes shall be aligned, tacked and kept in position on temporary supports. The Contractor shall not proceed with further work, until the circumferential joints of these pipes are fully welded. During assembly, the pipeline shall be supported on wooden sleepers and wedges, with the free end of the pipeline held in position by slings to avoid deflection due to temperature variations during the day. In general, the assembly of pipe strakes and one run of welding shall be done during the day time while full welding including the external gouging and sealing runs shall be done after 5 p.m. or so. The Contractor shall maintain the continuity of the work by adding two more pipes on the second day in a similar manner, after full welding of the previous joints is completed during the night. While this new work is being done, the Contractor shall proceed with the work of providing permanent supports for the pipeline assembled and welded previously.

#### ¶ **Fixing Expansion Joint**

The work of laying pipeline at above the ground, laying starts from the fixed points and proceeds towards the expansion joints. It shall be continued until the gap between the pipe ends is less than the lengths of the expansion joint plus pipe strake length. At this stage, the exact gap between the pipe ends shall be measured at mean temperature of that locality. Let it be 'X'. Similarly, the exact length of the pipe strake and the expansion joint bought at site shall be measured at the same temperature let these be 'Y' and 'Z' respectively. Normally, the length of the expansion joint ('Z') is standard.

1..1 Case when `Y' plus `Z' is more than `X' or equal to `X' (i.e. fixing of expansion joint without strip)

At mean temperature the exact gap between pipes shall be measured. Free ends of pipes shall be brought in a correct line and level; lateral movement, if any, shall be corrected. Then the gap between the free ends shall be made equal to the exact length of the expansion joint by cutting one of the pipe ends. Choice of the end to be cut must be made from the point of view of bringing the expansion joint to a central position.

The expansion joints are normally supplied without packing. The normal length of the expansion joint shall be reduced by about 100 mm by cutting the inside locks and inserting the inner strake by means of turn buckles. At mean temperature this expansion joint shall be inserted inside the gap (care being taken to keep the tapered portion on the down-stream side), and both ends shall be tack welded to the pipe ends, after pulling the expansion joint. (Tacks of these two joints shall be of longer length, approximately 100 mm long).

Welding of these two joints of the expansion joints shall be started only after it is ascertained by taking observations that the expansion joint is functioning properly. The procedure to be followed for taking observations as specified.

1..2 Case when `Y' plus `Z' is less than `X' (i.e. fixing of expansion joints with strap)

The expansion joint shall be laid in locked position. Before laying the pipes adjacent to the expansion joint, the exact gap between the pipes shall be calculated by taking measurements of the first pipe (upstream of the expansion joint), and the second pipe (downstream of the expansion joint) at Mean Temperature.

If the gap is less than 100 mm, the second pipe shall be cut to make the desired gap of at least 100 mm. If the gap is more than 200 mm, suitable distance piece of not less than 600 mm shall be inserted after cutting necessary length of the first pipe.

The second pipe shall then be laid in position. Then a strap of length equal to three times the gap length shall be welded to the pipe, overlapping the second pipe by the gap length. The other end of the strip shall be kept free.

At mean temperature the other end of the strap shall be tacked to the first pipe, after checking of the line and level. Simultaneously, all the locks of the expansion joint shall be removed and chipped off properly.

Welding of the joints between the strap and the first pipe shall be started only after observations are over and it is ascertained that the expansion joint is functioning properly.

1..3 Observations

Before fixing the expansion joint, two mercury cups - one on the left and the other on the right side - shall be fixed on the pipe near the upstream side of the expansion joint. Immediately after the expansion joint in case (a) above or the strap in case (b) above is tack welded, observations for total expansion or contraction shall be started and continued for 48 hours round the clock. Similarly, the central and end fixity pedestals shall be kept constantly under observation.

The expansion and contraction shall be measured by making a temporary marking on the inner strake (on the upstream side) and measuring the distance between this mark and the edge of the gland of the expansion joint.

The observations shall be recorded in the following Performa;

Reading No.	Time	Shell temp on upstream side	Shell temp on downstream side	Atmospheric temperature	Dist between edge of gland and marking
1	2	3	4	5	6

In case the pipeline is laid in trenches as shown on the drawing, after welding and field testing, the trench shall be filled with selected material up to 300 mm above pipes. This backfill shall be provided in layers not more than 150 mm, with a density more than 70 to 80% of the standard proctor density. Samples shall be tested as directed by the Engineer. Remaining depth of trenches shall be filled with ground backfill material.

## Ñ **Specials**

### 1..1 General

Specials, such as tees, Y-pieces, bends (single or composite), tapers, etc. shall necessarily be in steel and shall be manufactured as per standards and tested and laid in the same manner as the pipes. Small branches, single piece bends, etc. may be fabricated at site, care being taken to ensure that the fabricated fittings have at least the same strength as the pipeline to which they are to be jointed.

### 1..2 Bends

- a. Bends shall be fabricated taking into account the vertical and horizontal angles for each case.
- b. The bends shall have welded joints and the upstream and downstream ends of each bend shall have a straight piece of variable lengths as required.
- c. Bends shall be designed with deflection angle of maximum 10 deg. between segments.
- d. When the point of intersection of a horizontal angle coincides with that of a vertical angle, or when these points can be made to coincide, a single combined or compound bend shall be used, designed to accommodate both the angles. The combined bend should have a pipe angle equal to the developed angle, arrived at from appropriate formula.
- e. All joints in bends shall be thermally stress relieved as specified.
- f. Details of thrust collars anchor bolts, holding down straps, saddle Coils should be furnished together with full specifications in Contractor's fabrication drawing.

### 1..3 Manholes

Manholes of 750-mm dia. shall be provided at both the sides of butterfly valves and as directed by Engineer-In-Charge. Manholes in the pipeline shall be placed in suitable position in the top quadrant.

- a. The Contractor shall fabricate different parts of manhole in conformity with relevant IS Specification, well-established practices and as directed by the Engineer.

### 1..4 Closing or Make up sections

Closing or make up sections shall be furnished at appropriate locations on the line to permit field adjustments in pipeline length to compensate for shrinkage in field welded joints, differences between actual and theoretical lengths and discrepancies in measurements.

### 1..5 Heads

Test heads may be ellipsoidal, standard dished as per ASME code or hemispherical heads. They shall be welded in the shop and removed after the test. Allowance should be made in the length of the pipe section receiving the test head for the welding and removal of the head and preparation of the plate edges for the final weld after testing.

No separate payment will be made for such test heads. The rate quoted for the hydraulic test shall be deemed to cover the cost of such installations.

### 1..6 Walkways, Stairs, Ladders, Hand Rails etc.

Walkways, stairs, rungs, ladders, hand rails, etc. shall be provided as shown in the drawings and/or as directed by the Engineer. They shall conform to well established design and construction for each accessory concerned.

### 1..7 Flanges

Flanges shall be provided at the end of pipes or special where sluice valves, blank flanges, tapers, etc. have to be introduced. The flanges received from the MANUFACTURERS will have necessary bolt holes drilled. The Contractor shall assemble the flanges in the exact position by marginal cutting, if necessary, so as to get the desired position of the sluice valves, etc. either vertical or horizontal and shall then fully weld the flanges from both sides in such a way that no part of the welding protrudes beyond the face of the flanges. In case the welding protrudes beyond the flanges and if the Engineer orders that such protrusions shall be removed, the Contractor shall file or chip them off. If required and when ordered by the Engineer, the Contractor shall provide and weld gusset stiffeners, as directed on site. The drilling pattern shall be matching with the drilling pattern of flanges of valves.



### 1..8 Blank Flanges

Blank flanges shall be provided at all ends left unattended for the temporary closure of work and also for commissioning a section of the pipeline or for testing the pipeline laid. For temporary closures, non-pressure blank flanges consisting of mild steel Coils, tack welded at the pipe ends may be used. For pipes subjected to pressures, the blank flanges or domes suitably designed as per Engineer's requirements shall be provided.

### 1.9 Stiffener Rings

The Contractor shall provide stiffener rings wherever required by design. The Contractor shall weld the same to the pipes with one circumferential run on each side.

All fillet welds shall have a throat thickness of not less than 0.7 times the width of welding.

### Ñ **Field Hydraulic Test**

After erection at site and after the concrete Thrust/anchor blocks have been constructed, the pipeline shall be subjected to a 100% hydraulic test. The pressure test shall be conducted in as per IS-5822.

During the test, the pipe shall be struck sharp blows with 1 Kg hammer. Water shall not spout, ooze or sweat either through joints-welded or bolted or the body of the pipe. If any leakage noticed shall be repaired by the Contractor, which shall include coating and repairing of the damaged portion. Repairs and replacements and further testing including the cost of the Coils and other raw materials shall be carried out by the Contractor at his own cost. If any leakages are observed during the defects liability period due to defective workmanship or material supplied by the Contractor, he shall repair the same to the entire satisfaction of the Employer, at his own cost.

GWSSB shall assist the contractor in identifying the source & in obtaining permission for drawl of water for field-testing of pipe. The contractor shall pay for the water and carry the water to the test location at his cost. The cost of hydraulic testing of the installation by providing necessary testing equipment, pumping the water, creating and maintaining pressure, and the necessary bulk heads and their fixtures, and their subsequent removal and restoring the installation to working trim shall be included in the rate for laying and testing of the pipe. GWSSB may also provide water for testing and civil construction work from its adjacent pipeline at a rate of Rs. 4/- per Kiloliter, if feasible. Contractor shall seek prior permission of deptt in writing and shall water meter at his own expense.

### Ñ **Progress in Laying**

The TENDERER shall submit along with the tender his detailed bar chart for manufacturing and laying of the pipeline. While preparing his bar chart, the Tenderer shall plan his activities such that the laying of pipes shall closely follow the manufacturing schedule and no pipes shall remain stacked in factory or at site for a period more than two months.

It is mandatory that he shall submit an approach note on how he will carry out this Work within the contractual period and on the compatible resources in terms of construction equipment and other facilities that he shall utilize to complete the tendered Work.

#### **Ñ Field Destruction Test**

Contractor shall perform destruction test of any section of MS Pipeline which Engineer selects at every 5 KM pipeline laid and shall submit its result to him. The testing shall be done in the NABL approved laboratory in the presence of representative of the employer.

### **INTERNAL COATING: SOLVENT FREE FOOD GRADE EPOXY LININGS**

#### **GENERAL**

All steel pipes and fittings outside the pumping station shall be internally lined with a spray applied solvent free epoxy approved for contact with potable water under the United Kingdom Water Regulations Advisory Scheme authorized for use under Regulation 31 (4)(a) of the water supply (Water Quality) Regulations 2000 for contact with potable water. The applicable specifications for the coating system shall be in accordance with BS 6920/NACE RP-01-75/AWWA C210-97 or clients specifications.

#### **MATERIALS & WORKMANSHIP**

The coating system shall be factory lined and the lining shall be suitable for application in an environment with black bulb temperature up to 85 deg C. Coating materials shall be of GWSSB approved make only (If any).

All steel pipes shall be lined at the factory. Pipes welded on site shall be lined on site to the same standards as for pipes.

Detailed proposals of the lining method, materials and apparatus to be used for both factory and site application shall be submitted to and approved by the Engineer before work starts. Storage and application shall be accordance with recommendations of the coating MANUFACTURER, but as a minimum:

- a. A visual examination of the surface to be coated shall be carried out and any slivers or similar deposits removed.
- b. Prior to blasting all oil and grease shall be removed from the surface to be coated.
- c. Preparation of steel surfaces for both factory and site application shall be to a minimum of Sa 2.5 accordance with BS 7079/ ISO 8501-1:2007 specifications /or as per client specifications and roughness should be 50-75 micron.
- d. The surface to be coated shall be dry, clean and free from foreign material and coating shall take place before any surface rusting and at least within 4 hours of blasting.

- e. Surface preparation and coating shall not be carried out when the relative humidity exceeds 85% or when the surface to be coated is less than 3 deg C above the dew point.
- f. The coating shall have a minimum DFT (Dry Film Thickness) of 406 microns.
- g. Coatings shall be used within the pot life specified by the MANUFACTURER.

Pipe linings shall be inspected on site, and damaged, defective or otherwise unsatisfactory linings may be condemned. All defective areas shall be made good to the satisfaction of the Engineer. Inspection and testing shall be detailed in the contractors Quality Plan and as a minimum undertaken to the following frequencies:

- a. Visual Inspection of blasted profile on every pipe to be coated.
- b. Visual inspection of finished coating on every pipe.
- c. Measurement of coating thickness at four points on each pipe
- d. Each completed pipe shall be subjected to holiday detection tests which shall be carried out to the satisfaction of the Engineer. The applied voltage shall be those appropriate to the coating under test as recommended by the coating material MANUFACTURER.
- e. Peel Test as per Manufacturers standard specification shall also carried out.

## **PRESERVATION, MARKING AND SHIPPING PRESERVATION**

### **1..1 Preservation**

Cutback of minimum 50 mm +/- 10mm shall be provided over both ends of pipes on internal coating. The bare ends of each pipe shall be painted outside with a removable vanish as temporary corrosion protection during transportation. Spiders and/or Bevel protectors of a type to be approved by the Engineer shall protect the bare ends of each pipe. Spiders shall be welded with pipes in such a way that inside coating do not get burnt.

### **1..2 Marking**

In addition to the marking required by API 5L, the specification MO1 "Steel Pipes for Mainlines and other applicable project specifications, the Pipe Coating Contractor's unique coating number shall be marked to the internal surface or the pipe with synthetic resin paint.

Further marking details like colour coding, etc. shall be agreed upon with the Engineer.

The marking shall have at least a distance or 150 mm to the pipe end.

### **1..3 Shipping**

Shipping and Loading preparation shall be in accordance with API Specification 5L or otherwise stated in the contract documents.

The Pipe Coating Contractor shall submit detailed loading, stacking- and shipping procedures for approval by the Engineer.

## **DOCUMENTATION**

### 1..4 Pre-Production Documentation

The Pipe Coating Contractor shall submit the following documents to the Engineer for approval prior to commencing production:

- a. The MMANUFACTURER's trade name and data sheets for all proposed coating materials. This includes cleaning and abrasive blasting consumables.
- c. Procedure for identifying or maintaining the identification of each coated item.
- d. Handling procedure.
- e. Stacking procedure.
- f. Materials control and traceability procedure for the batches of coating materials.
- g. Materials storage procedure (pipe and coating materials)
- h. Procedure for steel surface preparation including materials, cleaning, inspection, verification of cleanliness and surface profile.
- i. Coating application procedures, including Fusion Bonded Epoxy (FBE). Adhesive and polyethylene layers.
- j. The results of the batch tests for batches to be used for pre-qualification tests.
- k. Details of testing methods including instrument types and copies or current calibration certificates.
- l. Details of inspection methods for bare and coated pipe.
- m. Full test results from the coating Procedure Qualification Test (PQT).
- n. Repair procedure and results or tests on demonstration of repairs.
- o. Project specific Quality Plan.

Work shall not commence until these procedures have been reviewed and approved by the Engineer.

The selection of proposed coating materials shall be subject to Engineer's approval.

### 1..5 Production Records

A daily log containing the following data shall be maintained and be available for inspection by the Engineer during and/or after production. Data shall be recorded against the pipe unique identification number.

- a. Bare pipe inspection data
- b. Ambient temperature (every 4 hours)
- c. Humidity (every 4 hours)
- d. Coating progress (no. of items coated. including item serial numbers)

- e. Blast pipe surface amplitude
- f. Tests for cleanliness of blast surface
- g. Tests for cleanliness or blast medium
- h. Film thickness measurements
- i. Average, maximum and minimum coating thickness during each shift
- j. Details of any coating defects recorded and defect density on respective pipe lengths
- k. Details of any coating repairs
- l. The unique identification number of all items that are stripped for recoating
- m. Pipe coating test results

This log shall be available to the Engineer throughout all coating operations

#### 1..6 Release Documentation

The Pipe Supplier and/or Pipe Coating Contractor shall submit to the Engineer the following documentation in hard copy and softcopy (format to be agreed upon with the Engineer) with each batch of pipes released:

- a. Mill certificates for line pipe
- b. Production listing for each batch
- c. Unique pipe identification numbers
- d. Unique coating identification number (if different)
- e. Pipe length
- f. Length of the coated portion of each pipe and total coated lengths of all pipes.
- g. Reductions in lengths due to use in tests, damage or repairs, recorded against pipe unique identification number
- h. Date of coating
- i. Batch numbers of coating materials used

**This shall be followed within two weeks by the following:**

- a. Manufacturer's certificates for each batch of coating materials
- b. Certification/calibration certificates for all testing and coating equipment
- c. Inspection and test records, results, and other documentation of all materials and coating tests

All reports shall be signed by the Pipe Coating Contractor to signify compliance with the requirements of this specification.

## EXTERNAL COATING: 3-LAYER POLYETHYLENE (3LPE)

### SCOPE

This Specification defines the minimum requirements for the application of three-layer polyethylene coating to the external surface of steel pipes and internal surface of steel pipes with solvent free liquid epoxy lining for water transmission pipe line.

For the factory applied coating the system shall comprise of a layer of fusion bonded epoxy (FBE), overlaid with adhesive with an outer layer for high density polyethylene (HDPE) and internally lined with a air less spray applied solvent free epoxy.

### CODES AND STANDARDS

This latest edition of the following codes and standards shall establish the minimum standards for the work

Sr. No.	Code	Description
1	ANSI/AWWA C213	Standard for Fusion-bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
2	ASTM D149	Standard test method for dielectric breakdown voltage and dielectric strength of solid electrical insulating materials at commercial power frequencies.
3	ASTM D257	Test methods for dc resistance or conductance of insulating materials.
4	ASTM D570	Standard test method for water absorption of plastics
5	ASTM D638	Standard test method for tensile properties of plastics
6	ASTM D746	Standard test method for brittleness temperature of plastics and elastomers by impact.
7	ASTM D790	Standard test method for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.
8	ASTM D1238	Standard test method for melt flow rates of thermoplastics by extrusion plastometer.
9	ASTM D1505	Standard test method for Density of plastics by the Density-Gradient Technique.
10	ASTM D1525	Standard test method for Vicat softening temperature of plastics.
11	ASTM D1531	Standard test methods for relative permittivity (dielectric constant) and dissipation factor by fluid displacement procedures.
12	ASTM D1603	Standard test method for carbon black in define plastics
13	ASTM D1928	Standard practice for preparation of compression-molded polyethylene test sheets and test specimens.

<b>Sr. No.</b>	<b>Code</b>	<b>Description</b>
14	ASTM D2240	Standard test method for rubber property – durometer hardness.
15	ASTM D3417	Standard test method for enthalpies of fusion and crystallization of polymers by differential scanning calorimetry (dsc)
16	ASTM D4703	Standard test practice for compression Molding Thermoplastic Materials into Test Specimen, Plaques or Sheets.
17	ASTM F372	Standard test method for water vapor transmission rate of flexible barrier materials using an infrared detection technique
18	AWWA C 200-97	Steel water pipe line
19	ASTM G8	Standard test method for Cathodic Disbonding of pipeline Coatings.
20	CAN/CSA Z 245:1	Internal fusion bond epoxy coating / lining of steel pipes.
21	DIN 30670	Polyethylene Coatings of Steel pipes and Fittings – Requirements and Testing.
22	DIN EN ISO 9001 2000	Quality management systems – Requirements
23	DIN EN ISO 8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
24	DIN EN ISO 8502-2	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 2: Laboratory determination of chloride on cleaned surfaces.
25	DIN EN ISO 8502-3	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
26	DIN EN ISO 8502-4	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 4: Guidance on the estimation of the probability of condensation prior to paint application.
27	DIN EN ISO 8502-9	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 9: Field method for the conductometric determination of water-soluble salts.

<b>Sr. No.</b>	<b>Code</b>	<b>Description</b>
28	DIN EN ISO 8503-1	Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast cleaned surfaces.
29	DIN EN ISO 8503-2	Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel – comparator procedure.
30	ISO 8502-5	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 5: Measurement of chloride on steel surfaces prepared for painting (ion detection tube method)
31	NACE RP0490	Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coatings of 250 to 760mm (10 to 30 mils)
32	NACE RP-01-75	Recommended practice: control of International corrosion in steel pipe line system.
33	SIS 05-5900	Preparation of steel substrates before application of paints and related products – visual assessment of surface cleanliness – PT 1: rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous.

## **GENERAL**

### 1..7 Environmental Conditions

The environmental conditions operating conditions, product data, etc. under which the pipes shall operate and defined in Documents. Scope of Work, Project Design Data and Site Conditions and Specification for Pipeline construction.

### 1..8 Definitions

The terms “Contractor”, “Pipe Supplier”, “Pipe Coating Contractor”, “Engineer”, etc. used in this specification shall have the meanings defined in the General and Special Conditions of Contract.

### 1..9 Abbreviations

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials



DIN	German Standards Institute
ISO	International Organization for Standardization
NACE	National Association of Corrosion Engineers
NPS	Nominal Pipe Size
MPI	Magnetic Particle Inspection
UT	Ultrasonic Testing
SIS	Swiss standard
AWWA	American Water Works Association.

#### 1..10 Conflicting Requirements, Exceptions

The Pipe Coating Contractor shall notify the Engineer of any conflict between this specification, the codes and standards and any other specifications included as part of the contract documents related with line pipes and coating.

Any exceptions to this specification and referenced documentation shall be raised by the Pipe Coating Contractor and approved by the Engineer in writing.

### **TECHNICAL REQUIREMENTS**

#### 1..11 HANDLING OF COATING MATERIALS

##### 1..11.1 General

Materials shall be brought from the GWIL approved vendor list only and shall be handled and stored in accordance with the material manufacture's recommendations, which shall be available for review by the Engineer at the Pipe Coating Contractor's premises. Materials shall be stored in temperature controlled environment until required for use.

Coating materials shall be segregated by type and batch during storage and handling. Materials from damaged containers shall be rejected unless otherwise agreed with the Engineer.

As a minimum, all packages of the coating materials shall be marked with the following data:

- a) Name of MANUFACTURER
- b) Complete material identification – trade name, chemical name and
- c) type of product details
- d) Batch number
- e) Date of manufacture
- f) Place of manufacture
- g) Shelf life/expiry date (if appropriate)
- h) Health and safety, and environmental instructions
- i) Hazard Warnings
- j) Storage instructions
- k) Quantity
- l) Manufacturing Standard

Any material not labelled with the above information shall not be used.

#### 1..11.2 Abrasive Grit

The abrasive shall be steel grit, also in combination with steel shot of the required grade to achieve the specified surface profile. The use of sand is not permitted. Blasting abrasives shall be kept dry, clean and free from contamination. When recovered metallic grit systems are used, a stabilized working mix of blast cleaning material shall be established. This mix shall be maintained throughout the entire course of the production, by frequent small additions from fresh or cleaned stock at a rate sufficient to refurnish consumption. Blasting and other dust producing areas shall be kept separate from coating application areas. The surface cleaning shall be degree of cleanliness as per SA 21/2 & ISO 8502-3.

#### 1..11.3 FBE Powder

The FBE powder selected shall be suitable for use at the design temperatures in the proposed environment and be suitable for a three layer polyethylene coating system. The FBE shall be endorsed by the Pipe Coating contractor of the adhesive and Polyethylene as being compatible with these products under the specified service conditions.

Each batch of FBE shall be accompanied by a certificate stating the following tests have been carried out on every batch and results are in accordance with the coating material MANUFACTURER's product specifications;

- a. Gel Time
- b. Moisture content
- c. Particle size distribution
- d. Density
- e. Infrared Scan
- f. Thermal analysis

#### 1..11.4 Adhesive

The adhesive selected shall be completely suitable for use at the design temperatures in the proposed environment and be suitable for a three layer polyethylene coating system.

Each batch of adhesive shall be accompanied by a certificate stating the following tests have been carried out on every batch and results are in accordance with the coating material MANUFACTURER's product specifications:

- a. Adhesion
- b. Density
- c. Melt flow index

#### 1..11.5 Polyethylene

The polyethylene selected shall be or high density and shall be completely suitable for use at the design temperatures in the described environment. The polyethylene

shall be suitable for a three-layer polyethylene can be stabilized against UV-rays before or after granulating the material.

Each polyethylene batch shall be accompanied by a certificate stating the following tests have been carried out on every batch and results are in accordance with the coating material MANUFACTURER's product specification:

#### 1..12 PROPERTIES OF EPOXY POWDER & ADHESIVE

MANUFACTURER shall choose such a brand of epoxy powder and adhesive that will achieve the functional requirement and properties of coating system as specified and shall submit a compatibility certificate in this regard from the MANUFACTURER of materials. In absence of such certificate, compatibility test shall be conducted by the contractor by contractor at his own cost. In addition, the Manufacturer shall also furnish Infra-red Scan for each batch of epoxy powder. The coating materials Supplier shall issue test certificates as per EN 10204 for each batch of materials supplied to MANUFACTURER and the same shall be submitted to PURCHASER for approval prior to their use. Epoxy powder properties shall be as per CSA Z245.20.98 (latest revision). The colour of epoxy powder shall be either green or dark red or any other colour approved by COMPANY except grey colour. Copolymer grafted adhesive shall have the following properties.

Sr.No.	Properties	Unit	Requirement	Test Method
a.	Melt Flow Rate (190 <sup>0</sup> C/216 kg)	g/10 minutes	1.0 min	ASTM D 1238
b.	Vicat Softening Point	<sup>0</sup> C	100 min	ASTM D 1525
c.	Specific Gravity	-	0.926 min	ASTM D 792

#### Properties of Polyethylene Compound

Sr.No.	Properties	Unit	Requirement	Test Method
a.	Tensile Strength @ + 25 <sup>0</sup> C	N/mm <sup>2</sup>	17 min	ASTM D638
b.	Melt Flow Rate (190 <sup>0</sup> C / 2.16 kg)	g/10 minutes	0.25	ASTM D 1238 or DIN 53735
c.	Specific Gravity + 25 <sup>0</sup> C	-	0.926 min. (MDPE) 0.941 min.(HDPE)	ASTM D 792
d.	Hardness @ + 25 <sup>0</sup> C	Shore D	50 min.	ASTM D 2240

<b>Sr.No.</b>	<b>Properties</b>	<b>Unit</b>	<b>Requirement</b>	<b>Test Method</b>
<b>e.</b>	Water Absorptions, 24 hours @ + 25 <sup>0</sup> C	%	0.05 mz.	ASTM D 570
<b>f.</b>	Volume Resistivity @ + 25 <sup>0</sup> C	Ohm-cm	10 <sup>15</sup> min.	ASTM D 257
<b>g.</b>	Dielectric withstand, 1000 Volt/sec rise @ + 25 <sup>0</sup> C	Volts/mm	30,000 min.	ASTM D 149
<b>h.</b>	Vicat Softening Point	<sup>0</sup> C	110 min.	ASTM D 1525
<b>i.</b>	Elongation	%	600 min.	ASTM D 638
<b>j.</b>	Oxidative Induction Time in Oxygen at 220 <sup>0</sup> C, Aluminium pan, no screen	Minutes	10 min.	ASTM D 3895
<b>k.</b>	Environmental Stress Crack Resistance (ESCR) (for F <sub>50</sub> ) - Medium Density , Condition "C" - High Density, Condition "B"	Hours	300  300	ASTM D 1693
<b>l.</b>	Carbon Black Content	%	2 min.	ASTM D 1603

In addition to vendor's certificate, the MANUFACTURER shall draw samples from each batch of epoxy, adhesive and polyethylene in the presence of PURCHASER and the test for the following properties at the coating yard at least one week prior to its use, to establish compliance with the Manufacturer's test certificates.

- a. Epoxy Powder: Gel Time, Cure Time, Moisture content, Thermal Characteristics (Tg1, Tg2, H)
- b. Adhesive: Specific gravity, Melt Flow Rate, Vicat Softening Point
- c. Polyethylene: Melt Flow Rat, Specific Gravity, Vicat Softening Point, Moisture content, Oxidative Induction Time.

In Case of the failure of any of the above tests in a batch, that batch of material shall be tested for all other tests required including the tests which failed. If all tests pass,

the batch shall be accepted for coating. If any of the tests fail, entire batch of material shall be rejected and shall not be used for the coating.

MANUFACTURER shall ensure that all coating materials are properly stored in accordance with the Manufacturer's recommendation at all times, to prevent damage and deterioration in quality prior to use.

### Properties of coating System

Sr.No.	Properties	Unit	Requirement	Test Method
a.	Bond Strength (using Type 2 test assembly i.e. Dynamometer) - @ 20+/- 5 <sup>0</sup> C - @ 65 +/- 5 <sup>0</sup> C	Kg/cm	8.0 min 5.0 min	DIN 30670
b.	Impact Strength (Mon. of 30 impacts on body along the length. No breakdown allowed when tested at 25 kV)	Joules per mm of coating thickness	7 min	DIN 30670
c.	Indentation Hardness - @ 23 +/- 2 <sup>0</sup> C - @ 70 +/- 2 <sup>0</sup> C	mm	0.2 max 0.3 max	DIN 30670
d.	Elongation at Failure	%	300 min	DIN 30670
e.	Coating Resistivity (*)	Ohm-m <sup>2</sup>	10 <sup>8</sup> min.	DIN 30670
f.	Heat Ageing (*)	-	Melt Flow rate shall not deviate by more than 35% of original value Melt flow rate shall not deviate by more than 35% of	DIN 30670
g.	Light Ageing (*)	-		DIN 30670

Sr.No.	Properties	Unit	Requirement	Test Method
			original value.	
h.	Cathodic Disbondment - @ + 65 <sup>0</sup> C after 30 days - @ + 65 <sup>0</sup> C after 48 hrs	Minimum radius of disbondment (**)	15 max 7 max	ASTM G42
i.	Degree of Cure of Epoxy - Percentage Cure, H - Tg	% <sup>0</sup> C	95 +3/-2	CSA Z 245.20 – 98 (***)

(\*)Test carried out in an independent laboratory of national / international recognition of PE top coat is also acceptable.

(\*\*) Disbondment shall be equivalent circle radius of total unsealed area as per ASTM G 42.

(\*\*\*) Temperature to which the test specimens are to be heated during cyclic heating shall however be as per the recommendations of epoxy powder MANUFACTURER.

### 1..13 Acceptance of Pipe Materials

#### 1..13.1 Identification and Tracking

Upon receipt at the coating factory, the Pipe Coating Contractor shall record the following pipe information:

The unique pipe identification number, measured length, and measured weight (both to be found stencilled in paint on one end or the pipe).

This data shall be used as a basis for monitoring pipe from the time of receipt until the delivery of coated pipe.

The Pipe Coating Contractor shall identify (or maintain identification of) every coated item, by using a weatherproof mark on the inside of the pipe and on the outside of the coated item. The pipe identification shall be the unique pipe identification number (the number required by the applicable pipes specification).

The pipe coating contractor may use additional tracking numbers at his discretion but these shall relate simply to the unique pipe number in the QC documentation.

Pipe tracking shall be carried out in accordance with approved procedures.

#### 1..13.2 Preliminary Inspection

The Pipe Coating Contractor shall carry out visual inspection of all pipes.  
The Pipe Coating Contractor shall record all external damage on pipes against the unique item serial number. This damage shall be brought to the attention of the Engineer and the Pipe shall not be coated without prior release by Engineer.  
Bevel protectors at each end of every pipe joint shall not be removed unless showing signs of damage or if removal is required to facilitate surface preparation, or they would be damaged by coating operations. If the protectors are removed the conditions of the bevel shall be recorded against the pipe serial number and any damage shall be brought to the attention of the Engineer.

#### 1..13.3 Damage to Pipe and Pipe Ends and Repair

No repair work shall proceed until a written procedure has been prepared by the Pipe Coating Contractor and approved by the Engineer.

Minor damage to pipe and pipe ends/bevels, identified either at time of receipt or after abrasive blasting shall be repaired by grinding. The number of such damages shall be not more than 3 per pipe. Repair by grinding on the pipe or pipe ends/bevels outside diameter shall not reduce the wall thickness to less than the minimum requirements of the line pipe specification, when measured using ultrasonic thickness measurement equipment.

All other damage to pipe ends/bevels shall be advised to the Engineer for review. Subject to Engineer's approval, these defects may be repaired by removal of damaged pipe material and re-bevelling. No welding on the pipe surface shall be allowed.

Pipe identification numbers shall be preserved during repair. Any reduction in pipe lengths shall be recorded in the relevant forms and files.

#### 1..14 Prior to Coating Application

##### 1..14.1 Stages

The principle stages of pipe coating shall be as follows:

- a. Solvent cleaning followed by steam or hot bath cleaning (if required)
- b. Abrasive blasting
- c. Application of fusion bond epoxy (FBE) layer
- d. Application of adhesive layer
- e. Application of polyethylene layer

##### 1..14.2 Cleaning Prior to Abrasive Blasting

All surface contaminants such as oil, grease, tar, salt, or other contaminants on the pipe shall be removed by solvent cleaning followed by steam or hot bath cleaning, in accordance with a procedure approved by the Engineer.

Following the steam or hot bath cleaning the pipe shall be tested for salt and chloride contamination in accordance with the requirements of DIN EN ISO 8502-2, ISO 8502-5 or DIN EN ISO 8502-9.

The removal of hydrocarbon contamination shall be confirmed by a water spray test, where a fine spray is applied to the surface and uniform wetting confirms the removal. This check shall be performed before and after blasting, as a pre-qualification test and as a minimum, once per 100 items during production, or when necessary.

Items found to be contaminated shall be cleaned as above and re-blasted if testing after blasting establishes that salt, chloride or hydrocarbon contamination is still present. The remainder of the batch concerned shall all be checked individually.

All water used for rinsing or cleaning purposes shall be potable with less than 200 ppm total dissolved solids and 50 ppm chlorides.

#### 1..14.3 Abrasive Blasting

Blasting and other dust producing areas shall be separate from coating application areas.

After cleaning and prior to abrasive blasting the pipe lengths shall be free from moisture, dust, and grease and free from other foreign materials.

Abrasive and dust, which entered the inside of the pipe during blasting operation, shall be removed by suitable means.

Weld joints, sharp-edge projections; weld spatter and slag etc. shall be dressed prior to blast cleaning.

Using dry blasting techniques only, the exterior surface of the pipe joints shall be abrasively cleaned to remove all mill scale, and other impurities from the surface.

No blast cleaning shall take place when the prevailing relative humidity is higher than 85 percent unless pipe is preheated to at least 3° C above the dew point.

Twice per shift, samples of the abrasives mixture shall be removed from the hopper and checked for hydrocarbon contamination. The sample shall be placed in a beaker to which de-ionized water is added. The beaker shall then be sealed and shaken vigorously. Once the grit has settled the surface of the water shall be examined for signs of hydrocarbon contamination. If any signs are found all the abrasive in the hopper shall be rejected and not re-used.

Additionally, abrasive materials shall be checked at least once per shift to ensure that only uncontaminated angular grit with an acceptable size distribution is used.

As a minimum the following shall be carried out.

Correct abrasive size distribution shall be carried out by sieve analysis.

Placing a sample of abrasive on a clean, dry sheet of absorbent paper to determine water contamination.

The surface of the pipes shall be blasted until a finish of Grade 2.5 to DIN EN ISO 8501-1 is attained. The surface profile shall be between 50 to 75 microns, measured in accordance with DIN EN ISO 8503-2. Profile measurements shall be made with a Keane Tator Profile Comparator, Testex Press –O-Film or other Engineer approved method suitable for the abrasive being used.

Following abrasive blasting, the surface shall not be contaminated with dirt, dust, metal particles, hydrocarbons, water, chlorides, sulphates or any other foreign matter, which would be detrimental to the coating.



Prior to the coating application, the exterior surface shall be thoroughly inspected under adequate lighting. Any damage such as surface imperfections, slivers, scabs, burrs, gouges, or sharp edged defects, shall be repaired in accordance with this specification. Pipes that have damage repaired by grinding and have ground areas greater than 50 mm diameter shall be re-blasted to meet the requirements. After grinding or mechanical repairs the wall thickness shall be ultrasonically examined and compared with the minimum requirements of the applicable code / standard.

Any dust or loose residue that has accumulated during blasting and/ or grinding operations shall be removed by the use of clean compressed air or by vacuum extraction. Alternative methods for removing dust and lint shall require approval of the Engineer.

The elapsed time between the start of blasting and the heating of pipe shall be indicated in the application procedure submitted by the Pipe Coating Contractor and shall be reflected on his plant scheme.

The total elapsed time between the start of blasting of any pipe and the heating of that pipe to the specified temperature shall not exceed the following time-humidity table:

<b>PERCENT RELATIVE HUMIDITY</b>	<b>ELAPSED TIME (HOURS)</b>
<b>85</b>	<b>0.5</b>
<b>80</b>	<b>1.0</b>
<b>70</b>	<b>2.0</b>
<b>60</b>	<b>2.0</b>

Any pipe surface not processed within the above time-humidity table shall be completely re-cleaned and re-blasted before coating. The maximum time limit between blasting and coating for humidity below 60% shall be 4 hours.

Note: The Method of Blasting will be finalized at the time of execution based on site condition.

## 1..15 Coating Application

### 1..15.1 General

The application of the coating shall be in accordance with the material MANUFACTURER recommendations and the procedure outlined below.

The Pipe Coating Contractor shall perform coating procedure qualification testing (PQT) prior to commencing production or on his own risk at the start of production in accordance with this specification.

Prior to start up of the coating process the powder application and recovery systems shall be thoroughly cleaned to remove any powder other than that is use, minimum once per day and the collected powder shall be disposed off.

### 1..15.2 FBE Layer

The FBE shall be applied to a minimum thickness of 200 microns.

The pipe shall be uniformly preheated in accordance with the FBE MANUFACTURER's instructions. This temperature shall have been confirmed during PQT. The surface temperature shall not exceed 260 deg C in accordance with AWWA C213.

Pipe temperature shall be checked periodically using pyrometer. The pyrometer shall be checked for error not less than every four hours against a calibrated temperature measuring instrument.

The coating shall be applied by electrostatic spray with the pipe at earth potential and the epoxy powder charged to high potential.

The use of reclaimed FBE powder is only permitted if the reclaimed powder is screened to remove foreign or deleterious material before being reintroduced into the powder application system.

The clean reclaimed powder up to a maximum of 20% shall be introduced back into the fresh virgin material by means of proportional weight.

During application, the bevelled ends and pipe bore shall be protected against mechanical damage and from contamination with coating material.

### 1..15.3 Adhesive Layer

The adhesive shall be applied to a thickness of 200 microns. The adhesive layer shall be applied before gel time of the FBE has expired. Application of the adhesive shall not be permitted after the FBE has fully cured. The Pipe Coating Contractor shall establish to the satisfaction of the Engineer that the adhesive is applied within gel time window of the FBE and at the temperature recommended by the adhesive MANUFACTURER. The Pipe Coating Contractor shall state the proposed minimum and maximum time interval between FBE and adhesive applications at the proposed pre-heat temperature.

### 1..15.4 Polyethylene Layer/Cutback

The polyethylene layer shall be applied to a minimum thickness as per DIN 30670 over the pipe body and to a minimum of 90% body thickness over the production welds.

Nominal Size	Minimum Thickness in mm	
	Normal (n)	Increased (v)
DN 100	1.8	2.5
> DN 100 to DN 250	2.0	2.7
> DN 250 to < DN 500	2.2	2.9
DN 500 to < DN 800	2.5	3.2

<b>DN 800</b>	<b>3.0</b>	<b>3.7</b>

A polyethylene layer cutback of 150 mm (+10/-10mm) shall be provided at pipe ends.

The polyethylene shall be applied over the adhesive within the time limits established during pre-production testing.

The coating shall be cooled to below 60 deg C before handling.

The ends of the coating shall be chamfered and bevelled to 30 to 45 deg. Immediately after the coating is fully cured, pipe identification marks shall be re-applied on the coated pipe using a method approved by Engineer.

## 1..16 INSPECTION, TESTING AND CERTIFICATION

### 1..16.1 GENERAL

In order to demonstrate that the MANUFACTURER's proposed coating procedure is capable of meeting the specification, the Pipe Coating Contractor shall undertake coating procedure qualification testing (PQT) prior to commencing production, or at his own risk at the start of production. The pipe coating Contractor shall also be required to test the finished coating during production to demonstrate continued compliance with this specification. Details of all inspections and testing shall be fully documented in accordance with this section.

All states of the surface preparation, coating and testing shall be subject to 100% inspection by the Pipe Coating Contractor. The Engineer shall be informed at least two weeks prior to the start of surface preparation to allow scheduling of inspection supervision work

### 1..16.2 Coating Procedure Qualification Testing (PQT)

Prior to commencing or at the start of full production five pipe joints of each diameter coated with FBE only and five pipe joints of each diameter with the full coating system shall be selected for PQT. All coating shall be in accordance with the coating procedure specifications and shall be witnessed by the Engineer or its representative.

The produced pipes will not be released until the successful results of the PQT can be provided. In case of long-term tests the PQT report shall be updated once the results can be provided. Any failure in meeting the specified acceptance criteria for the PQT will result in rejection of the coated pipes. Engineer shall approve any remedial action, repairs or re-use.

The test methods for all tests required for PQT on the FBE and the complete coating system shall be performed in the same manner as the production tests described in this specification.

Pipes selected for PQT testing shall pass all the criteria containing before production commences.

Any change in the coating material or coating procedure shall require re-qualification.

If any of the tests fails to meet the minimum acceptance criteria defined in this specification, then the pre-qualification pipes shall be rejected. Further pipes may be prepared and coated using revised procedures and further tests performed. Once acceptable results are obtained and approved by Engineer, the Pipe Coating Contractor's quality plan and procedures shall be revised, and submitted to the Engineer for approval. All items coated using the rejected procedures shall be striped and recoated to the revised procedures.

### 1..16.3 PQT Inspection and Test Summary

Inspection and testing summary for procedure qualification test (PQT) for three layer coating system for each pipe diameter:

<b>Property</b>	<b>Acceptable Values</b>	<b>Frequency</b>
<u>On Arrival</u>		
<ul style="list-style-type: none"> <li>• Pipe Damage</li> </ul>	Minor damage/grinding <3 Per Pipe	Each Pipe
<u>After Cleaning</u>		
Chloride	2 mg/cm <sup>2</sup>	Each Pipe
Oil	No contamination	
Salt	3 mg/cm <sup>2</sup>	
<u>After Abrasive Blasting</u>		
<ul style="list-style-type: none"> <li>• Cleanliness</li> <li>• Profile</li> <li>• Contamination</li> </ul>	Sa 2.5 acc to ISO 8501 50 – 75µm No contamination	Each Pipe Each Pipe Each Pipe
property	Acceptable Values	Frequency of Tests
<ul style="list-style-type: none"> <li>• Visual Inspection</li> <li>• Holidays</li> <li>• Thickness</li> <li>• Adhesion</li> </ul>	No surface defects No holidays Min/Max see as specified As specified	Each Pipe Each Pipe 10 per pipe 2 per pipe
<u>Holidays</u>		
<u>Visual Inspection</u>	No surface defects	Each Pipe
Coating	120+10/-0 mm width	Each Pipe
Bare steel at pipe ends	10 to 40 mm width, Chamfered	Each Pipe
Production FBE	150 + 10/-10 mm bevel	Each Pipe
PE cut backs	30 <sup>0</sup> to 45 <sup>0</sup>	
<u>Adhesion</u>		
<ul style="list-style-type: none"> <li>• Peel Test</li> </ul>	> 100 N/cm at 23 <sup>0</sup> C ±5 <sup>0</sup> > 50 N/cm at 50 <sup>0</sup> C ±5 <sup>0</sup>	2 per Pipe 2 per Pipe
<u>Impact Resistance</u>	As specified	1 per pipe
<u>% Elongation at Failure</u>	As specified	2 per pipe
<u>Cathodic disbondment</u>	As specified	2 per pipe
<u>DIN 30670</u>	As specified	1 per pipe

#### 1..16.4 PRODUCTION TESTING

Production testing shall be performed at the frequency shown below:

<b>property</b>	<b>Acceptable Values</b>	<b>Frequency of Tests</b>
<u>On Arrival</u> • Pipe Damage	Minor damage/grinding <3 Per Pipe	Each Pipe
<u>After Cleaning</u> Chloride Oil Salt	2 mg/cm <sup>2</sup> No contamination 3 mg/cm <sup>2</sup>	Each Pipe
<u>After Abrasive Blasting</u> Cleanliness Profile Contamination Pipe Damage	ISO-Sa 50 – 75µm No contamination As specified	Each Pipe 20 Each Pipe 20
<u>FBE Layer</u> • Visual Inspection • Holidays • Thickness • Adhesion	No surface defects No holidays Min/Max see As specified As specified	One pipe per day and one pipe when FBE batch changes
<u>Coating Thickness</u> (minimum)	As specified	Each Pipe
<u>Holidays</u>	No holidays	Each Pipe
<u>Visual Inspection</u> Coating Bare steel at pipe ends Production FBE PE cut backs	No surface defects 120+10/-0 mm width 10 to 40 mm width, Chamfered 150 + 10/-10 mm bevel 30 <sup>0</sup> to 45 <sup>0</sup>	Each Pipe Each Pipe Each Pipe Each Pipe
<u>Adhesion</u> Peel Test	> 100 N/cm at 23 <sup>0</sup> C +5 <sup>0</sup>	1 Pipe per 25 2 per Pipe
<u>Cathodic Disbondment</u> at Room Temperature	As specified	First pipe, last pipe and at intervals of every 500 pipes

The frequency of tests shown in the table above will be for normal production operations. This frequency of tests is subject to change at the discretion of the

Engineer as a result of change of materials or consistent poor production performance.

#### 1..16.5 HOLIDAY DETECTION

##### **a. FBE Layer:**

The FBE coating shall be 100 % holiday tested with a pulse type DC holiday detector equipped with audible signalling device. The test shall be carried out in accordance with NACE RP0490 or equivalent.

##### **b. Final Coating:**

Each fully coated pipe shall be inspected for holidays over 100 percent of its coated surface using a high voltage DC detector.

The detector shall be a type, which maintains complete contact with the coating. It may be either constant or pulsed voltage type. If constant voltage type, holiday detection shall be carried out on a dry coating. The operating voltage between electrode and pipe shall be checked at least twice per working shift, and shall be maintained at 10 kilovolt/mm of coating thickness.

The Pipe Coating Contractor shall demonstrate to the Engineer that the setting of the detector is satisfactory for detecting pinhole defects. This setting shall be checked once every two hours. The correct travel speed shall be determined by consistent detection of an artificial pinhole made in a good coating sample but shall not exceed 300 mm/s.

All holidays and other detects shall be marked for subsequent repair and re-testing. On retesting, no holidays shall be permitted in the final coating.

The number of holidays for each pipe length shall be recorded. Coated pipe having holidays in excess of 1 per 1 square metre shall be stripped and re-coated.

If there is an excess occurrence of holidays on successive pipes, the Pipe Coating Contractor shall immediately stop the coating operation to determine the cause and remedy it.

#### 1..16.6 ADHESION (PEEL) TSET

##### **a. FBE Layer:**

With a sharp narrow bladed knife, two incisions (approximately 13 mm long) shall be made, in the form of an X. through to the metal substrate. At the intersection of the X. an attempt shall be made to force the lining from the steel substrate with the knife point. The point of the knife shall be inserted horizontally i.e., the flat of the blade under the lining at the point of intersection of the X such that the blade point is on the metal surface. Using a levering action, the flat point shall be forced away from the steel in an attempt to pry off the coating. Refusal of the lining to disbond from the substrate shall be recorded as a pass. A pass shall also be recorded where the lining fails cohesively. Partial or complete adhesive failure between the lining and the substrate shall be recorded as a failure. Disbondment at the point of the intersection is common

due to the action of marking the 'X' cut. Therefore for 1 mm away from the tip of the intersection any disbandment shall be ignored.

**b. Final Coating:**

The adhesion for the complete coating shall be determined in accordance with the requirements for bond strength in DIN 30670. The relevant test temperature and acceptance criteria for these tests shall be as specified. Automatic chart recording equipment shall be used and the average peeling force shall be recorded.

The failure mode shall be recorded. The failure should occur at the adhesive/polyethylene interface or adhesive/FBE interface or cohesively in the polyethylene layer. If failure should occur at the FBE/steel interface this will be considered a total failure of the system.

**c. Impact Test**

A sample or coated pipe shall be impact tested in accordance with the procedures and acceptance criteria of DIN 30670.

**d. Resistance to Indentation Test (Indentation Hardness)**

Once per shift (and when the FBE or polyethylene batch is changed), the indentation hardness of two coated samples shall be measured (at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  and  $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ) in accordance with DIN 30670

Indentation depth shall not exceed 0.2mm at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  or 0.3mm at  $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ .

**e. Percentage Elongation at Failure**

This test shall be conducted in accordance with DIN 30670 on each of the full system pre-qualification pipes, but at least the coating of three pipes shall be tested for elongation at failure, from which five test pieces shall be taken. The percentage elongation at failure shall be at least 300% - on each of the full system pre-qualification pipes, 2 samples per pipe to the requirements of DIN 30670.

**f. Other DIN 30670 Tests**

The Pipe Coating Contractor shall demonstrate, for the same system to be applied for this order, attainment of DIN 30670 requirements for Coating Resistivity, to Thermal Ageing and Light Ageing as required by DIN 30670. .

**g. CATHODIC DISBONDMENT TEST**

Cathodic Disbondment testing shall be conducted:

as a pre-qualification test - 48 hours duration at  $65 \pm 2\text{ }^{\circ}\text{C}$

as a pre-qualification test - 28 days duration at  $23 \pm 2\text{ }^{\circ}\text{C}$

as a production test - 48 hours duration, at the frequency of one test per 50D coated pipes at  $65 \pm 2\text{ }^{\circ}\text{C}$

The test requirements shall be in accordance with ASTM G 8.

The final unsealed diameter (including the initial holiday diameter of 6.35 mm) shall not exceed 15 mm. This shall apply to both, the 28 day test at  $23 \pm 2\text{ }^{\circ}\text{C}$  and the 2 days test at  $65 \pm 2\text{ }^{\circ}\text{C}$ .

The Pipe Coating Contractor may propose alternative cathodic disbondment test standards provided the essential requirements of this specification are retained.

Any such alternatives shall be submitted to the Engineer for review and approval.

Every 24 hours the applied voltage and current flow shall be recorded. Any drift from the specified voltage setting shall be corrected.

#### **h. DESTRUCTIVE TEST**

A sufficient length of production pipe shall be cold cut to provide the required number of samples for conducting the coating destructive tests listed in this specification.

Items that fail individual tests and that cannot be repaired shall be rejected. Subject to the approval of Engineer, the rejected coating shall be stripped and the joint shall be re-blasted and coated in the manner specified for new pipe in this specification.

Where a test relates to a quantity of coated items, e.g. 1 per 50 items or 1 per 100 items etc., the quantity or items represented by the item tested (e.g. 50 or 100) shall be considered to be a batch.

If a test on an item in a batch fails then this item shall be rejected and two further items shall be randomly selected from the batch for repeat testing. If either of these tests fails then the whole batch shall be quarantined for review by Engineer. The cause of failure shall be established and reported to the Engineer and if deemed necessary by the Engineer the coating procedure shall be amended and re-qualified. The Engineer will decide whether the whole batch is rejected and sent for re-blasting and re-coating or whether acceptance may be on the basis of acceptable tests carried out on individual items.

#### **COATING REPAIRS**

The Pipe Coating Contractor shall submit detailed coating repair procedures for approval by Engineer. These shall include procedures for repair or 'pin-hole', 'small area' and 'large area' defects. The minimum and maximum areas for which each type of repair is applicable shall be stated taking into consideration the below mentioned requirements.

The maximum number of coating defects allowable, before a joint of pipe shall be classed as rejected and recoated, shall not exceed 1 per 1 square metre (exclusive of damage caused by testing).

- Repair areas of sizes  $< 5 \text{ mm}^2$

Pinhole damage shall be repaired by cleaning with an emery cloth followed by application of a two (2) pack epoxy repair kit or an approved hot melt mastic smoothed flush with the polyethylene surface. If the mastic is used, it shall be spread with the aid of a hot air or a propane torch.

- Repair areas of sizes  $> 5 \text{ mm}^2$  up to  $< 250 \text{ mm}^2$

The area shall be cleaned with solvent and abraded with an emery cloth to ensure that the surrounding polyethylene is well bonded; the surface shall be roughened for a distance of at least 25 mm beyond the damage area. Approved hot melt mastic shall be applied to the damage area and smoothed flush. The mastic and surrounding area shall be warmed with hot air or propane torch until the surrounding polyethylene has a slight sheen. An approved polyethylene patch material shall be applied overlapping the



damage but not overlapping the pre-abraded areas. Torch heat and smoothing pressure shall be applied to fuse the patch and ensure that no blisters are formed.

- Repair areas of sizes 250 mm<sup>2</sup> up to 625 mm<sup>2</sup>

Heat shrink-wrapping pipe sleeves shall be used for repair according to the following procedure:

Thoroughly clean the area to be coated

Bevel the extremities of the mill-coating with a rasp

Pre-heat the area to be coated to a temperature of approximately 700C.

Install the sleeve over the area to be coated

Warm the shrink sleeve to a temperature above 1500C with a propane torch or a warm-air ring.

- Repair areas of sizes exceeding 625 mm<sup>2</sup>

No single defect shall exceed an area of 625 mm<sup>2</sup>. Pipes with a coating defect exceeding 625 mm<sup>2</sup> shall be cause for rejection and shall be subsequently rejections and recoated. All rejections shall be recorded.

Repairs shall provide a finished coating equal in effectiveness to that of the parent coating. The limit of the repair area shall be revised.

Each repaired area shall be holiday inspected in accordance as specified.

The Pipe Coating Contractor shall submit coating stripping procedure for pipes rejected for coating quality. The rejected coating may be stripped by heating in an oven. Under these circumstances, the temperature of the pipe joint shall not be allowed to rise above 400 0C.

## **HANDLING, TRANSPORT AND STORAGE**

The Manufacture shall be responsible for any damage occurring to the pipes from unloading to reloading on the relevant transportation means.

The Manufacturer shall consequently:

- inspect the bare pipes upon delivery to check that they have suffered no previous damage,
- take all necessary precautionary measures to prevent any deterioration during the following operations:
- handling,
- transfer tot storage yards.
- storage,
- loading of pipes for shipment.

All repairs and inspections shall be at the Manufacturer's expense.

### **1..17 Handling**

The pipes shall b e handled without causing damage to the pipe bevels and coating.

Direct contact steel or hemp slings or with any material whose shape or nature may deteriorate the pipe coating shall be strictly prohibited. Polyamide slings or hooks fitted with thermoplastic protection may be used.

Use of electromagnetic device is recommended.

1..18 Transfer to Storage Yard

During transport of pipes to the storage yard of the Manufacturer, the latter shall take all their required measures to avoid pipe and coating damage.

1..19 Storage Yard of the Manufacturer

Stockpiling of coated pipes shall be made so as to avoid any deterioration of coating. Coated pipes, when non concrete weight coated, shall be protected against ultraviolet rays action in particular.

1..20 Pipe Loading for Shipment

When loading the coated pipes for shipment, the Manufacturer shall take all necessary measures to avoid the deterioration of pipes and coating during handling and transport.

1..21 End Caps

If the bare pipes have been delivered to the Manufacturer with end caps, these end caps or new ones) should be fitted again on the pipe ends after coating if required in the CONTRACT.

## REPAIR OF COATING

MANUFACTURER shall submit to PURCHASER, its methods and materials proposed to be used for executing a coating repair and shall receive approval from PURCHASER prior to use. In open storage the repair materials must be able to withstand a temperature of at least (+) 80°C without impairing its serviceability and properties. MANUFACTURER shall furnish MANUFACTURER's test certificates for the repair materials clearly establishing the compliance of the repair materials with the applicable coating requirements indicated in this specification.

All repair material will be of Class C.70 as specified in the relevant DIN Standard.

All pipe coating plan, shall have sound external with no holiday or porosity on 100% of the surface.

Defects, repairs and acceptability criteria shall be as follows:

- Pipes showing porosities or very small damage not picked up during holiday test and having a surface less than 0.5 cm<sup>2</sup> or linear damage (cut) of less than 3 mm shall be repaired by stick using material of same quality.
- Damages caused to coating by handling such as scratches, cuts, dents, gouges, not picked up during holiday test, having a total reduced thickness on damaged portion not less than 2 mm and an area not exceeding 20cm<sup>2</sup> shall be rebuilt as per approved method and without exposing to bare metal.
- Defects of size exceeding the above and mentioned area of or holidays of width less than 300 mm shall be repaired as per approved method by exposing the bare metal surface.
- Defect exceeding the above and in number not exceeding 2 per pipe and their length not exceeding 500 mm shall be repaired as per approved method.
- Pipes with bigger damage shall be stripped and recoated.

- In case of coating defect close to coating cut back, MANUFACUTRER shall remove the coating throughout the entire circumference of the pipe down to the steel surface and increase the coating cut back length. Now, if the coating cut back exceeds by 30 mm than the specified cut back length, then the coating shall be repaired as per approved method thereby making up the coating cut back length as per specification.

In case the defect exceeds 70 mm from the original coating cut back length, the entire coating shall be removed and the pipe shall be recycled through the entire coating procedure.

Irrespective of type of repair, the maximum number of repair of coating shall be as follows:

- Holiday repair of size 100 cm<sup>2</sup> attributable to process of coating application shall be maximum one number per pipe.

- In addition to the above, defects to be repaired as per approved method shall be maximum 2 (two) per pipe.

Defects exceeding the above limits shall cause pipe coating rejection, stripping and recoating. The above is exclusive of the repairs warranted due to testing as this specification.

All repairs carried out to the coating for whatever reason shall be to the account to MANUFACTURER.

Cosmetic damages occurring in the polyethylene layer only need not be repaired by exposing up to steel surface, as deemed fit by the PURCHASER. In any case the MANUFACTURER shall establish his material, methods and procedure of repair that result in an acceptable quality of product by testing and shall receive approval from PURCHASER prior to use.

Testing of repairs shall be in the same form as testing coating. All repairs shall result in a coating thickness no less than the parent coating thickness. MANUFACURTRER shall test repairs to coating as and when required as and when required by PURCHASER.

## **REPAIR MATERIAL**

HTPL-80, PERP 80 PERP FILLER, S 1239 Epoxy or Canusa GTS-80, CRP 80 Mastic Filler, S/E/liquid epoxy and then should be followed by or equivalent material to be qualified by the material MANUFACTURER and approved by Purchaser.

- Any combination of epoxy, adhesive and polyethylene shall be tested and certified by an internationally recognized agency.
- In case the MANGUACTURER proposed coating material other than above e mentioned combination of epoxy, adhesive and polyethylene, coating procedure and qualification need to be carried out by an internationally recognized agency by the coating material Manufacturer.
- All materials to be used shall be supplied in sealed, damage free containers and shall be suitable marked with the following minimum information:
  - a. Name of the Manufacturer

- b. Type of Materials
- c. Batch Number
- d. Place and Date of Manufacture
- e. Shelf Life/Expiry Date (if Applicable)
- f. Quantity

All materials noted to be without above identification shall be deemed suspect and shall be rejected by PURCHASER. Such materials shall not be used for coating and shall be removed from site and replaced by MANUFACTURER at his expense.

**ITEM NO. 19 :**

**Providing and supplying ISI mark CI Butterfly Valves including all taxes, insurance, transportation, freight charges, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. ( with ISI Mark)**

**900mm dia**  
**600mm dia**  
**500mm dia**  
**400mm dia**

The Contractor has to prepare approved Quality Assurance Plan (QAP) as per Specification and latest IS Code provisions before manufacturing. Resilient seated butterfly valve shall be as per IS 13095/ BS 5155. Valve shall be suitable for mounting in any position.

The valve seat shall be of integrally cast or replaceable design. When the valve is fully closed, the seal shall seat firmly so as to prevent leakage. The seat surfaces shall be machined smooth to provide a long life for the seal.

All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve and valve shall be suitable for throttling purpose. All valve, spindles and hand wheels shall be positioned to give good access for operational personnel.

Valve of diameter 450 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N. All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

**MATERIALS OF CONSTRUCTION**

<b>Sr. No.</b>	<b>Component</b>	<b>MOC for PN 2.0 Rating</b>	<b>MOC for PN 1.0 / 1.6 Rating</b>
1.	Body, Disc	Graded Cast Steel ASTM A216 Grade WCB	CI. IS 210 FG260
2.	Shaft /Thrust Pad	Stainless Steel AISI 410	
3.	Body ring ( Retainer/ seat)	Stainless Steel 304; BS 970 Gr. 316 S 13	
4.	Bearing Bush	G.M. IS :318 LTB 2	
5.	Seat	EPDM rubber/ Nitrile rubber	
6.	Internal Fastenings	Stainless Steel AISI 304	
7.	External Bolting	Stainless Steel AISI 304	

**ITEM NO. 21: TEMPER PROOF AIR VALVE WITH ISOLATING SLUICE VALVE**

Providing and supplying of 150 mm dia. C. I. Temper proof Air valves with SS 304 Float gun metal- nozzle of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete.(With Isolating Sluice Valve PN 1.6)

Tamper Proof Air Valves shall be cast iron body, cover and cowl. Temper Proof Air valve working temperature shall be upto 50° C.

Design and Manufacturing Code - AWWA C512

Hydraulic Test Pressure shall be as mentioned below.

Sr. No.	Rating	PN 1.0	PN 1.6	PN 2.0	Duration
1	Body Test	15 Kg/ cm <sup>2</sup>	24 Kg/ cm <sup>2</sup>	20 Kg/ cm <sup>2</sup>	5 Min
2	Seat Test	10 Kg/ cm <sup>2</sup>	16 Kg/ cm <sup>2</sup>	30 Kg/ cm <sup>2</sup>	2 Min

**Material of Construction**

Sr. No.	Component	MOC for PN 2.0 Rating	MOC for PN 1.0 / 1.6 Rating
1	Body, Cover	Graded Cast Steel ASTM A216 Grade WCB	CI. IS 210 FG260
2	Float	Stainless Steel 304	
3	Seat	Nitrile Rubber	
4	Nozzle	Bronze-LTB 2	
5	Bolts and Nuts	SS 304	
6	Gasket	Rubber , Type B (As per IS 638)	

### **Inspection and Testing**

- The Engineer-in-charge or his authorized representative shall have free access to the works for inspection at any stage of manufacture and to reject any materials, which does not confirm to the specified requirements.
- The manufacturer shall arrange to supply all labour and appliance for the tests if the testing is to be done at his works. Each valve shall be subjected to the hydraulic test and shall show no sign of leakage under these tests, i.e. the balls shall function properly. The valve shall be tested to double the maximum working pressure.

### **Manufacturer's Guarantee**

The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch be shall replace any part that prove defective, free of charge at the place of dispatch.

### **Information Required**

The following information shall be cast on each valve body:

- (a) Manufacturer's name or trademark.
- (b) Size of valve

### **Marking**

The methods of marking all the valves to be delivered under scope of contract shall ensure that all the information will remain legible even after transportation, storage in open space etc. In general the legible and indelible marking upon the valves shall indicate the followings:

- b) Manufacture's brand name and/or trademark
- c) Diameter and class of valves
- d) Any other important matter that the manufacturer or purchase deems fit to be inscribed

### **Packing and Handling**

- The materials shall always be packed separately dispatched from manufacturer's works with adequate protective measures to prevent damages deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.
- When the materials are transported at railway risk, special packing as per IRCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.

- The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the stores.

### **Materials and Workmanship**

- General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process of tanks.
- All the material shall be new and of high quality.
- In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacture.

### **Test Certificate**

- The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.
- The supplier shall also produce in addition to manufacturer's test certificate as mentioned under "inspection & testing above", the inspection certificate issued by the employer or his authorized person / agency appointed.

### **Inspection**

This clause is applicable in general to all materials such as all types of valves, pre-cast chambers, other specials and materials etc. which are to be supplied by the contractor.

Inspection of materials will be carried out at factory site by Rajkot Municipal Corporation or authorized person / agency appointed by Rajkot Municipal Corporation.

The inspection call for Air Valves should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.

For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batch with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually cleared material is stenciled. Manufacturer does not load material after sunset to avoid inadvertent dispatch of wrong material.



Inspection note issued by the inspection agency to supplier as well as consignee (Concerned Executive Engineer) materials with inspection mark will be dispatched to stores stipulated in supply order and on receipt at stores the verification will be carried out by concerned Deputy Executive Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Deputy Executive Engineer after verifying and satisfying the above requirements.

**ITEM NO. 20, 22 and 24:**

**ITEM NO 20 - Lowering, Laying, Jointing of ISI mark D.I / C.I. Butterfly valve in position including cost of all labour ,jointing material, including bolts and giving satisfactory hydraulic testing etc. complete**

**ITEM NO 22 - Lowering, laying and jointing of 150 mm dia. C. I. Temper proof Air valves in position, including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete. (Air valve double ball flanged)(With Isolating Sluice Valve PN 1.6)**

**ITEM NO 24 - Lowering, Laying, Jointing in position of 300 mm dia. D.I. Scour valve including cost of all labour ,jointing material, including bolts and giving satisfactory hydraulic testing etc. complete**

**FIXING OF SLUICE VALVES/BUTTERFLY VALVES:**

Fixing double flange cast iron sluice valves including loading, unloading, carting from store to site including all jointing materials and testing etc, complete.

The sluice valves and tail pieces shall be examined before laying for cracks and other flows. They shall be undamaged in all respect.

The sluice valve shall be operated before laying.

All grits and foreign material shall be removed from the inside of the valves before placing.

All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.

The tightening of gland shall be checked with a pair of inside calipers. Clearance between the top of the stuffing box and the underside of the gland shall be uniform on all the sides.

**Jointing materials:**

The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing, white zinc, jute, lead, wool etc.

All tools and plant required for installation of sluice valve shall be provided by the contractor.

All jointing materials shall be got approved from the Engineer-in-charge before use.

The nut and bolts shall conform to latest I.S.S.

The rubber packing shall be good quality and approved by the Engineer-in-charge of the work.

Installation:

The sluice valve shall be lowered into the trench carefully, so that no part is damaged during lowering operation.

If necessary tail pieces shall be fitted with sluice valve first outside the trench and then lowered into the trench.

The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice valve bore. It shall be even at both the inner and outer edges.

The flange faces thoroughly greased.

If flange faces are not free, the contractor shall use thin fibers of lead wood.

After placing the packing nuts and bolts shall be inserted and tightened to make the joints.

The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.

Each flange bolts shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.

The sluice valve shall be installed in such a way that its spindle shall remain in truly vertical position.

The other end of tail piece shall be fitted with pipes so that continuous lines can work.

Extra excavation required for facility of lowering and fixing of sluice valve shall not be paid for.

Testing:

After installation of sluice valve the same is tested to 1 ½ times of its test pressure.

The joints of sluice valve shall withstand the test pressure of pipe line.

Defects noticed during test and operation of sluice valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

Mode of measurement and payment:

The measurement shall be taken **per number of sluice valve** of specified size. The rate will be **per number** fitted in a pipe line.

30 percent of amount shall be withheld for hydraulic test and same shall be released after satisfactory hydraulic test.

#### FIXING OF AIR VALVES:

Fixing of cast iron air valve including loading, unloading carting from store to site, drilling and treading, wherever necessary including all jointing materials testing etc. complete.

The air valve shall be opened out cleaned and greased and checked properly before fixing.

Before fixing the air valve shall be observed for any damage during transit.

#### Jointing Materials:

The contractor shall provide all jointing materials such as G.I. Nipple, M.S. Clamps, nuts, bolts grease white zinc, rubber packing etc.

All tools and plant required for fixing air valves shall be provided by the contractor.

All the jointing materials shall be got approved from the Engineer-in-charge before use.

The nuts and bolts shall conform to latest I.S.S

The rubber packing shall be of good quality and approved by the engineer-in-charge of the work. It shall be three ply of approved thickness. The packing shall be of full diameter of flange with necessary holes and control valve bore. It shall be of even thickness of both inner and outer edges.

M.S. clamps shall be in two semi-circular pieces out of two coupling welded, suitable to the threads and size of single acting air valve.

#### Fittings:

The air valve shall be lowered into the trench, carefully, so that no part is damaged during lowering operation.

Double acting air Valve

The flanges of the air valve and tail pieces or pipe shall be properly cleaned and greased or applied with white zinc.

The rubber packing of approved quality and of required size shall be inserted on faces of air valve.

If flange faces are not true the contractor shall use thin fiber of lead wool at his own cost.

After placing the rubber packing the nuts and bolts shall be inserted and tightened evenly on all sides properly.

Each bolt shall be tightened a little at a time taking care to tighten diametrically opposite holes alternatively.

Testing:

The air valve shall be tested during the testing of the pipe line.

The joints and air valve shall be water tight.

During test if the joint or air valve, found leaking, the same shall be re-done to the entire satisfaction of Engineer-in-charge.

Mode of measurement of payment:

The measurement shall be size wise per number and payment shall be made per number of air valve fitted.

30 percent of amount shall be withheld for hydraulic test and shall be released after satisfactory hydraulic test.

In case of zero velocity valves, Air cushion valves & pressure relief valves shall be tested while running of the pipe line.

The measurement shall be taken for number of valve of specified size 30%

Amount shall be withheld for hydraulic test and same shall be released after satisfactory hydraulic test.

**ITEM NO. 23:**

**Supply, installation, satisfactorily testing & commissioning of 300 mm dia. CI Scour valves with all accessories as per specs & drawings etc comp.**

Scour valves are located at low points or between valved sections of the pipeline. Their function is to allow periodic flushing of the lines to remove sediment and to allow the line to be drained for maintenance and repair work.

The scour valve should be sized to allow a minimum scour velocity of 0.6 m/s to be achieved in the main pipe. Scour tees over required size should be offset tees to allow the debris to be taken from the invert of the pipe. Scour valve should be as per IS and make should be from approved vendor list and after approval from Rajkot Municipal Corporation authority.

**Manufacturer's Guarantee**

The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the valves within a period of one year of dispatch be shall replace any part that prove defective, free of charge at the place of dispatch.

**Information Required**

The following information shall be cast on each valve body:

- (a) Manufacturer's name or trademark.
- (b) Size of valve

**Marking**

The methods of marking all the valves to be delivered under scope of contract shall ensure that all the information will remain legible even after transportation, storage in open space etc. In general the legible and indelible marking upon the valves shall indicate the followings:

- e) Manufacture's brand name and/or trademark
- f) Diameter and class of valves
- g) Any other important matter that the manufacturer or purchase deems fit to be inscribed

**Packing and Handling**

The materials shall always be packed separately dispatched from manufacturer's works with adequate protective measures to prevent damages deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.

When the materials are transported at railway risk, special packing as per IRCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.

The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the stores.

### **Materials and Workmanship**

- General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process of tanks.
- All the material shall be new and of high quality.
- In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacture.

### **Test Certificate**

- The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.
- The supplier shall also produce in addition to manufacturer's test certificate as mentioned under "inspection & testing above", the inspection certificate issued by the employer or his authorized person / agency appointed.

### **Inspection**

This clause is applicable in general to all materials such as all types of valves, pre-cast chambers, other specials and materials etc. which are to be supplied by the contractor.

Inspection of materials will be carried out at factory site by Rajkot Municipal Corporation or authorized person / agency appointed by Rajkot Municipal Corporation.

The inspection call for scour valve should be given. Inspection will be carried out normally within one weeks time and on receipt of such intimation the inspecting agency will inspect the materials as per the specification and on satisfying itself, will mark the inspection marks on all pipes and issued inspection note to the supplier and concerned consignee.

For inspection purpose the manufacture has to go in for stenciling for identifying size and class for proper segregation. The stock of offered material shall be in a manageable batch with adequate space like spreading the pieces etc. to permit proper inspection and inspection authority to be present during stamping so as to ensure that only actually

cleared material is stenciled. Manufacturer does not load material after sunset to avoid inadvertent dispatch of wrong material.

Inspection note issued by the inspection agency to supplier as well as consignee (Concerned Executive Engineer) materials with inspection mark will be dispatched to stores stipulated in supply order and on receipt at stores the verification will be carried out by concerned Deputy Executive Engineer as regards quantity and quality. Here quality means physical soundness of materials as precaution against breakage during transit. The supplier has to submit the test certificate as well as detailed test results carried out by inspection authority to the consignee along with the dispatch documents of materials. The material shall be considered as received only on receipt given by the concerned Deputy Executive Engineer after verifying and satisfying the above requirements.

### **ITEM NO. 25- C.C. WORK for THRUST BLOCKS & PIPE ENCASING**

**Providing CC work 1:2:4 for Thrust Block using aggregate of size 10-20 mm, centering, curing, finishing etc. complete (without reinforcement)**

Anchorage in the form of a thrust block at each deflection in the horizontal and/or in vertical alignment of the pipeline shall be provided as per the design requirements to resist any unbalanced pressure at the bends. Gravity type thrust blocks shall be provided at horizontal and vertical deflections in the pipeline, which shall be designed according to the test pressure and the soil conditions at the site of the thrust block. Before designing the thrust blocks the Contractor shall assess the stability of the soil considering erosion due to wind and water. The general guidelines to be followed for providing and designing of thrust blocks shall be as under:

- The thrust blocks may not be required for bend angles up to 5%. However, necessary calculations shall be submitted by the Contractor for approval by Employer to establish that the thrust shall be taken care by pipe itself and that it is safe not to have the thrust block.
- The thrust shall be designed according to the field test pressure of the pipe.
- For above ground pipelines, thrust blocks shall be designed to take 100% thrust.
- For buried pipelines, thrust blocks on continuous pipe line sections shall be designed considering 50% thrust to be taken by block and balance by pipe as per CPHEEO manual.
- For buried pipelines, thrust blocks near valve chambers and/or any other dismantling joints shall be designed to take 100% thrust.
- In rock the passive pressure of rock shall be considered for thrust block design.



The thrust blocks shall be of concrete M20, cast in-situ, with minimum surface reinforcement of 5 kg/m<sup>2</sup>. No formwork is required to be used for construction of thrust blocks in buried conditions, unless desired by the Contractor. The calculations for the dimensioning and the shape of the thrust blocks shall be approved by the Employer.

Anchor blocks shall also be located wherever there is a transition between above ground and buried pipelines. All such anchor blocks shall have flexible joints at either end to allow for small amounts of settlement to occur.

The Contractor shall construct the thrust blocks/Pipe Encasing as early in the program of work as is practical, and at least six months prior to installation of the above ground pipeline in order to reduce the risk of settlement imposing additional loads on the pipeline supports. All thrust blocks are to be completed on each section before the sectional hydraulic testing is conducted.

Where possible, the base of the thrust block shall be cast against solid rock in order to prevent any settlement. Any material overlying the rock shall be excavated and replaced with class M15 mass concrete. In the event of no rock being encountered, the base of the thrust block shall be cast against undisturbed ground. Any ground, which in the Employer opinion is unsuitable, shall be excavated and replaced with class M15 mass concrete.

The rate shall be for a unit of one cubic meter.

### **VALVE CHAMBER**

Valve chambers shall be constructed according to approved drawings suitable for the respective valve. They shall be constructed as described in BOQ. The chambers shall be constructed after the laying of the pipes and the assembly of specials and valves. The size of the chambers shall be according to the following criteria/ as per direction of Employer.

Minimum distance of flanges from walls	:	30 cm
Minimum distance of sockets from walls	:	30 cm
Minimum distance between highest point of equipment and roof slab	:	30 cm

Pipes passing through walls should be coated by two layer of soft material (hessian felt) to allow for differential settling and longitudinal expansion if directed by Employer. Only metallic pipes may be cast into the walls for anchoring purposes.

## **ITEM NO. 26 - BRICK WORK**

**Brick work using common burnt clay building brick having crushing strength not less than 35 kg/Sqcm in foundation and plinth in cement mortar 1:6 ( 1 cement : 6 sand ) etc comp.**

**Materials:** Water shall confirm to M-1 and Cement shall confirm to M-3.

### **Brick:**

The bricks shall be hard or machine moulded and made from suitable soils and burnt. They shall be free from cracks and flaws and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform colors.

The bricks shall be moulded with a frog of 100 mm x 40 mm and 10 mm to 20 mm deep on one of its flat sides. The bricks should not be broken when thrown on the ground from a height of 600 mm.

The size of modular bricks shall be 190 mm x 90 mm x 90 mm.

The size of the conventional bricks shall be as under:

(9" x 4.3/8" x 2,3/4") 225 x 110 x 75 mm

Only bricks of one standard size shall be used in one work. The following tolerances shall be permitted in the conventional size adopted in a particular work.

Length  $\pm 1/8"$  (3mm) width :  $\pm 1/16"$  (1.5mm)

Height:  $\pm 1/16"$  (1.5 mm)

The crushing strength of the bricks shall not be less than 35 kg/sq.cm. The average water absorption shall not be more than 20 percent by weight. Necessary tests for crushing strength and water absorption etc., shall be carried out as per IS: 3495 (Part I to IV) - latest edition.

### **Workmanship:**

#### **Proportion:**

The proportion of the cement mortar shall be 1:6 (1-Cement, 6-Fine sand) by volume.

#### **Wetting of bricks:**

The bricks required for masonry shall be thoroughly wetted with clean water for

about two hours before use or as directed. The cessation of bubbles, when the bricks are wetted with water is an indication of thorough wetting of bricks.

**Laying:**

Bricks shall be laid in English bond unless directed otherwise. Half or cut bricks shall not be used except when necessary to complete the bond; closer in such case shall be cut to required size and used near the ends of walls.

A layer of mortar shall be spread on full width for suitable length of the lower course. Each brick shall first be properly bedded and set frame by gently tapping with handle of trowel or wooden mallet. Its inside face shall be flushed with mortar before the next brick is laid and pressed against it. On completion of course the vertical joints shall be fully filled from the top with mortar.

The work shall be taken up truly in plumb. All courses shall be laid truly horizontal and all vertical joint shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. the thickness of brick course shall be kept uniform.

The brick shall be laid with frog upwards. A set of tools comprising of wooden straight edges, mason's spirit level, square half meter rub, and pins, string and plumb shall be kept on site of work for frequent checking during the progress of work.

Both the faces of walls of thickness greater than 23 cms shall be kept in proper place. All the connected brick work shall be kept not more than one meter over the rest of the work. Where this is not possible, the work shall be raked back according to bond (and not left toothed) at an angle not steeper than 45 degrees.

All fixtures, pipes, outlets of water, hold fasts of doors and windows etc. which are required to be built in wall shall be embedded in cement mortar.

**Joints:**

Bricks shall be so laid that all joints are quite flush with mortar. Thickness of joints shall not expose 12 mm. The face joints shall be raked out as directed by raking tools daily during the progress of work when the mortar is still green so as to provide key for plaster or pointing to done.

The face of brick shall be cleaned the very day on which the work is laid and all mortar dropping removed.

**Curing:**

Green work shall be protected from rain suitably. Masonry work shall be kept moist on all the faces for a period of seven days. The top of masonry work shall be kept well wetted at the close of the day.

**Mode of measurement & Payment:**

The measurement of this item shall be taken for the brick masonry fully completed in foundation up to plinth. The limiting dimensions not exceeding those shown on the plans or as directed shall be final. Battered tapered and curved position shall be measured net.

The rate shall be for a unit of one cubic meter.

The testing of material is to be carried out at the cost of the contractor.

**ITEM NO. 27- PLASTER WORK**

**Providing cement plaster 12 mm thick using cement mortar in proportion 1:3 with Neeru finishing, curing etc comp.**

**Materials:** Water shall confirm to M-1 and Cement Mortar shall confirm to M-11

**Workmanship:**

12 mm thick cement plaster in single coat in CM 1:3 (1-cement : 3-sand) with a floating coat of neat cement slurry.

**Scaffolding:**

Wooden bullies, bamboos, planks, treatles and other scaffolding shall be sound. These shall be proper examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

This kind of Plaster is normally for interior side or as specified location by Consultant to be applied as above. NORMAL CEMENT PLASTER and the surface shall be rubbed smooth after coating it with a thick coat of pure Portland cement slurry while the base coat is still fresh. If Neeru plus cement finish is specified floating with neat cement will not be required.

**Mode of Measurement & Payment:**

The rate shall include the cost of all materials labour and scaffolding etc. involved in the operations described under workmanship.

All plaster shall be measured in square meter unless otherwise specified length, breadth or height shall be measured correct to a centimeter.

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves or open joints in brick work, stone work etc. or space between laths. Thickness of plaster shall be average thickness with minimum 10 mm at any point on this surface.

This item includes plastering up to floor two level.

The measurement of wall plastering shall be taken between the walls or partition (dimensions before plastering being taken) for length and from the top of floor or skirting to ceiling for height, depth of cover of cornices, if any, shall be deducted.

Soffits of stairs shall be measured as plastering on ceilings. Elowigns soffits shall be measured separately.

For jambs, soffits, sides, etc. for openings not exceeding 0.5 sq.mt. each in area for ends of joints, beams, posts girders, steps etc. not exceeding 0.5 sq.mt. each in area and for openings exceeding 0.5 sq.mt. and not exceeding 3.00 sq.mt. in each area deductions and additions shall be made in the following manner:

- a) No deductions shall be made for ends of joints, beams, posts etc. and openings not exceeding 0.5 sq.mt. each and no addition shall be made for reverse, jambs, soffits, side etc. of these openings, for finish to plaster around ends of joints, beams, posts etc.
- b) Deductions for openings exceeding 0.5 sq.mt. but not exceeding 3.00 sq.mt. each shall be made as following and no addition shall be made for reverse, joints, soffits, sides, etc. of these openings.
  - i) When both faces of all walls are plastered with same plaster. Deductions shall be made for one face only.
  - ii)
    - For openings having door squares equal to or projecting beyond the thickness of wall. Full deduction for opening shall be made from each plastered face of the wall.
    - In case of openings of area above 3 dq.mt. each deduction shall be made for opening but Jambs, soffits and slits shall be measured.
    - The rate shall be for a unit of square meter.

### **ITEM NO. 28 - IRON WORK**

**Iron work for valve chamber cover as directed by engineer in-charge etc comp.**

All structural steel shall confirm to IS 266 - Latest edition. The steel shall be free from the defects mentioned in IS 226 (Latest edition) and shall have a smooth finish. The material shall be free from loose mill scale, rust, pits or other defects affecting the strength and durability. River bars shall confirm to IS 1148 Latest edition.

When the steel is supplied by the contractor, test certificate of the manufacturer shall be obtained according to IS 226 Latest edition and other relevant Indian Standards.

The design should be made as per the instructions of engineer-in-charge. The rate includes supplying and welding (along with labours), transportation and fixing in position of the steel work.

The rate shall be for a unit of one Kilogram.

### **ITEM NO. 29 - REINFORCEMENT WORK**

**Supplying, Cutting, Bedding, Binding and Hooking and binding with wire for RCC work Tor steel TMT round bar including all cost etc comp.**

The design shall be for seismic zone as per Indian standard. Water density shall be taken as 9.81kN/m<sup>3</sup>. Age factor for increase in strength shall not be considered for design.

Corrosion resistant steel TMT Fe – 415/500 (from approved vendor list) shall be used.

Minimum steel: Design requirements as set out in relevant codes in respect of steel shall be fully satisfied. However following minimum steel should be provided.

<p>a. Vertical steel in columns</p>	<p>The cross sectional area of longitudinal reinforcement, shall not be less than 0.8 percent nor more than 6 percent of the gross cross sectional area of the column.</p> <p>NOTE : The use of 6 percent reinforcement may involve practical difficulties in placing and compacting the concrete, hence lower percentage is recommended. Where bars from the columns below have to be lapped with those in the column under consideration, the percentage of steel shall usually not exceed 4 percent.</p> <p>In any column that has a larger cross-sectional area than that required to support the load, the minimum percentage of steel shall be based upon the area of concrete required to resist the direct stress and not upon the actual area.</p>
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<p>b. Horizontal links in columns</p>	<p>Not less than 8 mm dia at 200 mm center to center or 10 mm dia not more than 300 mm center to center.</p>
<p>c. Exposed R.C.C. surface</p>	<p>On both faces when thickness is 150 mm or more</p> <p>2 kg/ sqm in one direction.</p> <p>-2 kg / sqm in perpendicular direction.</p> <p>The above requirement is satisfied if 8 mm bars @ 200 mm center to center or 10 mm bars @ 300 mm center to center are provided.</p> <p>Even if design steel is less than above, the above minimum shall be provided.</p>
<p>d. Water Retaining Members</p>	<p>The minimum reinforcement in walls, floors, roofs in each of two directions at right angles shall have an area of 0.35% of the concrete section in that direction for sections upto 100 mm thick. For section of thickness greater than 100 mm and less than 450 mm the minimum reinforcement in each of the two directions shall be linearly reduced from 0.35 % for 100 mm thick sections to 0.2 % for 450 mm thick section. For section of thickness greater than 450 mm minimum reinforcement in each direction shall be kept at 0.2 %. In concrete sections of thickness 225 mm or more, two layers of reinforcing steel shall be placed one over each face of the section to make up the minimum reinforcement specified in this clause.</p>

Minimum cover to reinforcement shall be as per I. S. 456 – 2000 and I. S. 3370 (Latest version).

Clear cover shall be provided as below:

- a) Footing/ raft : 60 mm at bottom, sides and at top  
b) Columns : 40 mm  
c) Beams, slabs, vertical wall, gallery landings. : 40 mm

Maximum spacing of Reinforcement: Maximum spacing of main reinforcement in slab or walls shall not be more than 150 mm center to center. The spacing of secondary bars, such as distribution steel or vertical bars in columns shall not be more than 300 mm.

Design shall be based on accepted bases and well known methods of design as well as the provision of I. S. (Latest edition). However methods based on experimental investigation on models as mentioned in para 18.2 3 in I. S. 456 – 2000 shall not be allowed. Similarly the methods / practice of design having no documented evidence shall not be entertained. Only well defined & well known methods of design shall be followed.

### **FLOW METER (DELETED)**

**Supply of Battery operated, IP-68, factory calibrated full bore electromagnetic flow meter with flanged connection, flow sensor, indicator, transmitter and totaliser with all accessories viz. Power and control cables, cabinets, hardwares, etc Flow Sensor: Neoprene/Polyurethane lining, DC pulsed, SS 316 electrods, CS/SS 316 flanges, Fully welded / SS304 sensor construction & housing. Flow transmitter / converter: Microprocessor based / Modular design/ HART type, 2 line back lit LCD for indication of actual flow rate, forward, reverse, sum totaliser display, one current (4- 20 mA) / one scalable pulse / one status output, Dia cast alluminium with PU finish and glass window encloser, 10 meter length sensor cable etc com**

SCOPE :

This specification covers design, supply, installation, testing and commissioning of Full bore Electromagnetic type flow meter with transmitter and totaliser with all required accessories.

- Full bore electromagnetic flow meter shall consist of flow tube, flow transmitter, flow indicator & integrator and any other item required to complete the system. To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow meter shall be provided, as recommended by the flow meter manufacturer and in line with the applicable standards (5D upstream & 2D downstream minimum). Contractor shall finalize the exact location of flow meter in consultation with Engineer.



- An expansion bellow (SS 316) type dismantling joint shall be provided adjacent to the flow meter to facilitate easy insertion / removal of the flow tube.
- Flow measurement shall not be affected by physical properties of water viz., temperature, pressure etc., within given limits. Contractor shall provide compensating electronic circuits, if required.
- A lockable & tamperproof enclosure shall be provided for the flow transmitter cum computing unit.
- Flow meters shall be suitable for the water turbidity at site during various seasons. Flow tube shall be rugged in construction and shall be suitable for continuous operation. Flow tube shall have waterproof construction and shall be suitable for installation on underground /above ground pipe lines.
- Flow transmitter shall accept inputs from flow tube, process the signals and shall provide an output proportional to the flow rate. The output shall be 4-20 mA with HART (version 6 or above), RS-485/Modbus.
- Necessary accessories, as required, shall be provided for installation of flow meters.

Technical specifications:

Flow Sensor:

The sensor shall be suitable for being directly buried or above ground and shall have a degree of protection to IP 68 or IP 67. The sensor shall have PN16 flanged end connections. Flange material & type shall be as per piping requirement.

The sensor shall be suitable for an operating pressure of 16 bar gauge and a system test pressure of 25 bar gauge.

The metering tube shall be suitably lined to withstand abrasion of the fluid. The lining shall be of Neoprene/ Polyurethane / EPDM. The electrodes for sensing the voltage induced in the liquid shall be made of type SS 316.

The coil housing shall be fabricated from corrosion resistant material with epoxy painting, capable of submerged/ buried/ above ground operation.

The sensor shall be supplied complete with a factory-fitted umbilical cable for communication with the electronic display unit. The cable length shall be determined by the contractor for each meter location, but shall be not be less than 15 meters long so that it can be cut on site to suit the selected location for the electronic display unit. The construction of the signal connectors and cable shall protect the water meter from electromagnetic interference and shall be suitable for buried/above ground use and outdoor installation. The cable shall be protected by a suitably robust polyethylene sleeve to prevent accidental damage.

The Contractor shall provide all sundry items such as grounding electrodes and/or grounding rings (SS material) necessary for satisfactory operation of the sensor.

**The Electronic Display Unit:**

The enclosure of the electronic display unit shall have a degree of protection to IP 67. The display unit shall have a configurable password protection for accessing the flow meter menu.

Power supply for flow transmitter shall be 230V AC, 50 Hz / 110V AC, 50 Hz.

The unit shall have backlit LCD displays to show the following parameters, as selected by the operator:

- Cumulative/totalized flow
- Instantaneous flow rate
- Instantaneous velocity
- Peak day flow
- Date and time

i. The user shall be able to configure the electronic display unit to display:

- Flow rate in m<sup>3</sup>/h or l/s
- Velocity in m/s
- Cumulative /Totalized Flow in ML.

ii. There shall also be status indicators for each of the following conditions:

- Fault
- Empty pipe

iii. **DIGITAL FLOW INDICATOR & FLOW INTEGRATOR**

Digital flow indicator and flow integrator shall be modular in design. It shall consist of two separate dedicated back-lit LCD/LED displays for flow rate indication and total flow indication. It shall accept 4-20 mA DC input from flow transmitters. It shall have a battery backup for flow totaliser. The flow indicator and flow totaliser shall have a facility on PCB for changing the multiplying factor. The flow indicator cum flow integrator will be provided with 4-20 mA retransmission signal for flow rate and RS-232 communication port for the pulsed output signal for integrated flow.

**REFILLING OF TRENCHES:**

On completion of the pipe laying operations in any section, for a length of about 100m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of Trench Excavation and the Contractor shall not permit

unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Engineer considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. The excavated material nearest to the trench shall be used filling. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline unless the trench has been filled to height of at least 30cm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench may be filled in with a mixture of hard and soft material free from boulders and clods of earth larger than 150mm in size if sufficient quantity of good earth and murrum are not available. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place. The top 300mm layer or fertile agricultural soil shall be kept aside during excavation and shall be laid in layers near ground level during refilling.

To prevent buckling of pipe shell of diameters 1200mm and above, pipes shall be strutted from inside while the work of refilling is in progress, for which no separate payment shall be made.

Strutting shall be done by means of strong spiders having at least 6 arms which shall be sufficiently stiff to resist all deformation. Spiders shall be provided at a maximum interval of 2m & shall be welded in such a way that internal coating does not get burnt.

The Engineer shall, at all times, have powers to decide which portion of the excavated materials shall be for filling and in which portion of the site and in what manner it shall be so used.

If any material remains as surplus it shall be disposed of as directed by the Engineer, which includes loading, unloading, transporting and spreading as directed within all lead. If the Contractor fails to remove the earth from site within 7 days after the period specified in a written notice, the Engineer may arrange to carry out such work at the Contractor's risk and cost or may impose such fine for such omission as he may deem fit. Particular care shall be taken to keep the trench dry during the entire refilling operation.

If suitable material for refilling is not available for excavation the Contractor shall bring earth, murrum of approved quality as directed by the Engineer.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval of the Engineer has been obtained.

Subsidence in filling in : Should any subsidence take place either in the filling of the trenches or near about it during the maintenance period of 12 months from the completion of the Contract Works, the Contractor shall make good the same at his own cost or the Engineer may without notice to the Contractor, make good the same in any way and with any material that he may think proper, at the expense of the Contractor. The Engineer may also, if he anticipates occurrence of any subsidence, employ persons to give him timely notice of the necessity of making good the same, and the expenses on this account shall be charged to the Contractor.

### **ITEM NO. 30 - EXPANSION BELLOW**

#### **Expansion Bellows (Flanged) :**

**Providing testing of corrugate design stainless steel expansion bellows with flanges, 15mm axial movement, 300mm overall length with tie roads, nuts etc with fitting and Fixing etc comp. PN 1.6**

Expansion bellow are used before butterfly valves, pumps and other equipment to provide flexibility to the equipment installations by joining flanged spigot and flanged coupling adapter into one assembly.

Expansion bellow are fully end load resistant and have a pressure rating equal to that of the flange and design and specification must be as per applicable Indian standard.

#### **Manufacturer's Guarantee**

The manufacturers shall guarantee that if any defects chargeable to faulty workmanship, design or materials are found in the dismantle joint within a period of one year of dispatch be shall replace any part that prove defective, free of charge at the place of dispatch.

#### **Information Required**

The following information shall be cast on each joint:

- (a) Manufacturer's name or trademark and size.

#### **Packing and Handling**

- The materials shall always be packed separately dispatched from manufacturer's works with adequate protective measures to prevent damages deterioration while in transport or stored at any place. The packing shall always be so neat and tidy that may withstand any robust and rough handling.
- When the materials are transported at railway risk, special packing as per IRCA rules are absolutely necessary for which the extra cost, if any, shall be borne in total by supplier only.

- The supplier shall use proper handling instruments/equipment's and shall follow to a suitable method of handling pipes as may be approved by Engineer, while unloading and stacking material in the stores.

### **Materials and Workmanship**

- General requirements of materials and workmanship shall mean any material or article either raw or finished one is required to be used in the manufacturing process of tanks.
- All the material shall be new and of high quality.
- In case, if material is not specified by relevant ISS for manufacturing part or the whole as item, the supplier shall prepare specifications in concurrence with manufacturer and shall seek an approval of Engineer prior to its use in the manufacture.

### **Test Certificate**

- The supplier shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.
- The supplier shall also produce in addition to manufacturer's test certificate as mentioned under "inspection & testing above", the inspection certificate issued by the employer or his authorized person / agency appointed.

### **Inspection**

This clause is applicable in general to all materials such as all types of valves, pre-cast chambers, other specials and materials, dismantle joints etc. which are to be supplied by the contractor. Inspection should be in presence of Rajkot Municipal Corporation officials and PMC officials as and when required.

The rate shall be paid per NUMBER basis of actual work done.

### **ITEM NO. 31 & 32 - CROSSINGS**

**ITEM NO. 31: Railway Crossing:** Drilling of 1300mm dia Horizontal borehole for wastewater main pipeline under the railway tracks incl strata with required length incl fixing of 1200mm dia M.S. casing pipe with welding pushing etc complete various size of pipe for 559mm to 711mm dia water main incl providing & fixing of required size of M.S. pipe for railway premises as per instruction of Railway authority & under supervision of Railway authority incl providing & supplying fixing of ISI make sluice valve of required size at both side of railway boundary with construction of brick age pavement incl C:C 1:3:6 encasing of pipe at both side. Providing & fixing of M.S.

Manhole frame with cover for valve chamber with locking arrangement etc. complete with all material labour fabrication, hydraulic testing of pipe & valve etc complete (45mt length) 559mm dia to 711 mm dia wastewater/water main pipe line.

Note:- Drilling of bore hole and M.S. casing pipe dia and thickness

**ITEM NO. 32: Highway Crossing:** Drilling of 1300mm dia Horizontal borehole for wastewater main pipeline crossing under the road incl in all strata with required length incl fixing of 1200mm dia M.S. casing pipe with pushing etc complete various size of pipe for 559 to 711mm dia wastewater main (For 55mt length)

### **CROSSING: GENERAL SPECIFICATIONS**

At public highways, or at such other crossings as are shown in the construction drawings issued by the company the pipeline shall be installed in MS casing pipe conforming to the specifications given herein.

- (a) The casing pipes shall be installed in accordance with the details given in drawing and the casing, bushing and insulators, etc., shall be installed on the carrier pipe as detailed in drawings. Casing pipe size shall be as per approved drawing of sanctioning authority, Casing shall be installed with even bearing throughout its length and shall slope towards one end, as specified or desired by the engineer-in-charge. The ends of the casing shall be sealed to outside of carrier pipe in accordance with the details given in drawing.
- (b) Before installation, holes for installing vent pipes shall be cut and burrs if any shall be removed. The welding of both carrier pipe and casing pipe shall be done in accordance with the welding specifications, given herein. Before installing the casing pipe, it should be cleaned of all internal obstructions and during installation care should be taken to keep the inside clean.
- (c) The section of carrier pipe to be placed in any casing shall be closed at each end, hydrostatically tested preferably with dead weight tester for at least two hours. Only on successful completion of this test, shall the carried pipe section be inserted in the casing pipe. The installation of casing may open cut as circumstances may permit or require as directed by the engineer-in-charge.
- (d) The installation of casing in bended section of the carrier pipe shall be performed by meter bends of the casing pipe provided that the length of each meter cut out of casing pipe shall be such as to provide a clearance of at least 1-1/2" between the inside of the casing pipe and the outside of the coated carrier pipe.

- (e) Excavation for casing installation shall be immediately backfilled at the completion of the work with suitable solid matter and packed thoroughly to prevent seepage of water into the excavation.

**ROAD AND IRRIGATION CANAL CROSSINGS :**

- (a) At road and canal crossings the work shall be performed to the specifications of local authorities or such public bodies as may be in charge (S) of roads and canals to be crossed.
- (b) In case, however the minimum requirements of the governing agencies are less than those set out in the drawing or the specifications given herein, then the requirements given in the drawings and the specifications given for encased line shall be followed.
- (c) Where as the casing pipe in the case of encased line to be laid normal by boring, tunneling, engineer-in-charge may at his discretion permit open-cuts to be made for the installation of casing provided, however, that the TENDERER shall procure the necessary permit / license for the same from competent authority. At locations wherein the open cut methods are permitted, the TENDERER shall pass the carrier pipe through the casing located in the trench after the approval of the engineer-in-charge in writing , if Open Cut method is not permitted by authority, pipe is to be laid through Push Through Method. and care shall be exercised to avoid damage to pipe coating and wrapping during this operation. The TENDERER shall produce a certificate in writing from concerned authorities for its satisfactory restoration and payment therefore.
- (d) At all crossings the carrier pipe shall be laid straight without bends so that if necessary the pipe at a later date may be replaced without cutting the casing. The carried pipe shall extend at least 2 meters beyond the end of casing pipe at either end.
- (e) At road crossings the TENDERER shall eliminate unnecessary bending of pipe to conform to the contour of ground by gradually deepening the ditch at such approaches as directed by the engineer-in-charge. Where the installation of the casing has been made by open cut TENDERER shall install suitable temporary bridge work ensuring the safety of the traffic aids and safeguards for protection of the public safety, or he shall provide suitable diversions as desired by the engineer-in-charge.
- (f) At all railways pipeline crossings shall be bored with horizontal boring machine.

- (g) The method of carrying out a cased crossing by boring for various crossings on this pipeline route shall be jointly inspected by the representative of the COMPANY and TENDERER for each category of work prior to commencement of actual work.
- (h) Pipeline under Road Track and irrigation canal an applicable portion of the right-of-way shall be encased in accordance with the specification. This item of work shall include, necessary clearing and grading required therefore, trenching to the depths and widths required, welding of casing and carrier pipes, testing, lowering in, installation of vent assemblies, end seals, insulator and all other fittings that may be required, backfilling, clean up, complete restoration to the original condition and further strengthening and protective works as may be required. The work shall be carried out in accordance with the drawings and as directed by the engineer-in-charge. For various operations mentioned above, the specifications pertaining to these operations shall apply in addition to the specifications given herein.

The TENDERER shall be permitted to use William Sons type Neoprene seals in place of concrete end seals for the crossings. The item shall be procured by the TENDERER himself as per the provisions under the appropriate head of work in case TENDERER so desires. The representative of the COMPANY may also be associated to determine the quality of the material and its delivery schedule from the open market. However, the particular work defined under the proper head shall not be delayed on account of non-availability of Neoprene end seals. In such case, concrete seals may be provided.

On both ends of pushing concrete supports are to be provided as per direction of engineer-in-charge.

#### **SPECIFICATIONS FOR CASTING RCC BOX & PUSHING THROUGH EMBANKMENT**

In order to avoid interference to railway traffic / excavation on existing roads intercepted on pipeline alignment, BOX PUSHING technique is envisaged in preference to any other conventional methods for the laying of pipeline through such railway & road crossings intercepted.

The R.C.C. box segments shall be cast using concrete grade of approved design mix in suitable segments as per the approved design, and pushed across the embankment by hydraulic jacks, of suitable capacities excavating manually the soil under the FRONT SHIELD of the box.

The thrust bed required for box pushing shall be of required width and of length and thickness as per design approved and laid along the longitudinal axis of proposed box. The thrust bed is envisaged in reinforced concrete using grade M-20 and designed to resist the reaction induced due to jacking force while pushing the box inside the embankment. The reaction due to jacking force shall mainly be resisted by frictional resistance between thrust bed and the earth. However, additional keys provided at the bottom of the bed shall be made use of to develop more resistance due to passive pressure of the earth.



The concrete below the bottom of each pin pocket shall be done first for positioning them. Aligning these pin pockets is very important aspect while casting the thrust bed in order to avoid any lateral shifting of the box with respect to its axis. Therefore, these boxes shall be held in position by welding MS bars between boxes in longitudinal and lateral directions. While concreting for entire thrust bed is carried out, two recesses shall be left along the entire length of the thrust bed at top for housing rails. Leveling of these rails shall be done by providing suitable MS packing Coils at suitable spacing. These recesses shall then be filled with screed mortar. Also, 50 mm thick screed shall be laid on top of the thrust bed and leveled such that the top of rails shall remain 2 mm protruding above top level of the thrust bed. The pin pockets shall be covered with precast cover slab before screeding. The thrust bed shall be laid in a slope of 1:700 to avoid lifting of box during pushing.

In order to facilitate jacking and steering, it is envisaged to cast the box in segments of suitable lengths. The first box shall be provided with FRONT SHIELD and REAR SHIELD. The front shield shall consist of M.S. Plate with suitable stiffeners. Anchor bars, welded to the Plates shall be embedded in the concrete of the box. The front shield shall be 1.0 M wide on all four faces with 0.50 M width embedded in box concrete. Similarly, rear shield shall be provided at the rear end of each box. Half the width of rear shield shall be embedded in box concrete with outer face being flush with outer surface of the box. For the front 0.50 M length of box, the thickness of top and bottom slab and both sides shall be reduced by 30 MM. so that rear end of the first box and at front end of remaining box pockets, suitably lined with 6 mm thick M.S. Coils shall be provided to house hydraulic jacks for intermediate jacking. Two pockets shall be provided in the side walls of box, just below top Haunches and two shall be provided in bottom slab of box, next to Haunches.

The box is designed as a normal box but subject to longitudinal thrust while pushing.

8 mm thick M.S. Plates shall be laid over rails placed in thrust bed to form bottom of box along the length. The bottom surface of these Coils shall remain flush with the bottom of the box. These Plates shall be anchored in bottom slab concrete with welded anchor bars. With this arrangement, while pushing the box over the thrust bed, the contact between steel to steel surfaces shall reduce friction. Before casting the box, polythene sheets suitably greased shall be laid on the top of thrust bed & bottom of box to prevent contact between thrust bed and bottom of box and facilitate pushing with very smooth, frictionless surface between the thrust bed and bottom of the box.

To withstand reactions of jacking force, jacking pins are provided with M.S. bar handle to facilitate the lifting when required. The overall dimensions of the pins shall ensure smooth insertion and lifting inside pin pockets.

A jacking rig, fabricated from M.S. Plates and structural steel shall be provided to ensure proper alignment of jacking force. One end of the jacking rig shall have saddles to house hydraulic jack. The clear width inside rig shall be more than pin pocket to ensure smooth

sliding of rig. Spacers fabricated from M.S. Plates shall be used for filling gaps between hydraulic jack and jacking pin while pushing. These spacers shall be meant to rest against jacking pin at one end and jack ram at the other end.

After completion of casting of box, pushing operation shall commence with the rigs laid on top of the thrust bed with one end of the rig resting against face of the rear end of bottom slab of the first box. The hydraulic jacks shall be properly housed in the rig so that one end of jack shall rest against the end plate of the rig. The other, ram side of the jack shall rest against face of jacking pin. When the jack shall be operated, the ram shall be pushed against the jacking pin. This will make the box to move in the direction of thrust away from jacking pin. When the full displacement of ram be obtained, the jacks shall be closed and spacers shall be inserted between the jacking pin and the jacks. the jacks shall be operated again and the box shall be pushed in the direction of thrust. When the rig travel to expose next row of pin pockets, the jacking pin shall be removed and installed in the next row of pin pockets. This process shall be repeated till the front shield shall cut into the embankment for about 1.0 M.

The excavation at the front end of the box shall be carried out manually within front shield. the muck shall be removed from the box. When about 0.50 M of excavation shall be done, the jacks shall be operated again so that front shield shall be pushed for 30 or 40 cms further inside the embankment. Again, the excavation shall be continued till the entire length of first box is fully pushed inside the embankment. When rear end of the first box shall be very close to the embankment, the second box shall then be cast and after adequate curing, pushed to lock inside the rear shield of the first box. Hydraulic jack shall be housed in intermediate jacking pockets and an intermediate jacking station shall be opened up. The operation of the jacks in the intermediate jacking station shall be similar to that in the initial stage. However, in this case, the ram shall rest against plate lining in pockets. After opening the intermediate jacking station, the intermediate jacks shall be operated while the rear end of 2nd box shall be made to anchor against the jacking pin through the jacks.

**In General following sequence shall be adopted in carrying out the job :**

- a) After casting thrust bed, polythene sheets suitably greased shall laid on the top of thrust bed as above explained to prevent contact between thrust bed and bottom of box.
- b) The reinforcement cage required for base slab with reinforcement for side walls shall be placed in position on bed. The precast blocks or chairs for provision of cover shall be provided under the cage.
- c) The base slab and side walls up to top of bottom haunch would be concreted with M-25 grade concrete in one operation leaving the top of side wall rough.

- d) The reinforcement cage for side wall shall be laid in proper position. The lap length shall be provided properly. The side walls shuttering shall be provided by proper checking of alignment & vertically up to bottom of top haunch.
- e) The surface of hardened concrete shall be thoroughly hacked, swept clean, wetted and covered with a layer of neat grout. The neat grout shall be applied to the top and this shall be followed by a 10 mm thick layer of mixed the same proportion as that of and sand in concrete and concreting shall be resumed immediately thereafter. The first batch of concrete shall be rammed against the old work to avoid formation of any stone pockets particular attention being paid to corners and closed spots and the concreting of side walls shall be carried out up to the bottom of top haunch.
- f) The reinforcement cage for top slab shall be laid properly on centering and chairs or precast units for providing cover shall be laid under cage. The centering shall be checked in alignment and props shall be of sufficient strength.
- g) Concreting of top slab shall be carried out in the same manner as per 5 above.
- h) Pushing of the completed segments of the box shall be commenced as per the procedure described in above paras till the entire length of the box in the embankment is built up.
- i) After completion of jacking, pressure grouting of concrete shall be carried out of fill joint between segments to make then water tight and the inside face of the joint treated with smooth finishing and box indicators shall be placed at both ends of box showing necessary details of box and communication. Both ends shall be closed with BB Masonry keeping provision of air vents.

### **ADDITIONAL CONDITIONS:**

1. The contractor shall have to provide his own level instrument for this work (if required).
2. Lowering, laying and jointing works of the DI pipelines shall have to be carried out by using Sight Rails and Boning Staves (if required).
3. Work is required to be carried out in residential area where all the services like water supply, sullage water pipeline, gas pipeline, telephone / electric cable are existing. Under the circumstances, prior to starting the work agency shall have to excavate the trenches **manually** for up to minimum **1.20 mt. depth**. During the course of execution, all the services shall have to be maintained by the agency and any damage to any services or property, the agency shall have to get it repair at their cost.
4. For excavation of trench, use of JCB machine will not be permitted directly on the top surface of the road. After excavation up to minimum 1.00 mt. depth from road surface or existing ground level, same shall have to be carried out manually or by using Breaker and after locating underground services like; water supply pipeline, gas pipeline, water connection lines, pipe gutters, telephone cables, electric cables etc., and thereafter upon taking the prior approval of the Engineer-In-Charge, the excavation can be carried out by using JCB machine.
5. Rajkot Municipal Corporation shall recommend to the competent authority to give Controlled Blasting License to the contractor for carrying out excavation in hard rock. In case of blasting license not permissible from the competent authority in some places then excavation is to be done by using wedges and hammers, chiseling, breakers, pneumatic tools, etc. Also in case where blasting license is permitted but even then if there is no possibility of carrying out the blasting for whatsoever reason, the excavation is to be done by using Wedges and hammers, chiseling, breakers, pneumatic tools etc. No extra payment shall be made for excavation to be carried out in any of the above mentioned both the situations.
6. Excavation in soft rock and hard rock shall have to be carried out only by Chiseling, Breaker (pneumatic tools) etc., as far as possible. If excavation is not possible in terms of above and if excavation is required to be carried out with the help of blasting then the same shall have to be carried out only after taking prior approval and necessary license for blasting from the competent authority.
7. In case of excavation not possible manually or by chiseling in certain place(s) as well as if blasting is also not possible due to various reasons i.e. to avoid damage to nearby water pipeline, pipe gutter, telephone cables / Duct, Raw houses / week buildings / narrow street etc., then the excavation by blasting will not be permitted. Under these circumstances, excavation shall have to be carried out only by Breaker (pneumatic tools) as per the instructions of the Engineer-In-Charge.

No extra payment will be made for such type of excavation done by using Breaker. The rate for excavation shall be paid as per the rate of related item mentioned in Schedule-B.

8. The safety of the trenches is the prime important factor. Along the trenches on both the side, a hump of excavated stuff of minimum height 3 to 5 ft shall have to be provided till the work is got completed. However, where there is no defined road, in such area, the fencing/ lighting etc., requires to be provided as per safety clause. Sign Board shall have to be provided at required locations, so that there will not be any fatal accident.
9. The quantity of various items mentioned in the schedule-B is liable to increase or decrease up to any extent. Under the circumstances, the contractor shall have to carry out the work accordingly without any rate escalation. Rajkot Municipal Corporation will not entertain any dispute in this regard.
10. In excavation, the decision regarding classification of strata shall rest with the Engineer-In-Charge and his decision in this regards shall be final and binding to the Contractor.
11. The rates are inclusive of dewatering, if required.
12. In case of any ambiguity found in specifications / drawings etc, the decision of engineer-in-charge shall be final and binding to the contractor.
13. The contractor shall have to arrange for a vehicle at his own cost for staff of Rajkot Municipal Corporation to visit the factory for testing of M.S., D.I. pipe and valve. The contractor himself shall also have to join the staff of RMC at the time of visit to factory for testing of M.S., D.I. pipe and valve.
14. RMC will accept saving material of only M.S./D.I. pipe 5% of tender quantity or 50.00meter whichever is less and full length of pipe without any defect.
15. The 1300 mm dia borehole and 1200 mm dia casing pipe has been considered in this work for Railway Crossing and Highway Crossing, however, the diameter of borehole as well as casing pipe for this work as may be directed by the Railway / Highway Authority, shall be binding to the contractor and shall have to carry out and execute the work accordingly, for which, the payment will be considered as per the SoR of G.W.S & S.Board and will be made as per the Percentage Rate quoted Above/Below by the agency. The mode of payment will be done on one Running Meter / Job basis for this work. Upon receiving the approval from the Railway / Highway authority for the aforesaid work, the agency shall have to carry out and complete the work within the time period of 45 days. If the approval from Railway / Highway authority is received during the course of execution of work and the time limit of 45 days is covered under the original time limit of completion of work of 9 months then the work is to be completed within the total completion period of 9 months only. However, suppose, if the approval is received having left one month of time limit to complete the work then the remaining period of 30 days of time limit of 9 months will be considered in

original time limit of 9 months whereas other 15 days out of time limit of 45 days, will be extended additionally by Rajkot Municipal Corporation to complete the work.

### **ARRANGEMENT OF TRAFFIC DIVERSION DURING CONSTRUCTION**

**a) General:** The contractor shall at all times carry out work on the road in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing road the contractor shall, in accordance with the directives of the Engineer-in-charge, provided and maintain, during the execution of the work, a passage for traffic along a part of the existing way under improvement, or along a temporary diversion constructed close to the road.

**b) Passage of traffic along a Temporary Diversion:** If in the opinion of the Engineer-in-charge it is not possible to pass the traffic on part width of the carriage way for any reason, a temporary diversion close to the road shall be constructed as directed. It shall be paved with locally available materials such as hard murrum, gravel, brick or stone metal to the specified thickness and provided with bituminous surfacing, where directed. In all case, the alignment, gradients and surface type of the diversion, including its junctions, shall be approved by the Engineer-in-charge before the highway is detoured and closed to traffic. At cross drainage points, the contractor shall provide temporary crossings for the diversion according to the designs approved by the Engineer-in-charge.

**c) Traffic Safety and control:** The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, fights and flagmen as may be required by the Engineer-in-charge for the information and protection of traffic approaching or passing through the section of the road under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

The barricades erected on either side of the carriage/portion of the carriage way closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept throughout from sunset to sunrise.

At the point where traffic is to deviate from its normal path whether on temporary diversion or part width of the carriage way the channel for traffic shall be clearly marked with the aid of pavement markings painted drums or a similar device to the directions of the Engineer-in-charge. At night the passage shall be delineated with lanterns or other suitable light source.

One way traffic operation shall be established wherever the traffic is to be passed over part of the carriage way inadequate for two-lane traffic. This shall be done with the help

of flagmen kept positioned on opposite sides during all hours for regulation of traffic. The flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides suitable regulatory/warning signs shall be installed for the guidance of road users, On each approach at least two signs shall be up put one close to the point where transition of carriage way begins and the other 120 meters away. The signs shall be of approved design and of refractory type if so directed.

**d) Maintenance of Diversion and traffic control Devices:** Signs, lights, barrier and other traffic control devices as well as the riding surface of diversions shaft be maintained, in satisfactory conditions till such time they are required as directed by the Engineer-in- charge. The temporary travel way shall be kept free of dust by frequent application of water if necessary.

**e) Measurements for payment traffic Arrangement:** All arrangements for traffic during construction including maintenance these off but excluding initial dressing and/or extra treatment of the shoulders and construction of temporary diversions shall be considered as incidental to the works and Contractor responsibility. There will be no extra charge to contractor for this.

The work in general shall be carried out as per instructions & approval of engineer in charge.

**Add. Asst. Engineer  
Rajkot Muni. Corporation**

**Dy.Executive Engineer  
Rajkot Muni. Corporation**

**Executive Engineer  
Rajkot Muni. Corporation**

**Signature of Contractor**

**APPROVED VENDOR LIST**

<b>SR. NO.</b>	<b>PARTICULARS</b>	<b>DESCRIPTION</b>
1.0	DI PIPES & SPECIALS/FITTINGS	ELECTROSTEEL,JINDAL, ELECTROTHERM,
2.0	UPVC PIPES ASTM STANDARDS	SUPREME, PHINOLEX, JAIN, ASTRAL, WATERFLO,
3.0	UPVC - FITTINGS	SUPREME, PHINOLEX, JAIN, ASTRAL, WATERFLO,
3.0	TAPPING FERRULES	AS PER IS STANDARD BUT LONG BODY
4.0	RIGID PVC SADDLE	ISI MARKED & REPUTE COMPANY,
5.0	SLUICE VALVE/BUTTERFLY VALVE ISI MARKED ONLY.	KIRLOSKAR / IVC / IVI/ FOURESS.
6.0	AIR VALVE	KIRLOSKAR / IVC / IVI/ FOURESS.
7.0	MS PIPE SPECIALS	SAIL, WELSPUN, JINDAL, SAW, ESSAR STEEL.
8.0	PRESSURE GUAGE	H GURU / BELLS & CONTROL / GENERAL INSTRUMENT
9.0	FLOW METER	ACCUSONIC (U.S.A) / DANFOS / RITTMAYER (I,S,K, ENGG. MUMBAI) / E+H / KROHNE MARSHALL / ULTRAFLUX (FRANCE)
10.0	CHECK VALVE	KIRLOSKAR / IVC / IVI / UPADHAYA
11.0	CEMENT	AMBUJA, ULTRA-TECH, ACC, SANGHI, SIDDHI, LOTUS, HATHI
12.0	WELDING ROD	ADOR(ADAWANI), ESAB

Signature of contractor