

**ELECTROSTEEL  
CASTINGS LTD.**





## VISION

Electrosteel Castings Limited (ECL) aims to be world class, committed to customer satisfaction and to encourage the spirit of leadership amongst our dedicated team by creating a healthy environment for continuous growth, profit and prosperity.

Umang Kejriwal  
Managing Director

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## A PROFILE

ELECTROSTEEL CASTINGS LIMITED (ECL) is a five decade old company engaged in water infrastructure business. It caters to a large customer base spread in the Indian subcontinent, South East Asia, Middle East, Europe, Africa, USA etc. A coherent marketing network spearheaded by a dedicated work force serves customers spread around the globe. More than 10,000 numbers of water supply projects have already been implemented with Ductile Iron Spun Pipes & Fittings made by ECL in India and abroad.

## QUALITY ACCREDITATION

ELECTROSTEEL CASTINGS LIMITED (ECL), is an ISO 9001 organization producing Ductile Iron Pipes as per acclaimed quality conforming to Bureau of Indian Standard (BIS), European Standard (EN), ISO Standard and American Standard (AWWA). Its quality is approved and accepted in more than 50 countries. Over the years, the company has received quality approvals, certifications and marks for its Ductile Iron Pipes from the ISI (India), ACS (France), DVGW (Germany), BSI Kitemark (UK), SIRIM (Malaysia), UL (USA), FM (USA) among others.

## COMPLETE INTEGRATION

The Company consistently invests in backward integration as a strategy that has helped the company to maintain consistency in supply.

### **Captive coal mines and Coke Oven Plant**

The Company has a Coal Block at Jharia Coal Field. This captive source assures steady supply of Coking Coal and insulates the company from

demand-supply volatility in the market. The allotment of iron Ore Mines to the Company at Kodoliband, Jharkhand will also ensure steady supply of iron ore.

### **Captive Power Plant**

In addition to its existing 3.5 MW power plant at Khardah, the Company has a 12 MW power plant at Haldia. It uses waste gas from the Coke Oven and Sponge Iron plants to generate power.

### **Diversification**

Electrosteel group has an integrated steel plant of 2.2 MTPA in Jharkhand, near Bokaro and will soon be the major producers of Iron and Steel in Eastern India. The plant is based on Coke Oven-Sinter Plant-Pellet Plant-Blast Furnace-Basic Oxygen Furnace-Billet Caster-Wire Rod Mill and Bar Mill. A Ductile iron pipe plant is a part of this venture producing pipes upto 1200mm dia.





## A GREEN COMPANY

□ Electrosteel is effectively maintaining the Environmental Management System Standard ISO 14001 since 2004. It is one of the first ductile iron pipe plants in the world to be accredited with ISO 14001 certification.

□ Electrosteel has a 12 MW Power Plant at Haldia as a Clean Development Mechanism (CDM) Project. In this project the sensible heat in the waste gas emissions from Coke Oven Plant and Sponge Iron Plant is utilized for power generation saving approximately 78,000 MT of Carbon Dioxide emissions to atmosphere, every year. It is registered as a CDM project with UNFCCC (United Nations Framework Convention for Climate Change) under Kyoto Protocol.

□ 92% of the waste water at our plant is recycled and reused.

□ The Company conducts plantation programmes as a regular activity in all its premises as a part of green belt development. A number of local flora has been planted at the plant premises and adjoining areas. The 750 species of plant in and around the works helps in the abatement of suspended particulate matter.

□ The sintering Plant uses iron ore fines and utilize wastes generated from treatment process, Blast Furnace Gas cleaning Plant and other carbon bearing and Iron bearing Solid wastes to produce sinters for feeding in blast furnace. The sintering Plant is declared a zero waste plant.

□ Electrosteel has sponsored various campaigns for spreading awareness of environment issues in the neighborhood. Staff members from various Polytechnics, along with the Faculty of National Institute of Technology Teachers' Training & Research are regularly provided in-plant training on Environment and Safety Measures.

## REACH

REACH is the European Union Chemical Regulation (EC) N°1907/2006 governing the Registration, Evaluation, Authorisation and Restriction of Chemicals. The Regulation came into force on 1st June 2007 and implementation started in 2008. As on February 2012, European Chemical Agency, ECHA has published a list of 73 SVHC (Substances of Very High Concern).

REACH requires industry to ensure that the chemicals it manufactures and places on the market in the EU do not adversely affect human health or the environment. Electrosteel supports the aims and objectives of REACH.

Electrosteel is a downstream user of chemical substances only (not a manufacturer or importer), therefore we have no registration obligations for substances we use within the EU. We are committed to timely fulfillment of all other obligations under REACH. We confirm that in the Electrosteel's Product, any of the 73 substances of very high concern (SVHC) which the European Chemicals Agency (ECHA) added to the candidate list for Annex XIV are not present or less than 0.1% weight/weight. We will continuously monitor all future additions on the SVHC list and where necessary will work to ensure that our products are free from these substances.





## ENVIRONMENT AND ENERGY MANAGEMENT

- A full fledged laboratory monitors and controls pollution in the plant and finds ways and means to minimize energy consumption
- The Blast Furnace gas is utilized in the Heat Treatment Furnace resulting in substantial energy saving and carbon emission reduction.
- Blast furnace gas also runs a Captive Power Plant of 3.5 MW providing power to the plant and effecting considerable reduction of CO<sub>2</sub> emission.
- The Zinc dust is collected by Pollution Control Equipment and used as Raw Material to produce fertilizer for agriculture avoiding soil and air contamination.
- Extensive use of solar lamps and CFL bulbs in the plant and office reduces energy consumption.
- Electrosteel makes fittings by VLFP technique, thereby eliminating use of sand and binders, thus preventing environmental contamination.
- Electrosteel has achieved an emission rate of only 300mg/kg of hot metal handled which is one of the lowest in the industry. Air quality is regularly monitored.
- Innovative use of waste material has been effected in many cases. As an example, Wooden spacers to support pipes during transportation are now being replaced with spacers made out of wastes of various products, saving huge quantity of valuable wood.



## HEALTH AND SAFETY

Electrosteel is committed to the safety and health of its employees. The Safety Management Systems are constantly being monitored for improvement and upgradation to compete with the best in the industry. Mechanisms for monitoring activities related to health, hygiene and safety have been set up at every plant. Some of the steps taken on this account are as under:

- The Company conducts regular training programmes to create health and safety awareness among employees.
- In addition to normal periodical medical check-ups for the employees, special tests like Pulmonary functions, audiometric tests, chest X-rays are regularly done for concerned areas.
- Use of JIPM - TPM methodology of KYT (Danger Prediction Drill) is being continuously enhanced to further improve the consciousness of workmen and supervisors. In addition, to avoid failure, mistake proof (Pokayoke) and Safety assurance perfect line (SAPL) have been introduced.
- Workmen involvement at all levels is continuously enhanced by creating safety volunteers in each shop. Safety related quiz competition among staff, workers and contractor's workmen is regularly organized to increase the knowledge.
- Observations of Senior Managers in the 'Planned Visit' of the plants are paid due attention and also form one of the basis of improving 'Safe Operating Practices'.
- Safety audits by experts is a regular practice.
- There is a regular thrust on Involvement of the associate agencies like transporters, contractors etc by way of training and monitoring ensuring implementation of safe operating procedures in their area of work.
- Ambient air quality (SPM) around the Factory is regularly monitored to ensure health work environment at Khardah and Haldia.
- Electrosteel also focuses on the development of the eco-system and improvement of the green belt in and around its manufacturing plants.



## CORPORATE SOCIAL RESPONSIBILITY

Social Welfare, community development, economic and environmental responsibilities are at the core of the CSR of the company. As part of its policy for corporate social responsibility, the company undertakes a range of activities to improve living conditions of people in the neighborhood of all its plants. These activities include education, healthcare, sports, cultural events, vocational training such as:

- Development, repair, renovation and extension of classrooms of local Institutes.

- Rewards for good & bright students in the locality. Distribution of Education Kit to poor children. Supplying study benches to local schools.

- Free Medical check up and Blood donation camps in the Neighborhood. Our company runs and operates two charitable medical facilities involving local people.

- Setting up of Drinking water Kiosks in the local area.

- Giving entrepreneurial opportunity to local unemployed youths to supply material and through encouraging contract activities.

- Financial assistance to local organizations to pursue their sports activities. Distribution of sports kits in nearby localities.

- Organize sports Tournaments involving local schools and clubs at District level with an aim to promote sports activities in the District.

- Organizing Cultural Programs involving local residents.

- Organizing Workers day for promoting cultural activities among workers, their families and locality.

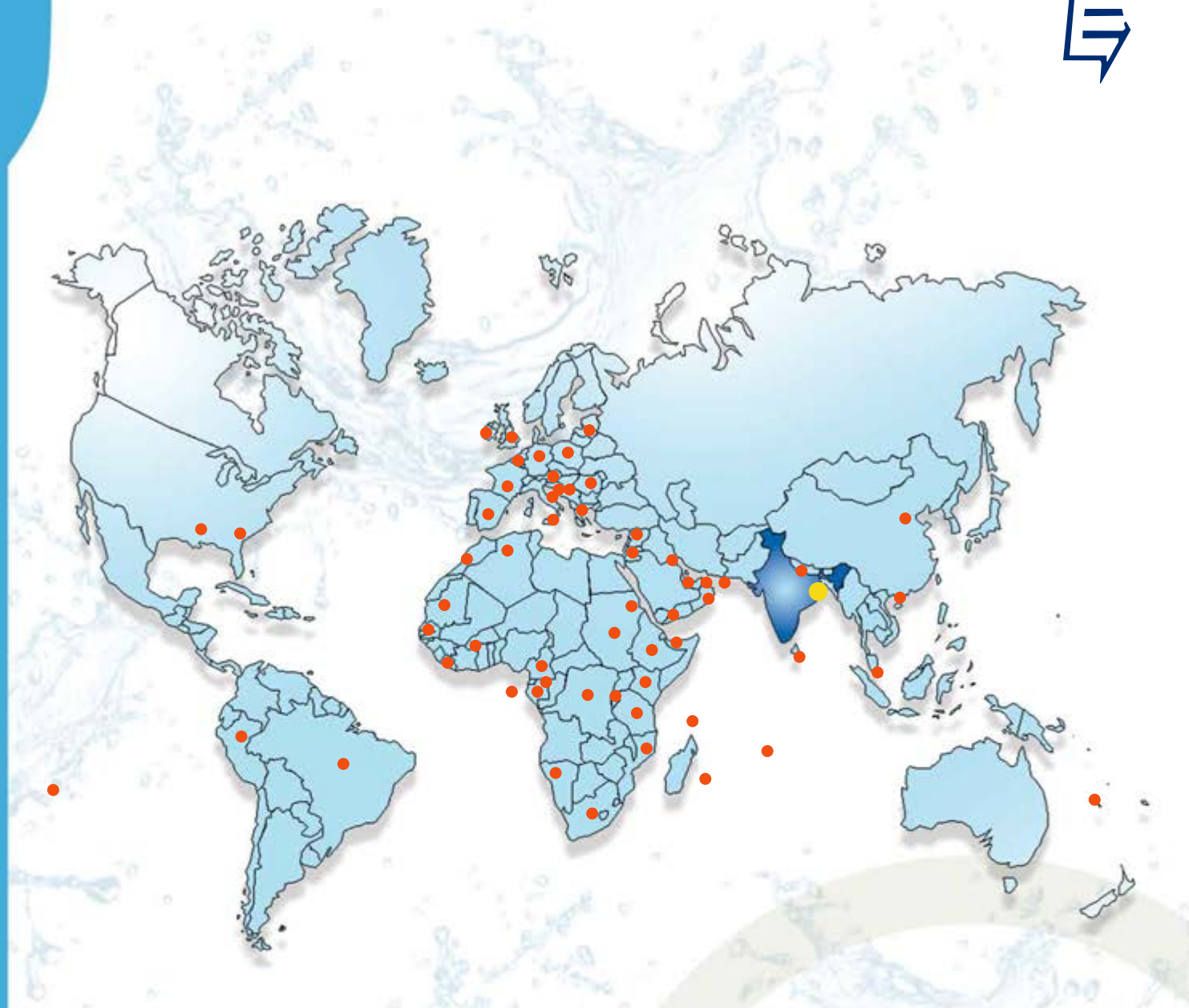
- Development, repair and renovation of local religious shrines.

- Distribution of free clothes and assistance to the underprivileged.

- "ORGANIC FARMING" is conducted that benefits employees through distribution of healthy foodgrain, fruits & vegetables at a subsidized rate.







## ELECTROSTEEL WORLDWIDE

Electrosteel exports Ductile Iron Pipes and Fittings to various countries in Europe, Africa, USA, South America, Middle East and Gulf, SAARC Countries, South East Asia etc competing with other global manufacturers.

Electrosteel has subsidiaries in France, Spain, Italy, Germany, UK, USA, Singapore, Algeria and branch office in Abu Dhabi stocking and selling DI pipes and fittings to the local and neighboring markets/countries. Stockyards have a comprehensive stock of DI pipes, fittings and flanged pipes. It offers technical advice at the design stage and later full after sales support to its customers.

Besides the above, Electrosteel also has a network of distributors and agents in many countries in the world.



## DUCTILE IRON - PROPERTIES

Ductile cast iron is a material with substantially improved mechanical properties of cast iron. Its minimum elongation of 10% before failure offers adequate strength to bear traffic and top load without being brittle.

DI pipes are very robust, can withstand mechanical stress and physical abuse, can be laid in unfavorable terrain and operating conditions and work without failure offering a very long service life.

Properties	Ductile Iron Pipes
Tensile strength	Min. 420 Mpa
Elongation	Min. 10%
Modulus of Elasticity	$1.7 \times 10^{10}$ kg/m <sup>2</sup>
Hardness	Max. 230 BHN
Density	7050 kg/m <sup>3</sup>
Bending/Beam Strength	Over 200 Mpa
Bursting strength (min)	Factor of Safety against bursting is 8 to 10



## QUALITY CHECKS AT EVERY STAGE OF MANUFACTURING

Strict selection of raw materials is an indispensable requirement for production of Quality Ductile Iron pipes & fittings. Electrosteel endeavors to achieve 'Quality right the first time' with strict quality control on raw material selection and procurement.

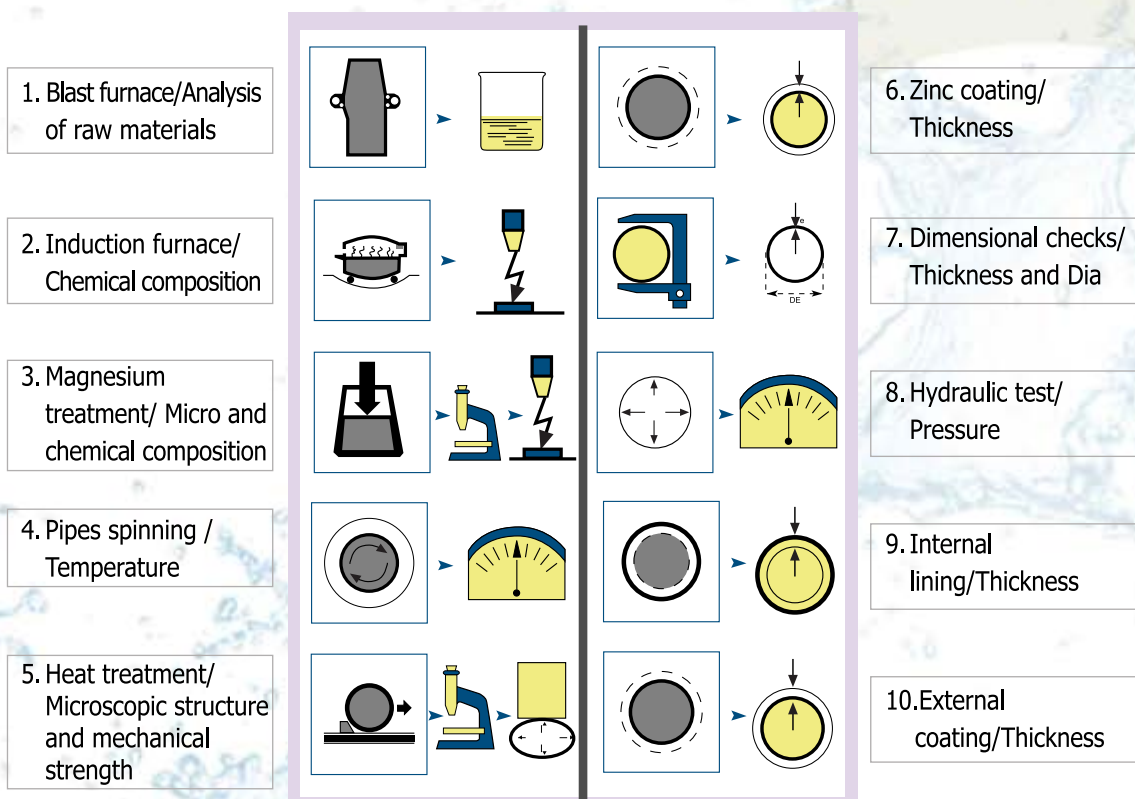
Electrosteel has a Mini Blast Furnace (MBF) at its plant at Khardah using TKES technology. MBF produces liquid metal suited to the manufacture of Ductile Iron pipes. The liquid metal is further processed and superheated in induction furnaces. It is then treated with magnesium for nodularisation and transferred to the centrifugal spun casting machines.

The pipes are then heat treated and hydrostatically tested. Various types of coatings and linings are applied depending on soil corrosivity and aggressivity of the fluid to be

transmitted. Special coating/lining like PU coating or Ceramic lining is also available. The in-process inspection and quality control at all points during the production cycle is strictly maintained and documented as per ISO 9001 quality systems.



### PROCESS / TEST





## QUALITY POLICY

- ❑ Electrosteel is committed to providing goods and services which meet customer's expectations and needs.
- ❑ The aim is to achieve "Quality right at the first Time".
- ❑ Electrosteel is committed to complying with the requirements and to continually improve the effectiveness of quality management system through teamwork, training and motivation.
- ❑ Electrosteel shall formulate Quality objectives for all functions and involve employees in fulfillment of the same.
- ❑ The quality policy and the quality objectives will be reviewed for continuing suitability.

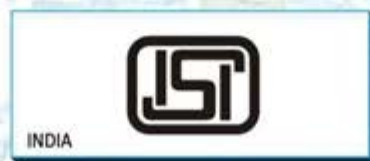
### **Total Productive Maintenance (TPM)**

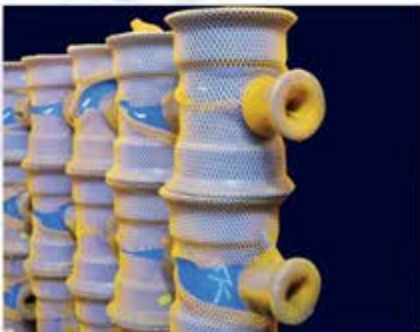
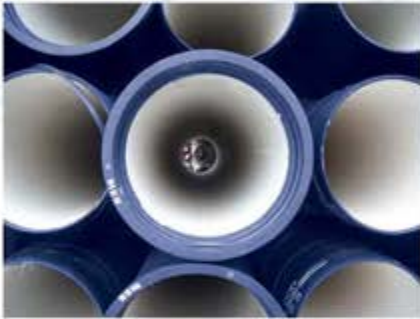
TPM and the Kaizen culture have percolated, both upward and downward and continuously maintained with all the enthusiasm involving and motivating personnel at all levels. 'Award in TPM excellence' achieved by Khardah works has further motivated the teams to take up the challenge of competing with best in the industry worldwide.

Use of JIPM – In 2010 JIPM Japan has awarded 'Award for excellence in consistent TPM commitment'. TPM methodology of KYT (Danger Prediction Drill) is being continuously enhanced to further improve the consciousness of workmen and supervisors. In addition, to avoid failure, mistake proof (Pokayoke) and safety assurance perfect line (SAPL) are also vigorously practiced.



## QUALITY ACCREDITATIONS





## PRODUCT RANGE

Electrosteel produces pipes and fittings in the range DN80mm to DN1000mm in accordance with the following standards:

- ISO2531 / EN 545 for Water
- ISO 7186 / EN 598 for Sewerage
- IS 8329 / IS 9523 for water and sewerage
- AWWA C151

### RANGE OF PIPES

- Socket and spigot pipes with flexible Push on joint pipes
- Restrained flexible joint pipes
- Flange pipes
- Piling pipes

### RANGE OF FITTINGS

Electrosteel produces comprehensive range of fittings and ancillaries including:

- Push on joint socketed fittings
- Flanged fittings
- Rotating flange fittings
- Mechanical joint fittings
- Express Type Mechanical joint fittings
- Restrained joint fittings

### OUR BRANDS

- Electrosteel brand of pipes, fittings and flanged pipes
- Electrofresh brand of pipes
- Electrofresh Plus brand of pipes
- Electrolock Joint



## APPLICATION

- Raw and Clear water transmission (pumping and gravity main)
- Distribution network of potable water
- Water supply for industrial /process plant application
- Ash-Slurry Handling & Disposal system
- Fire-fighting systems - on-shore and off-shore
- Desalination Plants
- Sewerage and waste water force main
- Gravity sewerage collection and disposal system
- Storm water drainage piping
- Effluent disposal system for domestic and industrial application
- Recycling system
- Piping work inside water and sewage treatment plants
- Vertical connection to utilities and reservoirs
- Piling for ground stabilization
- Protective piping under major carriage-ways





## VARIOUS JOINTING SYSTEMS

### PUSH ON JOINT

#### Socket and spigot push-on joints

The socket and spigot push fit joint is a simple male-female flexible joint that uses the compression of a synthetic rubber gasket to provide the water tight seal. The simplicity of the joint and its flexible nature accommodates angular deflection and some longitudinal withdrawal without any loss in performance. The design of the gasket incorporating a hard 'heel' and softer 'bulb' ensures that gasket compression is achieved without it being displaced on insertion of the spigot.

#### Rubber Gaskets

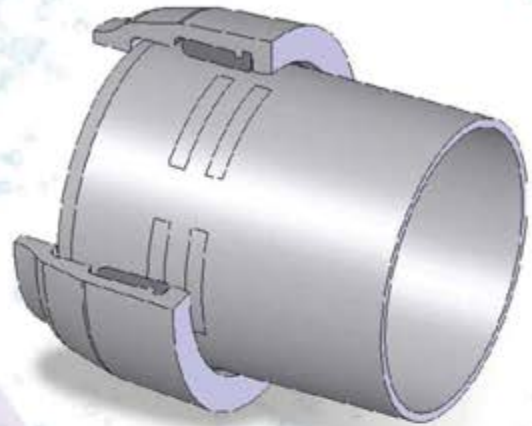
Gaskets are normally made of EPDM Rubber as per ISO 4633 / EN 681. These gaskets are approved by WRc (Water Research Centre) UK for safe use with potable drinking water.

#### Jointing Procedure

1. **Clean:** Clean the inside of the socket and outside of the spigot end of the two pipelines to be joined.
2. **Install the gaskets:** Insert the rubber gasket into the groove of the socket.
3. **Lubrication:** Apply a thin layer of lubricant on the visible surface of gasket and the plain end of pipe.
4. **Assembly:** Align the two pipes and insert the plain end into the socket.
5. **Check:** Verify that the gasket is properly seated in its housing around the perimeter.

#### Electrosteel Ductile Iron Pipe joint designs are Type Tested

Electrosteel's design of the socket and the rubber gasket ensures leak-tight joint through Type Tests as per BSEN:545 and ISO:2531. Type Test is testing the pipe and pipe joint at extreme working conditions (the product and use) to ensure satisfactory performance.







## RESTRAINED JOINT

Normal Push-On or Mechanical Joint in DI Pipes and Fittings does not provide significant restraint against longitudinal separation. Hydraulic thrust forces are created due to change of direction, reduction in diameter and at the end of pipelines under pressure during operation. These forces may cause joint separation if anchor blocks or anchoring devices are not provided in the pipeline.

One of the most common methods of providing resistance to thrust forces is the use of thrust blocks. Resistance is provided by transferring the thrust force to the soil through this thrust block.

In many cases the site condition does not allow the space required to construct concrete thrust block and time to cure the concrete of the Thrust Block to be effective.

So, Electrosteel offers different designs of self restrained joints to replace the concrete thrust block.

### These include :

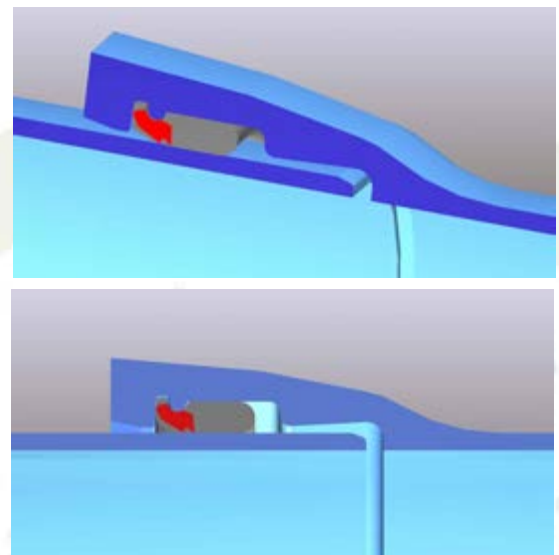
- Tooth gasket Restrained Joint**
- Bolted Restrained Joint**
- Electrolock Restrained Joint**

### Remember...

- Restrained joints are for Underground Application.
- All pipes in the pipeline need not be with Restrained.
- Restraining length depends on Soil type, backfill compaction, Pipeline Profile and Working Pressure.
- All Bends, Reducers End blocks and Tees with its adjacent restraining lengths are to be with Restrained Joints.
- Joints on both sides of the fittings are to be Restrained.

## Tooth Gasket Restrained Joint

1. Can be used on any Push on Joint Socket & Spigot pipe.
2. Need specially manufactured Steel teeth Inserted Gasket in place of normal Gasket.
3. Gasket has to be set in the Socket Groove like any other gasket.
4. Like any other pipe the steel teeth allow the spigot to be pushed into the socket.
5. Once the Spigot is fully inserted, teeth bite into the spigot and restrict the spigot to come out.
6. This specially designed gasket performs the dual role of water sealing and restraining.



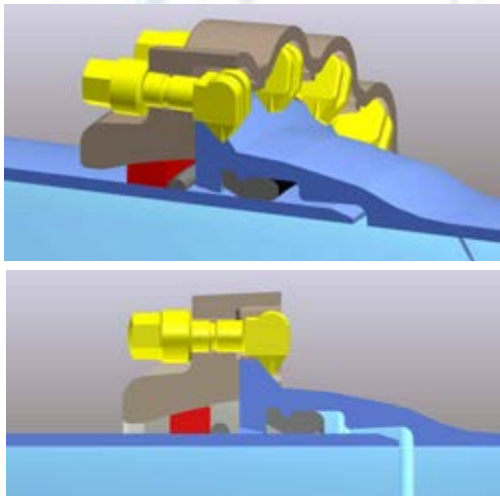
Nom. Dia	PFA [Bar]	Max. Angular * Deflection
80	16	2.0 <sup>o</sup>
100	16	2.0 <sup>o</sup>
125	16	2.0 <sup>o</sup>
150	16	2.0 <sup>o</sup>
200	16	2.0 <sup>o</sup>
250	10	2.0 <sup>o</sup>
300	10	1.5 <sup>o</sup>
400	10	1.5 <sup>o</sup>
500	10	1.5 <sup>o</sup>
600	10	1.5 <sup>o</sup>
700	10	1.5 <sup>o</sup>

\* For higher angular deflection please contact the manufacturer



## Bolted Restrained Joint

1. Can withstand very high pressure.
2. Need specially manufactured pipes, with Factory manufactured Hood on the socket and Weld Bead on spigot.
3. Need special accessories like Gland, Split Retainer Ring and Nuts/ Hook Bolts.
4. The water sealing and restraining are in two different systems.
5. Normal gasket to be used for sealing.
6. The Hook Bolts with the support from socket hood hold the gland and the socket together. The welding bead on the other pipe's spigot cannot pass through Retainer Ring housed in the gland, ensures restraining axial movement between the two pipes.
7. Easy to assemble and disassemble when required.



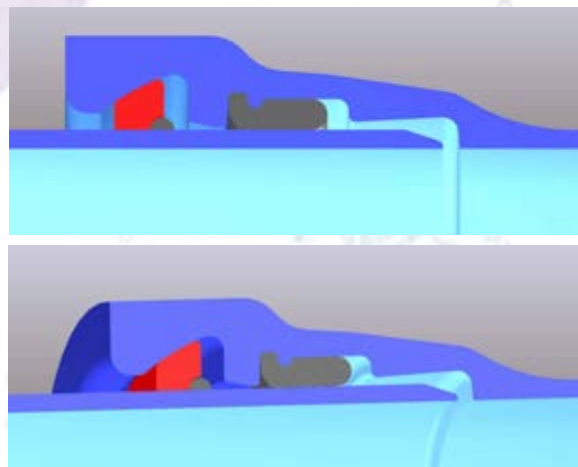
Nom. Dia	PFA bar	Gland Bolts		Tightening Torque (Nm)		Max Angular* Deflection	
		Hole size	No. of Hole	PRE	Final (Max)		
80	64	25	4	20	100	2.0°	
100		25	4	20	80		
150		55	25	6	20		60
200		44	25	8	20		60
250	39	30	6	20	70	1.5°	
300	37	30	8	20	60		
350	32	30	8	10	20		
400	30	30	10	10	20		
450		30	12	10	20		
500		30	16	10	30		
600	27	30	20	10	20	1.0°	
700	25	30	24	10	10		
750	20	30	28	10	30		
800	16	30	30	20	90		
900		30	30	10	30		
1000		30	30	10	10		

## Electrolock Restrained Joint

1. Can withstand very high pressure.
2. Need Factory manufacture Long Socket Pipes with two chambers one for normal sealing and the other for restraining axial movement.
3. The water sealing is done by Push-on gasket and restraining is done by Weld Bead and Locking Bar.
4. Normal Push on joint gasket to be used for sealing.
5. After assembly, the locking bars in parts are to be inserted in the Locking Chamber. The weld bead on the spigot gets locked with the locking bar against separation force.
6. Can be used for trenchless applications where all pipes with such joints are used in the trenchless portion.
7. Easy to assemble and disassemble when required.
8. Please contact us for Snow Application.

Nom. Dia	PFA bar	No. of Locking Bar	No. of Rubber Segment	Max Angular** Deflection
80	100/110*	2	1	5.0°
100	75/100*	4	2	
125	63/100*	4	2	
150	63/75*	4	2	4.0°
200	42/63*	4	2	
250	40/44*	4	2	
300	40	4	2	3.0°
400	30	4	2	
500	30	8	4	
600	30	8	4	
700	25	8	4	

\*With high pressure locking bar \*\* For higher angular deflection please contact the manufacturer





## FLANGED JOINT

Over ground and specialized applications require restrained joints where Flanged pipes are used. Flanged Pipes have the following advantages:

1. Acts as self-restrained Joint reducing the requirement of thrust blocks.
2. Ideal for over-ground and Exposed Installations.
3. Flanged Pipes are ideal for Vertical pipelines.
4. Used for Temporary Installations (over pillars) where pipelines need to be disengaged or displaced.
5. Widely used for interconnection in Pump House and Treatment Plant.

Type of Pipe	Dia Range and lengths	PN Ratings
<b>WELDED FLANGED PIPES</b>		
Flanges are welded on either side of a Class K9 barrel	From 80 to 1000 mm diameter, in lengths upto 5.3 m.	PN 10, PN 16, PN 25, PN 40
<b>SCREWED FLANGED PIPES</b>		
Flanged are screwed-fit on either side of a Class K9	From 80 to 300 diameter, in lengths upto 5.0 m.	PN 10
<b>CAST FLANGED PIPES</b>		
Flanged Pipe is cast as a single unit using advanced Lost Foam method.	From 80 to 700 mm diameter, in lengths upto 1.2 m.	PN 10, PN 16, PN 25, PN 40

## Joining Procedure

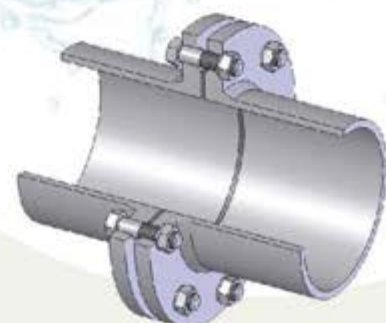
- Properly align the pipes.
- Clean flange faces and remove rust and dirt.
- Position the gasket. Use 3 mm. thick moulded rubber gaskets with quality conforming to ISO 4633.
- Use automotive grade oil / grease to lubricate bolt threads etc.

- Insert the nut-bolts one by one. Tighten diametrically opposite bolts to the recommended torque.
- If necessary, re-tighten bolts before pressure testing.

Electrosteel manufactures Flanged Pipes using all the three methods, that is, Welded Flanged Pipes, Screwed Flanged Pipes and integrally Cast Flanged Pipes (short lengths). Other types of coating and lining to the Flanged Pipes are also available. All flanged pipes are normally lined with Cement Mortar and has outside Zinc and Bitumen Coating. Other types of coating and lining to the Flanged Pipes are also available.

## Remember...

- Buried installation is not recommended.
- Flanged joint being a rigid joint, perfect alignment of the flange faces during jointing and bolt tightening is absolutely vital.
- Use of duck foot bend at bottom of vertical flange pipe line is necessary.
- For high pressure application, flanged pipeline needs thrust block / support at bends / tees.





# PIPE DIMENSIONS

## PUSH ON JOINT

### K CLASS

Dimension of Socket & Spigot pipes	Nominal Dia.	External Dia.	Tol. on	*Nominal Thickness	ECL Works Test Pressure	*Nominal Thickness	ECL Works Test Pressure	Allowable Deflection
	DN (mm)	DE (mm)	DE (mm)	K7 (mm)	K7 (Kg/cm <sup>2</sup> )	K9 (mm)	K9 (Kg/cm <sup>2</sup> )	(Degree)
	80	98	+1/-2.8		40	6.0	60	5
	100	118	+1/-2.8		40	6.0	60	5
	125	144	+1/-2.8		40	6.0	60	5
	150	170	+1/-2.9		40	6.0	60	5
	200	222	+1/-3	6.0	40	6.3	60	4
	250	274	+1/-3.1	6.0	40	6.8	60	4
	300	326	+1/-3.3	6.0	40	7.2	60	4
	350	378	+1/-3.4	6.0	32	7.7	50	3
	400	429	+1/-3.5	6.3	32	8.1	50	3
	450	480	+1/-3.6	6.6	32	8.6	50	3
	500	532	+1/-3.8	7.0	32	9.0	50	3
	600	635	+1/-4	7.7	32	9.9	50	3
	700	738	+1/-4.3	9.0	25	10.8	42	2
	800	842	+1/-4.5	10.4	25	11.7	42	2
	900	945	+1/-4.8	11.2	25	12.6	42	1.5
	1000	1048	+1/-5	12.0	25	13.5	42	1.5

\*As per ISO 2531-1998/EN 545 - 2007

### C CLASS

Dimension of Socket & Spigot pipes	Nominal Dia. DN (mm)	External Dia. DE (mm)	Tol. on DE (mm)	Preferred Class #		Minimum Thickness* (mm)	Allowable Deflection (Degree)
				Pressure Class	Nominal Thickness (mm)		
	80	98	+1/-2.8	C40	4.4	3.0	5
	100	118	+1/-2.8	C40	4.4	3.0	5
	125	144	+1/-2.8	C40	4.5	3.0	5
	150	170	+1/-2.9	C40	4.5	3.0	5
	200	222	+1/-3	C40	4.7	3.1	4
	250	274	+1/-3.1	C40	5.5	3.9	4
	300	326	+1/-3.3	C40	6.2	4.6	4
	350	378	+1/-3.4	C30	6.3	4.7	3
	400	429	+1/-3.5	C30	6.5	4.8	3
	450	480	+1/-3.6	C30	6.9	5.1	3
	500	532	+1/-3.8	C30	7.5	5.6	3
	600	635	+1/-4	C30	8.7	6.7	3
	700	738	+1/-4.3	C25	8.8	6.8	2
	800	842	+1/-4.5	C25	9.6	7.5	2
	900	945	+1/-4.8	C25	10.6	8.4	1.5
	1000	1048	+1/-5	C25	11.6	9.3	1.5

#As per ISO 2531 - 2009 \* As per EN 545 - 2010

### FOR SEWERAGE

Dimension of Socket & Spigot pipes	Nominal Dia. (mm)	External Dia. (DE) (mm)	Tol. on DE (mm)	Pressure Sewer		Allowable Deflection (Degree)
				Nom Thickness (mm)**	Nom Thickness (mm)#	
	80	98	+1/-2.8	4.4	4.8	5
	100	118	+1/-2.8	4.4	4.8	5
	125	144	+1/-2.8	4.5	4.8	5
	150	170	+1/-2.9	4.5	4.8	5
	200	222	+1/-3	4.7	4.9	4
	250	274	+1/-3.1	4.9	5.3	4
	300	326	+1/-3.3	5.1	6.6	4
	350	378	+1/-3.4	5.7	6.0	3
	400	429	+1/-3.5	6.3	6.3	3
	450	480	+1/-3.6	6.4	6.7	3
	500	532	+1/-3.8	6.5	7.0	3
	600	635	+1/-4	7.5	7.7	3
	700	738	+1/-4.3	8.5	9.6	2
	800	842	+1/-4.5	9.6	10.4	2
	900	945	+1/-4.8	10.6	11.2	1.5
	1000	1048	+1/-5	11.6	12.0	1.5

\*\*As per ISO 7186 # As per EN 598





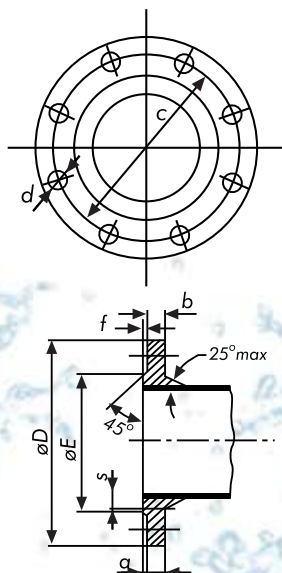
## FLANGED JOINT

Dimensions of Flanges	PN-10				PN-16				PN-25				PN-40			
	DN	Outside Dia	Dia. of raised face	Pitch Circle Dia.	Flange Width	Outside Dia	Dia. of raised face	Pitch Circle Dia.	Flange Width	Outside Dia	Dia. of raised face	Pitch Circle Dia.	Flange Width	Outside Dia	Dia. of raised face	Pitch Circle Dia.
80	200	132	160	16	200	132	160	16	200	132	160	16	200	132	160	16
100	See PN 16 Dimension				220	156	180	16	235	156	190	16	235	166	190	16
125	See PN 16 Dimension				250	184	210	16	270	184	220	16	270	184	220	20.5
150	See PN 16 Dimension				285	211	240	16	300	211	250	17	300	211	250	23
200	See PN 16 Dimension				340	266	295	17	360	274	310	19	375	284	320	27
250	395	319	350	19	400	319	355	19	425	330	370	21.5	450	345	385	31.5
300	445	370	400	20.5	455	370	410	20.5	485	389	430	23.5	515	409	450	35.5
350	505	429	460	20.5	520	429	470	22.5	555	448	490	26	580	465	510	40
400	565	480	515	20.5	580	480	525	24	620	503	550	28	660	535	585	44
450	615	530	565	21	640	548	585	26	670	548	600	30.5	685	560	610	46
500	670	582	620	22.5	715	609	650	27.5	730	609	660	32.5	755	615	670	48
600	780	682	725	25	840	720	770	31	845	720	770	37	890	735	795	53
700	895	794	840	27.5	910	794	840	34.5	960	820	875	41.5				
750	960	857	900	29	970	857	900	36	1020	883	940	45				
800	1015	901	950	30	1025	901	950	38	1085	928	990	46				
900	1115	1001	1050	32.5	1125	1001	1050	41	1185	1028	1090	50.5				
1000	1230	1112	1160	35	1255	1112	1170	45	1320	1140	1210	55				

Note : All dimensions are in millimeter.

Summary of minimum tightening torque for flanged joints	PN-10				PN-16			PN-25			PN-40		
	DN	Bolt size M	No. of bolts	Tight Torque N.m	Bolt size M	No. of bolts	Tight Torque N.m	Bolt size M	No. of bolts	Tight Torque N.m	Bolt size M	No. of bolts	Tight Torque N.m
80	16	8	7.8	16	8	7.8	16	8	16.6	16	8	16.6	
100	16	8	11.9	16	8	11.9	20	8	20.5	20	8	31.1	
125	16	8	18.5	16	8	18.5	24	8	37.9	24	8	57.4	
150	20	8	32.7	20	8	32.7	24	8	54.4	24	8	82.4	
200	20	8	39.4	20	12	38.6	24	12	64.3	27	12	110.6	
250	20	12	40.7	24	12	71.2	27	12	113.4	30	12	188.8	
300	20	12	58.4	24	12	102.2	27	16	121.9	30	16	203	
350	20	16	59.4	24	16	103.8	30	16	181.7	33	16	300.2	
400	24	16	91.6	27	16	153	33	16	257.1	36	16	428.3	
450	24	20	92.2	27	20	154.1	33	20	258.9	36	20	431.2	
500	24	20	113.7	30	20	209	33	20	319.2	39	20	580	
600	27	20	185.8	33	20	327.9	36	20	504.9	45	20	950	
700	27	24	209.4	33	24	369.5	39	24	620.8				
750	27	24	240.3	33	24	424.1	39	24	712.4				
800	30	24	300.8	36	24	530.9	45	24	923.4				
900	30	28	325.6	36	28	574.6	45	28	999.5				
1000	33	28	437.8	39	28	772.6	52	28	1427.1				

Note : All dimensions are in millimeter.



Nuts and Bolts for Flanged Pipes	DN	PN-10		PN-16		PN-25		PN-40	
	Nom. Dia. (mm)	No. of bolts.	Bolt size/Total length/Thread length (mm)	No. of bolts.	Bolt size/Total length/Thread length (mm)	No. of bolts.	Bolt size/Total length/Thread length (mm)	No. of bolts.	Bolt size/Total length/Thread length (mm)
80	4, 8	M16 x 70/38	8	M16 x 70/38	8	M16 x 70/38	8	M16 x 70/38	8
100	8	M16 x 70/38	8	M16 x 70/38	8	M20 x 80/46	8	M20x 80/46	8
125	8	M16 x 70/38	8	M16 x 70/38	8	M24 x 80/54	8	M24x 90/54	8
150	8	M20 x 80/46	8	M20 x 80/46	8	M24 x 90/54	8	M24x 100/54	8
200	8	M20 x 80/46	12	M20 x 80/46	12	M24 x 90/54	12	M27x 100/60	12
250	12	M20 x 80/46	12	M24 x 90/54	12	M27 x 100/60	12	M30x 120/66	12
300	12	M20 x 90/46	12	M24 x 90/54	16	M27 x 100/60	16	M30x 130/72	16
350	16	M20 x 90/46	16	M24 x 90/54	16	M30 x 110/66	16	M33x 140/78	16
400	16	M24 x 90/54	16	M27 x 100/60	16	M33 x 120/78	16	M36x150/84	16
450	20	M24 x 90/54	20	M27 x 100/60	20	M33 x 120/78	20	M36x150/84	20
500	20	M24 x 100/54	20	M30 x 110/66	20	M33 x 120/78	20	M39x160/90	20
600	20	M27 x 100/60	20	M33 x 120/78	20	M36 x 140/84	20	M45x180/102	20
700	24	M27 x 110/60	24	M33 x 130/78	24	M39 x 150/90	-	-	-
750	24	M27 x 110/60	24	M33 x 130/78	24	M39 x 160/90	-	-	-
800	24	M30 x 120/66	24	M36 x 140/84	24	M45 x 180/102	-	-	-
900	28	M30 x 120/66	28	M36 x 150/84	28	M45 x 180/102	-	-	-
1000	28	M33 x 130/78	28	M39 x 160/103	28	M52 x 200/116	-	-	-

Note : All dimensions are in millimeter.



## DI FITTINGS

### Manufacturing Procedure

The 'Lost foam' process used for manufacturing DI fittings is an advanced technique and it scores over other conventional processes.

### Lost Foam Technique

- First an exact replica of the fitting is made with 'Styro-foam' popularly known as Thermo-cole.
- This replica, moulded in special machines, acts as a pattern for the casting. The patterns are then kept in mechanized moulding box and then packed with sand.
- When hot metal is poured, the Styro-foam pattern vaporizes and the metal takes the shape of the fitting by filling up the cavity.
- After cooling, castings are taken out, shot blasted, fettled and cleaned.
- After thorough inspection and fettling, the castings (Fittings) are subjected to hydrostatic testing.
- Tested fittings are then Zinc coated, cement lined and a bituminous finishing coat is applied from outside. Alternatively fittings are shot blasted, fusion bonded epoxy coated and lined in our special FBE plant.

### Advantages of Lost Foam Technique

- Higher productivity. Casting process is much faster.
- No need of core setting. So no question of core displacement resulting in uneven thickness.
- Much lower chances of having pinhole, slag inclusion or blowhole.
- Maintains high dimensional tolerance, which is so vital for proper fitment and leak-tightness. The castings have excellent finish.
- In flanged fitting no drilling hole is necessary as all the holes are as cast.

### Hydrostatic Testing

D.I. fittings are tested at works at the following test pressure as specified in ISO/EN.

Diameter (mm)	Works Test Pressure (Kg/cm <sup>2</sup> )
80-300	25
350-600	16
700-1000	10

It may appear that test pressures of Fittings are low, compared to the allowable working pressures in pipes. But fittings with K-12 thickness of Ductile Iron have higher factor of safety and do not fail at allowable working pressure.



### Loose Flange Fittings

Electrosteel has also introduced fittings with Adjustable Flange or Loose Flange. Unlike 'As cast' Flanged fitting, in this case, separately cast loose Flanges are mounted on the fittings. A loose Flanged Fittings comprises of a Flange ring (in two or more parts bolted together), which can be fixed on the fittings end. This loose Flange can be freely rotated around the axis of the fittings.

#### Advantages

- Since the flanges can be freely rotated, bolthole alignment with the mating Flange becomes easier.
- As it can be fixed and removed easily, dismantling of adjoining accessories becomes easier. Small angles can be adjusted.
- The PN rating of the Fittings can be changed at will, just by changing the loose flange.

#### Special fittings

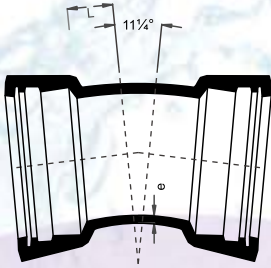
Apart from push-on joint and mechanical joint fittings we also manufacture some special fittings, which are extremely useful for practical applications which would have same wall thickness, material and quality tests of standard fittings. Few of these are mentioned below:

- 4 way Crosses
- Double Socket Branch Flange level Invert Tee (Scour Tee)

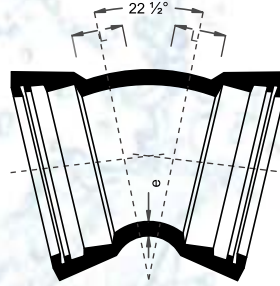
- Puddle flange of required length
- Special variation of conventional Fittings such as:
  - Fittings with one side Flange & one side plain-ended /socketed of a particular length.
  - Tees and Reducers with other non standard DN x dn combinations.
  - In fact due to the immense flexibility of our manufacturing process by Lost Foam method, virtually any combination of socket/flange/plain-end is possible.

#### Fabricated Fittings

Electrosteel manufactures DI fabricated fittings, by welding together sections of DI Pipes and Castings to form a basic pipe connecting piece, similar in function to some fittings. One such regularly manufactured product is Air Valve Tee or scour tee. As an example, a 100 mm dia Flanged outlet can be fixed on a 500 mm pipe or larger dia, which serves the purpose of a 500x500x100 Double Socket Branch Flange (DSBF) Tee, ideal for air valve installation. It saves the cost of a DSBF Tee and provides considerable cost economy. These products are made and tested as per the provision of ISO/EN.

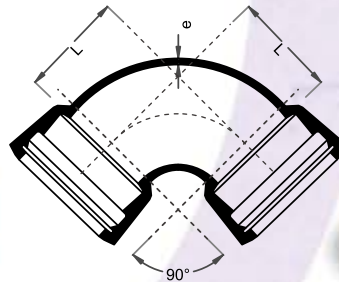
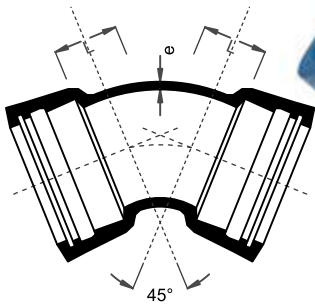


DOUBLE SOCKET 11 1/4° BEND



Double Socket 11 1/4° Bend	Nominal Size mm	e mm	L mm
	80	7.0	30
	100	7.2	30
	150	7.8	35
	200	8.4	40
	250	9.0	50
	300	9.6	55
	350	10.2	60
	400	10.8	65
	450	11.4	70
	500	12.0	75
	600	13.2	85
	700	14.4	95
	800	15.6	110
	900	16.8	115
1000	18.0	120	

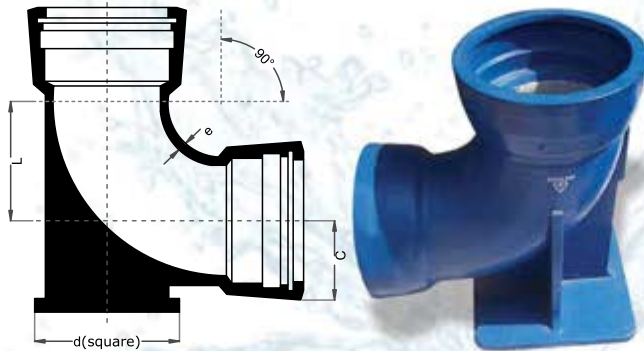
Double Socket 22 1/2° Bend	Nominal Size mm	e mm	L mm
	80	7.0	40
	100	7.2	40
	150	7.8	55
	200	8.4	65
	250	9.0	75
	300	9.6	85
	350	10.2	95
	400	10.8	110
	450	11.4	120
	500	12.0	130
	600	13.2	150
	700	14.4	175
	800	15.6	195
	900	16.8	205
1000	18.0	210	



Double Socket 45° Bend	Nominal Size mm	e mm	L mm
	80	7.0	55
	100	7.2	65
	150	7.8	85
	200	8.4	110
	250	9.0	130
	300	9.6	150
	350	10.2	175
	400	10.8	195
	450	11.4	220
	500	12.0	240
	600	13.2	285
	700	14.4	330
	800	15.6	370
	900	16.8	415
1000	18.0	460	

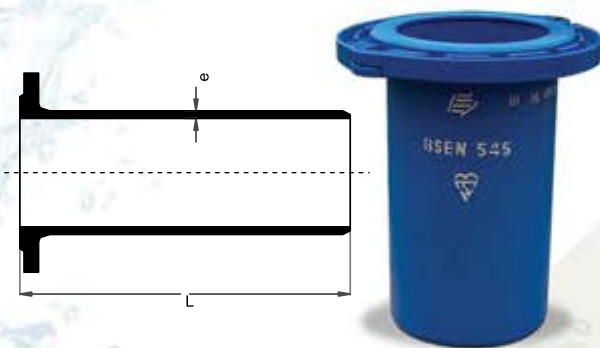
Double Socket 90° Bend	Nominal Size mm	e mm	L mm
	80	7.0	100
	100	7.2	120
	150	7.8	170
	200	8.4	220
	250	9.0	270
	300	9.6	320
	350	10.2	370
	400	10.8	420
	450	11.4	470
	500	12.0	520
	600	13.2	620
	700	14.4	720
	800	15.6	820
	900	16.8	920
1000	18.0	1020	





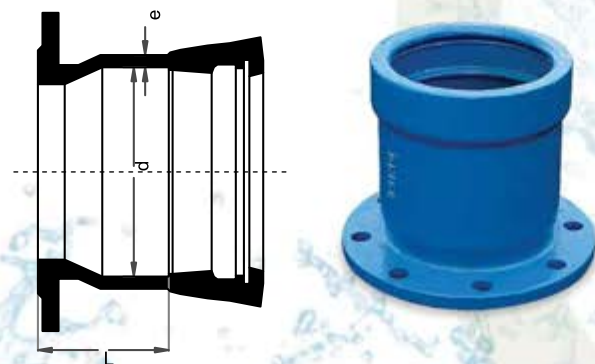
Double Socket 90° Duck Foot Bend

Nominal Size mm	e mm	L mm	H mm	D mm
80	7.0	110	110	180
100	7.2	130	125	200
150	7.8	180	160	250
200	8.4	230	190	300
250	9.0	280	225	350
300	9.6	325	255	400
350	10.2	380	290	450
400	10.8	430	320	500
450	11.4	480	355	550
500	12.0	530	385	600
600	13.2	630	450	700
700	14.4	730	515	800
800	15.6	830	580	900
900	16.8	930	645	1000
1000	18.0	1030	710	1100



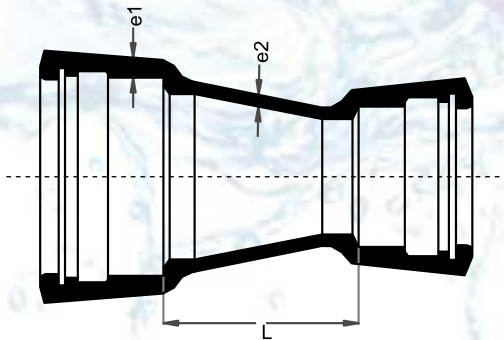
Flanged Spigot

Nominal Dia (DN) mm	DE mm	e mm	L mm
80	98	7.0	350
100	118	7.2	360
150	170	7.8	380
200	222	8.4	400
250	274	9.0	420
300	326	9.6	440
350	378	10.2	460
400	429	10.8	480
450	480	11.4	500
500	532	12.0	520
600	635	13.2	560
700	738	14.4	600
800	842	15.6	600
900	945	16.8	600
1000	1048	18.0	600



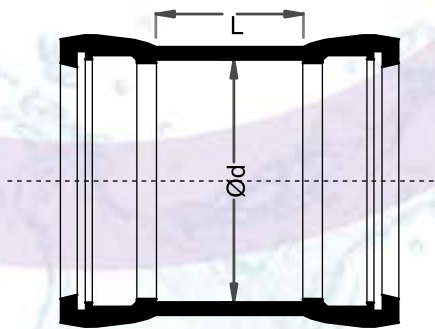
Flanged Socket

Nominal Dia (DN) mm	e mm	L mm	d mm
80	7.0	130	109
100	7.2	130	130
150	7.8	135	183
200	8.4	140	235
250	9.0	145	288
300	9.6	150	340
350	10.2	155	393
400	10.8	160	445
450	11.4	165	498
500	12.0	170	550
600	13.2	180	655
700	14.4	190	760
800	15.6	200	865
900	16.8	210	970
1000	18.0	220	1075



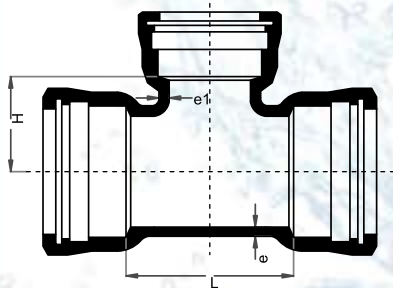
Double Socket Concentric Taper

Nominal Diameter (DN)		e	e <sub>1</sub>	L
Larger End	Smaller End			
mm	mm	mm	mm	mm
100	80	7.2	7.0	90
150	80	7.8	7.0	190
150	100	7.8	7.2	150
200	100	8.4	7.2	250
200	150	8.4	7.8	150
250	150	9.0	7.8	250
250	200	9.0	8.4	150
300	150	9.6	7.8	350
300	200	9.6	8.4	250
300	250	9.6	9.0	150
350	200	10.2	8.4	360
350	250	10.2	9.0	260
350	300	10.2	9.6	160
400	250	10.8	9.0	360
400	300	10.8	9.6	260
400	350	10.8	10.2	160
450	350	11.4	10.2	260
450	400	11.4	10.8	160
500	350	12.0	10.2	360
500	400	12.0	10.8	260
600	400	13.2	10.8	460
600	500	13.2	12.0	260
700	500	14.4	12.0	480
700	600	14.4	13.2	280
800	600	15.6	13.2	480
800	700	15.6	14.4	280
900	700	16.8	14.4	480
900	800	16.8	15.6	280
1000	800	18.0	15.6	480
1000	900	18.0	16.8	280



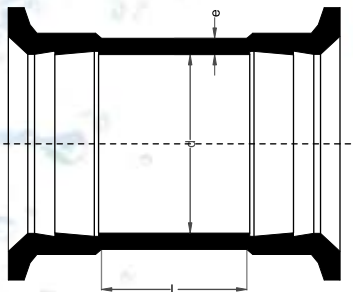
Double Socket Collar

Nominal Dia (DN)	e	L	d
mm	mm	mm	mm
80	7.0	160	109
100	7.2	160	130
150	7.8	165	183
200	8.4	170	235
250	9.0	175	288
300	9.6	180	340
350	10.2	185	393
400	10.8	190	445
450	11.4	195	498
500	12.0	200	550
600	13.2	210	655
700	14.4	220	760
800	15.6	230	865
900	16.8	240	970
1000	18.0	250	1075



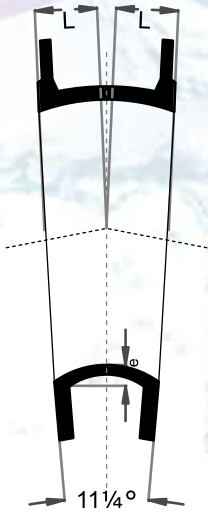
All Socket Tee

Nominal Diameter (DN)		e mm	e <sub>1</sub> mm	L mm	H mm
Body mm	Branch mm				
80	80	7.0	7.0	170	85
100	80	7.2	7.0	170	95
100	100	7.2	7.2	190	95
150	100	7.8	7.2	195	120
150	150	7.8	7.8	255	125
200	80	8.4	7.0	175	145
200	100	8.4	7.2	200	145
200	150	8.4	7.8	255	150
200	200	8.4	8.4	315	155
250	80	9.0	7.0	180	170
250	100	9.0	7.2	200	170
250	150	9.0	7.8	260	175
250	200	9.0	8.4	315	180
250	250	9.0	9.0	375	190
300	100	9.6	7.2	205	195
300	150	9.6	7.8	260	200
300	200	9.6	8.4	320	205
300	250	9.6	9.0	380	215
300	300	9.6	9.6	435	220
350	100	10.2	7.2	205	220
350	150	10.2	7.8	265	225
350	200	10.2	8.4	325	230
350	250	10.2	9.0	380	240
350	300	10.2	9.6	440	245
350	350	10.2	10.2	495	250
400	80	10.8	7.0	185	245
400	100	10.8	7.2	210	245
400	150	10.8	7.8	270	250
400	200	10.8	8.4	325	255
400	300	10.8	9.6	440	270
400	400	10.8	10.8	560	280
450	100	11.4	7.2	215	270
450	250	11.4	9.0	385	290
450	450	11.4	11.4	620	310
500	100	12.0	7.2	215	295
500	200	12.0	8.4	330	305
500	400	12.0	10.8	565	330
500	500	12.0	12.0	680	340
600	200	13.2	8.4	340	355
600	400	13.2	10.8	570	380
600	600	13.2	13.2	800	400
700	200	14.4	8.4	345	405
700	400	14.4	10.8	575	430
700	700	14.4	14.4	925	460
800	200	15.6	8.4	350	455
800	400	15.6	10.8	580	480
800	600	15.6	13.2	815	500
800	800	15.6	15.6	1045	525
900	200	16.8	8.4	355	505
900	400	16.8	10.8	590	530
900	600	16.8	13.2	820	550
900	900	16.8	16.8	1170	585
1000	200	18.0	8.4	360	555
1000	400	18.0	10.8	595	580
1000	600	18.0	13.2	825	600
1000	1000	18.0	18.0	1290	645



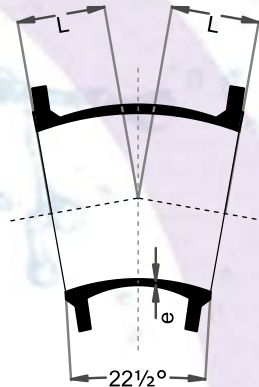
Nominal Dia (DN)	e mm	L mm	d mm
80	7.0	160	109
100	7.2	160	130
150	7.8	165	183
200	8.4	170	235
250	9.0	175	288
300	9.6	180	340
350	10.2	185	393
400	10.8	190	445
450	11.4	195	498
500	12.0	200	550
600	13.2	210	655
700	14.4	220	760
800	15.6	230	865
900	16.8	240	970
1000	18.0	250	1075

MJ Collar



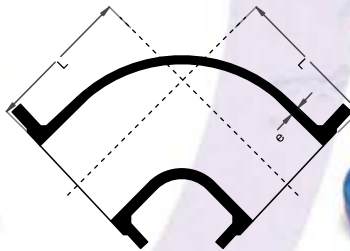
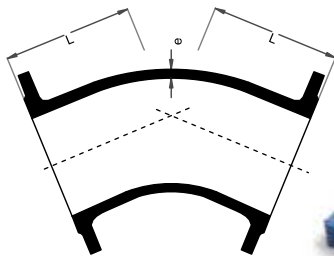
Double Flanged 11 1/4° Bend

Nominal Size DN mm	e mm	L mm
80	7.0	113
100	7.2	115
125	7.5	111
150	7.8	113
200	8.4	132
250	9.0	165
300	9.6	175
350	10.2	191
400	10.8	205
450	11.4	349
500	12.0	375
600	13.2	426
700	14.4	478
800	15.6	529
900	16.8	581
1000	18.0	632



Double Flanged 22 1/2° Bend

Nominal Size DN mm	e mm	L mm
80	7.0	105
100	7.2	110
125	7.5	105
150	7.8	109
200	8.4	131
250	9.0	190
300	9.6	210
350	10.2	210
400	10.8	239
450	11.4	349
500	12.0	375
600	13.2	426
700	14.4	478
800	15.6	529
900	16.8	581
1000	18.0	632



Double Flanged 45° Bend

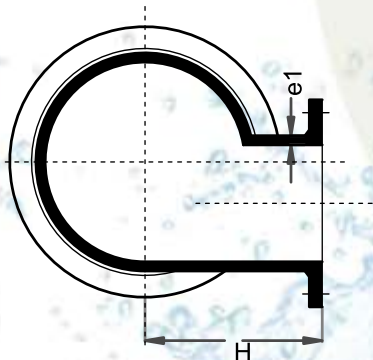
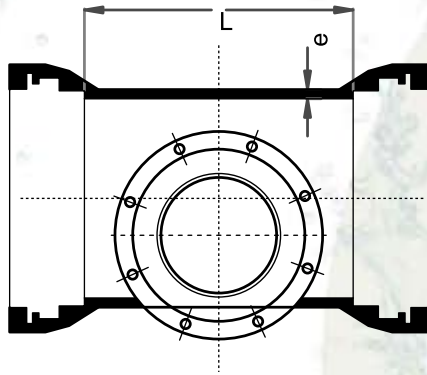
Nominal Size DN mm	e mm	L mm
80	7.0	130
100	7.2	140
125	7.5	150
150	7.8	160
200	8.4	180
250	9.0	350
300	9.6	400
350	10.2	298
400	10.8	324
450	11.4	350
500	12.0	375
600	13.2	426
700	14.4	478
800	15.6	529
900	16.8	581
1000	18.0	632

Double Flanged 90° Bend

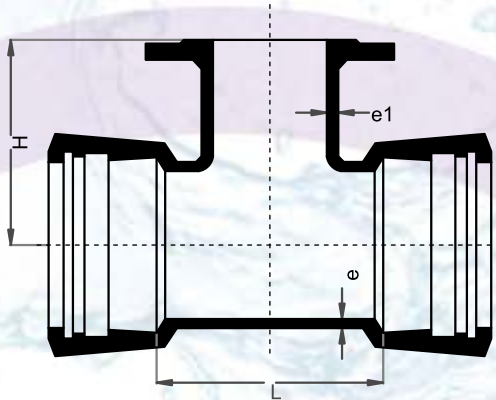
Nominal Size DN mm	e mm	L mm
80	7.0	165
100	7.2	180
125	7.5	200
150	7.8	220
200	8.4	260
250	9.0	350
300	9.6	400
350	10.2	450
400	10.8	500
450	11.4	550
500	12.0	600
600	13.2	700
700	14.4	800
800	15.6	900
900	16.8	1000
1000	18.0	1100



Double Socket Level Invert Tee with Flanged Branch



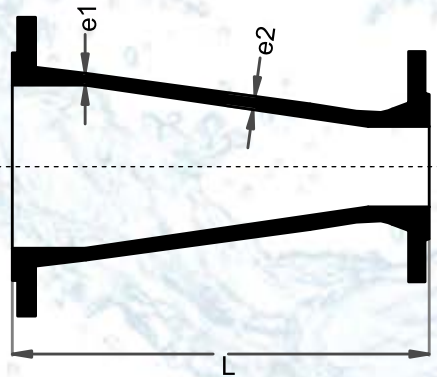
Nominal Diameter (DN)		e	e <sub>1</sub>	L	H
Body DN	Branch dn				
mm	mm	mm	mm	mm	mm
100	80	7.2	7.0	170	175
150	80	7.8	7.0	170	205
150	100	7.8	7.2	195	210
200	80	8.4	7.0	175	235
200	100	8.4	7.2	200	240
200	150	8.4	7.8	255	250
250	80	9.0	7.0	180	265
250	100	9.0	7.2	200	270
250	150	9.0	7.8	260	280
250	200	9.0	8.4	315	290
300	80	9.6	7.0	180	295
300	100	9.6	7.2	205	300
300	150	9.6	7.8	260	310
300	200	9.6	8.4	320	320
300	250	9.6	9.0	380	330
350	80	10.2	7.0	185	325
350	100	10.2	7.2	205	330
350	150	10.2	7.8	265	340
350	200	10.2	8.4	325	350
350	250	10.2	9.0	380	360
400	80	10.8	7.0	185	355
400	100	10.8	7.2	210	360
400	150	10.8	7.8	270	370
400	200	10.8	8.4	325	380
400	250	10.8	9.0	385	390
400	300	10.8	9.6	440	400
450	80	11.4	7.0	190	385
450	100	11.4	7.2	215	390
450	150	11.4	7.8	270	400
450	200	11.4	8.4	330	410
450	250	11.4	9.0	385	420
450	300	11.4	9.6	445	430
450	400	11.4	10.8	560	450
500	80	12.0	7.0	195	415
500	100	12.0	7.2	215	420
500	150	12.0	7.8	275	430
500	200	12.0	8.4	330	440
500	250	12.0	9.0	390	450
500	300	12.0	9.6	450	460
500	350	12.0	10.2	505	470
500	400	12.0	10.8	565	480
500	450	12.0	11.4	620	490
600	80	13.2	7.0	200	475
600	100	13.2	7.2	220	480
600	150	13.2	7.8	280	490
600	200	13.2	8.4	340	500
600	250	13.2	9.0	395	510
600	300	13.2	9.6	455	520
600	350	13.2	10.2	510	530
600	400	13.2	10.8	570	540
600	450	13.2	11.4	630	550
600	500	13.2	12.0	685	560
700	80	14.4	7.0	205	505
700	100	14.4	7.2	230	510
700	150	14.4	7.8	285	520
700	200	14.4	8.4	345	525
800	150	15.6	7.8	290	580
800	200	15.6	8.4	350	585
900	150	16.8	7.8	300	640
900	200	16.8	8.4	355	645
1000	150	18.0	7.8	305	700
1000	200	18.0	8.4	360	705



Double Socket Flanged Branch Tee

Nominal Diameter (DN)		e mm	e <sub>1</sub> mm	L mm	H mm
Body mm	Branch mm				
80	80	7.0	7.0	170	165
100	80	7.2	7.0	170	175
100	100	7.2	7.2	190	180
150	80	7.8	7.0	170	205
150	100	7.8	7.2	195	210
150	150	7.8	7.8	255	220
200	80	8.4	7.0	175	235
200	100	8.4	7.2	200	240
200	150	8.4	7.8	255	250
200	200	8.4	8.4	315	260
250	80	9.0	7.0	180	265
250	100	9.0	7.2	200	270
250	150	9.0	7.8	260	280
250	200	9.0	8.4	315	290
250	250	9.0	9.0	375	300
300	100	9.6	7.2	205	300
300	200	9.6	8.4	320	320
300	250	9.6	9.0	380	330
300	300	9.6	9.6	435	340
350	100	10.2	7.2	205	330
350	200	10.2	8.4	325	350
350	350	10.2	10.2	495	380
400	80	10.8	7.0	185	355
400	100	10.8	7.2	210	360
400	150	10.8	7.8	270	370
400	200	10.8	8.4	325	380
400	300	10.8	9.6	440	400
400	400	10.8	10.8	560	420
450	100	11.4	7.2	215	390
450	250	11.4	9.0	385	420
450	450	11.4	11.4	620	460
500	100	12.0	7.2	215	420
500	400	12.0	10.8	565	480
500	500	12.0	12.0	680	500
600	200	13.2	8.4	340	500
600	400	13.2	10.8	570	540
600	600	13.2	13.2	800	580
700	200	14.4	8.4	345	525
700	400	14.4	10.8	575	555
700	700	14.4	14.4	925	600
800	200	15.6	8.4	350	585
800	400	15.6	10.8	580	615
800	600	15.6	13.2	815	645
800	800	15.6	15.6	1045	675
900	200	16.8	8.4	355	645
900	400	16.8	10.8	590	675
900	600	16.8	13.2	820	705
900	900	16.8	16.8	1170	750
1000	200	18.0	8.4	360	705
1000	400	18.0	10.8	595	735
1000	600	18.0	13.2	825	765
1000	1000	18.0	18.0	1290	825

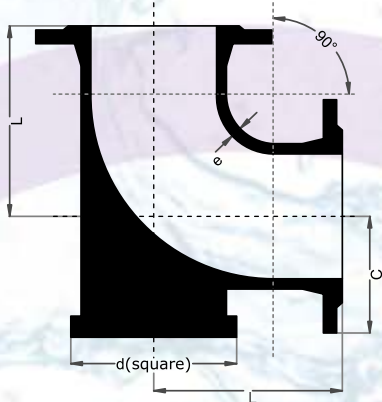




Double Flanged Concentric Tapers

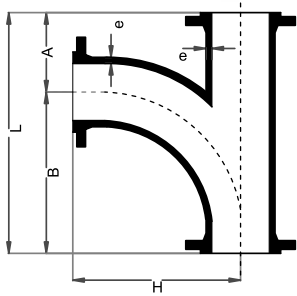
Nominal Diameter (DN)		e <sub>2</sub>	e <sub>1</sub>	L
Larger End Body	Smaller End Body			
mm	mm	mm	mm	mm
100	80	7.2	7.0	200
125	80	7.5	7.0	180
125	100	7.5	7.2	200
150	80	7.8	7.0	230
150	100	7.8	7.2	300
150	125	7.8	7.5	200
200	80	8.4	7.0	335
200	100	8.4	7.2	290
200	125	8.4	7.5	240
200	150	8.4	7.8	300
250	80	9.0	7.0	440
250	100	9.0	7.2	400
250	125	9.0	7.5	350
250	150	9.0	7.8	295
250	200	9.0	8.4	300
300	80	9.6	7.0	550
300	100	9.6	7.2	510
300	125	9.6	7.5	460
300	150	9.6	7.8	405
300	200	9.6	8.4	300
300	250	9.6	9.0	300
350	80	10.2	7.0	655
350	100	10.2	7.2	615
350	125	10.2	7.5	565
350	150	10.2	7.8	510
350	200	10.2	8.4	410
350	250	10.2	9.0	305
350	300	10.2	9.6	300
400	100	10.8	7.2	720
400	125	10.8	7.5	670
400	150	10.8	7.8	615
400	200	10.8	8.4	510
400	250	10.8	9.0	410
400	300	10.8	9.6	300
400	350	10.8	10.2	300
450	150	11.4	7.8	715
450	200	11.4	8.4	610
450	250	11.4	9.0	510
450	300	11.4	9.6	410
450	350	11.4	10.2	305
450	400	11.4	10.8	300
500	200	12.0	8.4	725
500	250	12.0	9.0	625
500	300	12.0	9.6	520
500	350	12.0	10.2	420
500	400	12.0	10.8	600
600	300	13.2	9.6	730
600	350	13.2	10.2	625
600	400	13.2	10.8	525
600	500	13.2	12.0	600
700	600	14.4	13.2	600
800	700	15.6	14.4	600
900	800	16.8	15.6	600
1000	900	18.0	16.8	600





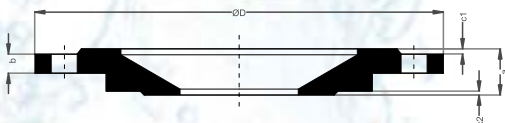
Double Flanged 90° Duck-Foot Bend

Nominal Size (DN) mm	e mm	L mm	H mm	D mm
80	7.0	165	110	180
100	7.2	180	125	200
150	7.8	220	160	250
200	8.4	260	190	300
250	9.0	350	225	350
300	9.6	400	255	400
350	10.2	450	290	450
400	10.8	500	320	500
450	11.4	550	355	550
500	12.0	600	385	600
600	13.2	700	450	700
700	14.4	800	515	800
800	15.6	900	580	900
900	16.8	1000	645	1000
1000	18.0	1100	710	1100



All Flanged Radial Tee

SIZE		e mm	A mm	B mm	H mm	L mm
Body DN mm	Branch dn mm					
80	80	7.0	165	380	380	545
100	100	7.2	180	400	400	580
150	150	7.8	220	450	450	670
200	200	8.4	260	500	500	760
250	250	9.0	350	550	550	900
300	300	9.6	400	600	600	1000



$b = 10 + 0.035DN$  with a minimum value of 16

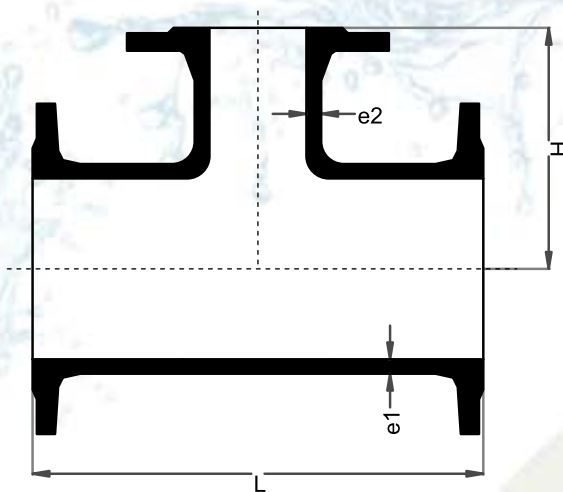
Reducing Flanges, Type PN16 Nominal Dia DN mm	Larger End			Smaller End		
	D mm	b mm	C1 mm	Nominal Dia DN mm	c2 mm	a mm
200	340	17.0	3	80	3	40
200	340	17.0	3	100	3	40
350	520	22.5	4	250	3	54
400	580	24.0	4	250	3	54
400	580	24.0	4	300	4	55
700	910	34.5	5	500	4	67
900	1125	41.5	5	700	5	73
1000	1255	45.0	5	700	5	73
1000	1255	45.0	5	800	5	77

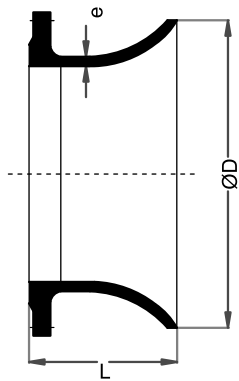
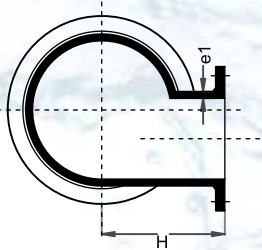
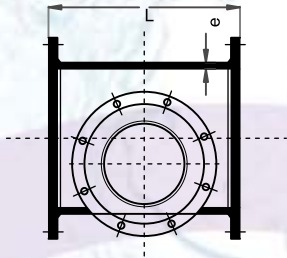




All Flanged Tees

Body DN mm	Nominal Diameter		e mm	e <sub>1</sub> mm	L mm	H mm
	Branch dn mm					
80	80		7.0	7.0	330	165
100	80		7.2	7.0	360	175
100	100		7.2	7.2	360	180
125	80		7.5	7.0	400	190
125	125		7.5	7.0	400	200
150	80		7.8	7.0	440	205
150	100		7.8	7.2	440	210
150	150		7.8	7.8	440	220
200	80		8.4	7.0	520	235
200	100		8.4	7.2	520	240
200	150		8.4	7.8	520	250
200	200		8.4	8.4	520	260
250	80		9.0	7.0	700	265
250	100		9.0	7.2	700	275
250	150		9.0	7.8	700	300
250	200		9.0	8.4	700	325
250	250		9.0	9.0	700	350
300	80		9.6	7.0	800	290
300	100		9.6	7.2	800	300
300	150		9.6	7.8	800	325
300	200		9.6	8.4	800	350
300	250		9.6	9.0	800	375
300	300		9.6	9.6	800	400
350	80		10.2	7.0	850	325
350	100		10.2	7.2	850	325
350	150		10.2	7.8	850	325
350	200		10.2	8.4	850	325
350	250		10.2	9.0	850	325
350	300		10.2	9.6	850	425
350	350		10.2	10.2	850	425
400	80		10.8	7.0	900	350
400	100		10.8	7.2	900	350
400	150		10.8	7.8	900	350
400	200		10.8	8.4	900	350
400	250		10.8	9.0	900	350
400	300		10.8	9.6	900	450
400	400		10.8	10.8	900	450
450	100		11.4	7.2	950	375
450	150		11.4	7.8	950	375
450	200		11.4	8.4	950	375
450	250		11.4	9.0	950	375
450	300		11.4	9.6	950	475
450	350		11.4	10.2	950	475
450	400		11.4	10.8	950	475
450	450		11.4	11.4	950	475
500	100		12.0	7.2	1000	400
500	150		12.0	7.8	1000	400
500	200		12.0	8.4	1000	400
500	250		12.0	9.0	1000	400
500	300		12.0	9.6	1000	500
500	350		12.0	10.2	1000	500
500	400		12.0	10.8	1000	500
500	500		12.0	12.0	1000	500
600	100		13.2	7.2	1100	450
600	150		13.2	7.8	1100	450
600	200		13.2	8.4	1100	450
600	250		13.2	9.0	1100	450
600	300		13.2	9.6	1100	550
600	350		13.2	10.2	1100	550
600	400		13.2	10.8	1100	550
600	450		13.2	11.4	1100	550
600	500		13.2	12.0	1100	550
600	600		13.2	13.2	1100	550
700	200		14.4	8.4	650	525
700	400		14.4	10.8	870	555
700	700		14.4	14.4	1200	600
800	200		15.6	8.4	690	585
800	400		15.6	10.8	910	615
800	600		15.6	13.2	1350	645
800	800		15.6	15.6	1350	675
900	200		16.8	8.4	730	645
900	400		16.8	10.8	950	675
900	600		16.8	13.2	1500	705
900	900		16.8	16.8	1500	750
1000	200		18.0	8.4	770	705
1000	400		18.0	10.8	990	735
1000	600		18.0	13.2	1650	765
1000	1000		18.0	18.0	1650	825



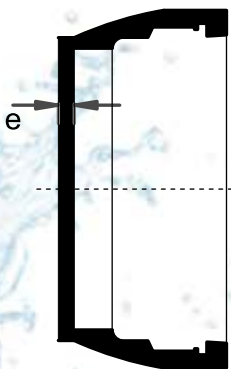
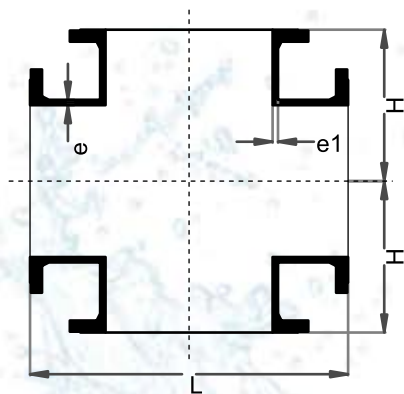


All Flanged Level Invert Tees

Body DN mm	Nominal Diameter		e mm	e <sub>1</sub> mm	L mm	H mm
	Branch dn mm					
80	80		7.0	7.0	330	165
100	80		7.2	7.0	360	175
125	80		7.5	7.0	400	190
150	80		7.8	7.0	440	205
150	100		7.8	7.2	440	210
200	80		8.4	7.0	520	235
200	100		8.4	7.2	520	240
200	150		8.4	7.8	520	250
250	80		9.0	7.0	700	265
250	100		9.0	7.2	700	275
250	150		9.0	7.8	700	300
250	200		9.0	8.4	700	325
300	80		9.6	7.0	800	290
300	100		9.6	7.2	800	300
300	150		9.6	7.8	800	325
300	200		9.6	8.4	800	350
300	250		9.6	9.0	800	375
350	80		10.2	7.0	850	325
350	100		10.2	7.2	850	325
350	150		10.2	7.8	850	325
350	200		10.2	8.4	850	325
350	250		10.2	9.0	850	325
350	300		10.2	9.6	850	425
400	80		10.8	7.0	900	350
400	100		10.8	7.2	900	350
400	150		10.8	7.8	900	350
400	200		10.8	8.4	900	350
400	250		10.8	9.0	900	350
400	300		10.8	9.6	900	450
450	100		11.4	7.2	950	375
450	150		11.4	7.8	950	375
450	200		11.4	8.4	950	375
450	250		11.4	9.0	950	375
450	300		11.4	9.6	950	475
450	350		11.4	10.2	950	475
450	400		11.4	10.8	950	475
500	80		12.0	7.0	1000	400
500	100		12.0	7.2	1000	400
500	150		12.0	7.8	1000	400
500	200		12.0	8.4	1000	400
500	250		12.0	9.0	1000	400
500	300		12.0	9.6	1000	500
500	350		12.0	10.2	1000	500
500	400		12.0	10.8	1000	500
500	450		12.0	11.4	1000	500
600	80		13.2	7.0	1100	450
600	100		13.2	7.2	1100	450
600	150		13.2	7.8	1100	450
600	200		13.2	8.4	1100	450
600	250		13.2	9.0	1100	450
600	300		13.2	9.6	1100	550
600	350		13.2	10.2	1100	550
600	400		13.2	10.8	1100	550
600	450		13.2	11.4	1100	550
600	500		13.2	12.0	1100	550
700	150		14.4	7.8	595	520
700	200		14.4	8.4	650	525
800	150		15.6	7.8	635	580
800	200		15.6	8.4	690	585
900	150		16.8	7.8	675	640
900	200		16.8	8.4	730	645
1000	300		18.0	9.6	880	720

Flanged Bell-mouth

Nominal SIZE mm	e mm	L mm	D mm
80	7.0	135	160
100	7.2	140	185
150	7.8	155	245
200	8.4	170	310
250	9.0	190	370
300	9.6	210	435
350	10.2	225	495
400	10.8	245	560
450	11.4	260	620
500	12.0	280	685
600	13.2	300	810
700	14.4	340	945
800	15.6	380	1055
900	16.8	420	1165
1000	18.0	440	1290

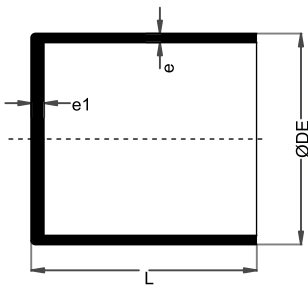
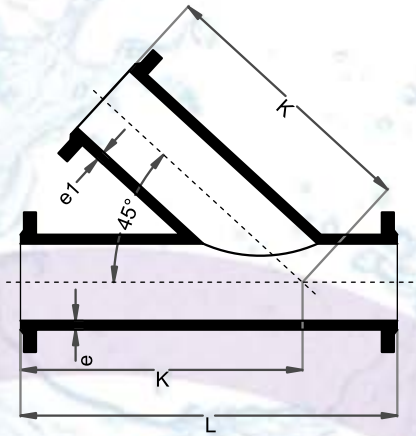


End Caps

SIZE Body DN mm	e mm
80	18
100	18
125	18
150	18
200	18
250	20
300	23
350	24
400	25
450	26
500	27
600	30
700	31
800	33
900	35
1000	37

All Flanged Cross

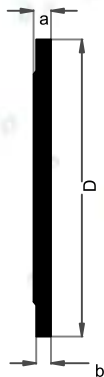
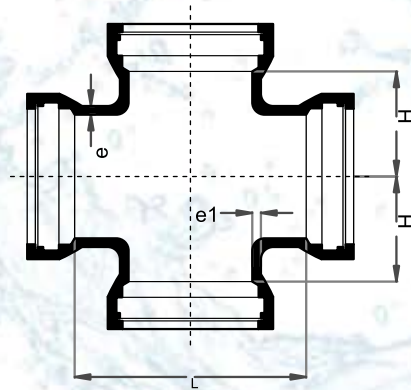
Nominal Diameter		e mm	e <sub>1</sub> mm	L mm	H mm
Body DN mm	Branch dn mm				
80	80	7.0	7.0	330	165
100	80	7.2	7.0	360	175
100	100	7.2	7.2	360	180
125	80	7.5	7.0	400	190
125	125	7.5	7.0	400	200
150	80	7.8	7.0	440	205
150	100	7.8	7.2	440	210
150	150	7.8	7.8	440	220
200	80	8.4	7.0	520	235
200	100	8.4	7.2	520	240
200	150	8.4	7.8	520	250
200	200	8.4	8.4	520	260
250	80	9.0	7.0	700	265
250	100	9.0	7.2	700	275
250	150	9.0	7.8	700	300
250	200	9.0	8.4	700	325
250	250	9.0	9.0	700	350
300	80	9.6	7.0	800	290
300	100	9.6	7.2	800	300
300	150	9.6	7.8	800	325
300	200	9.6	8.4	800	350
300	250	9.6	9.0	800	375
300	300	9.6	9.6	800	400
350	100	10.2	7.2	850	325
350	150	10.2	7.8	850	325
350	200	10.2	8.4	850	325
350	250	10.2	9.0	850	325
350	300	10.2	9.6	850	425
350	350	10.2	10.2	850	425
400	100	10.8	7.2	900	350
400	150	10.8	7.8	900	350
400	200	10.8	8.4	900	350
400	250	10.8	9.0	900	350
400	300	10.8	9.6	900	450
400	350	10.8	10.2	900	450
400	400	10.8	10.8	900	450
450	100	11.4	7.2	950	375
450	150	11.4	7.8	950	375
450	200	11.4	8.4	950	375
450	250	11.4	9.0	950	375
450	300	11.4	9.6	950	475
450	350	11.4	10.2	950	475
450	400	11.4	10.8	950	475
450	450	11.4	11.4	950	475
500	100	12.0	7.2	1000	400
500	150	12.0	7.8	1000	400
500	200	12.0	8.4	1000	400
500	250	12.0	9.0	1000	400
500	300	12.0	9.6	1000	500
500	350	12.0	10.2	1000	500
500	400	12.0	10.8	1000	500
500	450	12.0	11.4	1000	500
500	500	12.0	12.0	1000	500
600	100	13.2	7.2	1100	450
600	150	13.2	7.8	1100	450
600	200	13.2	8.4	1100	450
600	250	13.2	9.0	1100	450
600	300	13.2	9.6	1100	550
600	350	13.2	10.2	1100	550
600	400	13.2	10.8	1100	550
600	450	13.2	11.4	1100	550
600	500	13.2	12.0	1100	550
600	600	13.2	13.2	1100	550
700	700	14.4	14.4	1200	600
800	800	15.6	15.6	1350	675
900	900	16.8	16.8	1500	750
1000	1000	18.0	18.0	1650	825



All Flanged 45° Angle Branch

Nominal Diameter		e	e <sub>1</sub>	K	L
Body DN	Branch dn				
mm	mm	mm	mm	mm	mm
80	80	7.0	7.0	375	500
100	80	7.2	7.0	390	500
100	100	7.2	7.2	405	540
150	80	7.8	7.0	480	590
150	100	7.8	7.2	480	640
150	150	7.8	7.8	480	640
200	80	8.4	7.0	535	635
200	100	8.4	7.2	535	635
200	150	8.4	7.8	560	735
200	200	8.4	8.4	560	735
250	80	9.0	7.0	585	660
250	100	9.0	7.2	610	710
250	150	9.0	7.8	640	830
250	200	9.0	8.4	640	830
250	250	9.0	9.0	640	830
300	80	9.6	7.0	610	685
300	100	9.6	7.2	610	685
300	150	9.6	7.8	660	790
300	200	9.6	8.4	685	865
300	250	9.6	9.0	715	930
300	300	9.6	9.6	715	930
350	100	10.2	7.2	635	685
350	150	10.2	7.8	660	740
350	200	10.2	8.4	710	840
350	250	10.2	9.0	740	880
350	300	10.2	9.6	790	940
350	350	10.2	10.2	790	970
400	100	10.8	7.2	710	760
400	150	10.8	7.8	740	815
400	200	10.8	8.4	760	865
400	250	10.8	9.0	820	970
400	300	10.8	9.6	870	1000
400	350	10.8	10.2	870	1030
400	400	10.8	10.8	870	1070
450	100	11.4	7.2	710	740
450	150	11.4	7.8	760	840
450	200	11.4	8.4	790	890
450	250	11.4	9.0	820	990
450	300	11.4	9.6	900	1040
450	350	11.4	10.2	950	1090
500	150	12.0	7.8	765	790
500	200	12.0	8.4	810	890
500	250	12.0	9.0	840	940
500	300	12.0	9.6	865	990
500	350	12.0	10.2	950	1065
600	150	13.2	7.8	840	890
600	200	13.2	8.4	890	940
600	250	13.2	9.0	915	990
600	300	13.2	9.6	965	1090
700	300	14.4	9.6	1090	1170
800	300	15.6	9.6	1170	1200
900	400	16.8	10.8	1315	1410
1000	400	18.0	10.8	1415	1485

Plug	SIZE				
	Body DN	DE	e	e <sub>1</sub>	L
	mm	mm	mm	mm	mm
80	7.0	165	110	180	
100	7.2	180	125	200	
150	7.8	220	160	250	
200	8.4	260	190	300	
250	9.0	350	225	350	
300	9.6	400	255	400	
350	10.2	450	290	450	
400	10.8	500	320	500	
450	11.4	550	355	550	
500	12.0	600	385	600	
600	13.2	700	450	700	
700	14.4	800	515	800	
800	15.6	900	580	900	
900	16.8	1000	645	1000	
1000	18.0	1100	710	1100	



Blank Flanges, Type PN16

DN mm	D mm	a mm	b mm	c mm
80	200	19.0	16.0	3
100	220	19.0	16.0	3
125	250	19.0	16.0	3
150	285	19.0	16.0	3
200	340	20.0	17.0	3
250	400	22.0	19.0	3
300	455	24.5	20.5	4
350	520	26.5	22.5	4
400	580	28.0	24.0	4
450	640	30.0	26.0	4
500	715	31.5	27.5	4
600	840	36.0	31.0	5
700	910	39.5	34.5	5
800	1025	43.0	38.0	5
900	1125	46.5	41.5	5
1000	1255	50.0	45.0	5

All Socket Cross

Body DN mm	Branch dn mm	SIZE			
		e mm	e <sub>1</sub> mm	L mm	H mm
80	80	7.0	7.0	170	85
100	80	7.2	7.0	170	95
100	100	7.2	7.2	190	95
150	150	7.8	7.8	255	125
200	80	8.4	7.0	175	145
200	100	8.4	7.2	200	145
200	150	8.4	7.8	255	150
200	200	8.4	8.4	315	155
250	80	9.0	7.0	180	170
250	100	9.0	7.2	200	170
250	150	9.0	7.8	260	175
250	200	9.0	8.4	315	180
250	250	9.0	9.0	375	190
300	80	9.6	7.0	180	195
300	100	9.6	7.2	205	195
300	150	9.6	7.8	260	200
300	200	9.6	8.4	320	205
300	250	9.6	9.0	380	215
300	300	9.6	9.6	435	220
350	100	10.2	7.2	205	220
350	150	10.2	7.8	265	225
350	200	10.2	8.4	325	230
350	250	10.2	9.0	380	240
350	300	10.2	9.6	440	245
350	350	10.2	10.2	495	250
400	100	10.8	7.2	210	245
400	150	10.8	7.8	270	250
400	200	10.8	8.4	325	255
400	250	10.8	9.0	385	265
400	300	10.8	9.6	440	270
400	400	10.8	10.8	560	280
500	100	12.0	7.2	215	295
500	150	12.0	7.8	275	300
500	200	12.0	8.4	330	305
500	250	12.0	9.0	390	315
500	300	12.0	9.6	450	320
500	400	12.0	10.8	565	330
500	500	12.0	12.0	680	340
600	200	13.2	8.4	340	355
600	400	13.2	10.8	570	380
600	600	13.2	13.2	800	400
700	200	14.4	8.4	345	405
700	400	14.4	10.8	575	430
700	600	14.4	13.2	810	450
700	700	14.4	14.4	925	460
800	200	15.6	8.4	350	455
800	400	15.6	10.8	580	480
800	600	15.6	13.2	815	500
800	800	15.6	15.6	1045	525
900	200	16.8	8.4	355	505
900	400	16.8	10.8	590	530
900	600	16.8	13.2	820	550
900	800	16.8	15.6	1050	575
900	900	16.8	16.8	1170	585
1000	200	18.0	8.4	360	555
1000	400	18.0	10.8	595	580
1000	600	18.0	13.2	825	600
1000	800	18.0	15.6	1060	625
1000	1000	18.0	18.0	1290	645



## EXTERNAL PROTECTION

### 1. Protection system for pipes

a) **Metallic Zinc or Zinc alloy coating** with following options:

- Metallic Zinc coating having a mass of 130gm/m<sup>2</sup> or 200 gm/m<sup>2</sup> or 400 gm/m<sup>2</sup>.
- Zinc Aluminium coating having a mass of 200 gm/m<sup>2</sup> or 400 gm/m<sup>2</sup>.

The Metallic Zinc or Zinc alloy coating is covered with a finishing layer of bitumen or Epoxy.

b) **Aluminium pigmented Bitumen**

Aluminium pigmented Bitumen – Normally applied over Zinc inner coating

c) **Epoxy coating** : Normally applied over metallic coating as a finishing coat. Compared to normal bitumen coated pipes it offers:

- More resistance to external galvanic/soil corrosion in aggressive soil.
- More resistance to external chemical (acid, alkali, organic) attack.
- Higher scratch resistance. So more resistant to coating damage during transportation/Handling /laying.
- The coating comes in attractive blue/green (for water) or red (for sewerage) colour. Hence offers much better look and aesthetics.

d) **Polyethylene Sleeving** : Loose Polyethylene encasement is very effective for protection of Ductile Iron Pipes and Fittings in corrosive environments and widely practiced in USA, Europe and Australia. Investigation of many field installations, where loose polyethylene encasement has been used as protection for Cast Iron and Ductile Iron pipelines indicates

a high degree of protection even in the highly corrosive soils. The dielectric capability of polyethylene provides shielding for Ductile Iron Pipes and Fittings from stray direct current at most levels encountered in the field.

e) **Polyurethane Coating**: Polyurethane Coating is normally factory applied on prepared pipe surface.

f) **PE tape Wrapping**: In highly aggressive soil conditions, additional external protection in the form of a spirally applied anti-corrosion mastic tape may be required. This can either be applied at our works prior to dispatch or, if the facility exists, it may be site applied. The tape wrap provides high electrical resistance and excellent corrosion protection in highly aggressive environments.

The pipe is wrapped from just behind the socket to just prior to the spigot insertion marks. Wrapping can be provided with either a 25mm or 55% overlap. After jointing the jointing area is also wrapped.





## Selection of Suitable External Coating

Soil Corrosivity	Typical Ground Conditions Pipes	Protection System Pipes
Slight to moderately aggressive	* Soil resistivity above 2500 ohm.cm * Soil resistivity between 1500 and 2500 ohm.cm without water table	Metallic Zinc(130 to 200gms/mtr <sup>2</sup> min.) with Bitumen or Epoxy as finishing layer
Aggressive	* Soil resistivity between 1500 and 2500 ohm.cm with water table * Soil resistivity between 500 and 1500 ohm.cm without water table	* Metallic Zinc-Aluminium (400gms/mtr <sup>2</sup> ) or * Metallic Zinc(200gms/mtr <sup>2</sup> min.) with Bitumen or Epoxy as finishing layer, PE sleeving recommended
Highly aggressive	* Soil resistivity below 500 ohm.cm without water table * Soil resistivity below 1500 ohm.cm with water table * Ground with light chemical contamination * Stray electrical currents	Coating for Aggressive soil plus tape wrap (25mm overlap) Alternately Polyurethane coating (Min. 750 micron)
Special condition	* Soil resistivity below 500 ohm.cm with water table * Ground containing clinker, bricks, flints etc. likely to cause mechanical damage * Ground with heavy chemical contamination * Tidal water e.g. estuaries, shorelines	Coating for Aggressive soil plus tape wrap (55% overlap) or Polyurethane coating (Min. 1000 micron)

Note : The above table is only for guidance. User should decide the type of coating depending on prevailing site condition.

## 2. Protection system for fittings

- a) Zinc rich paint and finishing layer of bituminous paint or liquid epoxy
- b) External polyethylene sleeving
- c) Fusion Bonded Epoxy Coating
- d) Polyurethane Coating

### Fusion Bonded Epoxy Coating

FBE coating is applied in a state-of-the-art automated facility to coat DI fittings with powdered epoxy by fusion bonding process. This inert coating in attractive colours is suited for aggressive soil condition.

#### Advantages

- Gives high Gloss and smooth coatings with excellent adhesion.
- Difficult shapes can be coated evenly.
- Provides enhanced corrosion resistant properties.
- A choice of Blue or Red colour for water or sewage applications is available.
- Film thickness of 250 micron, can be specified as per EN 14901.
- Higher film thickness (above 250 micron) can also be applied as per customer requirement.





## INTERNAL PROTECTION

### 1. Protection system for pipes

**a) Cement Mortar Linings** : Pipes are generally supplied with centrifugally applied cement mortar lining. This lining creates a mildly alkaline environment at the internal metal surface and protects the pipe from corrosion and tuberculation.

The different types of cement Lining offered are:

- Blast Furnace slag cement
- Sulphate resistant cement
- High Alumina Cement for sewage pipes

Water Characteristics	Portland cement	Sulfate resisting cements	High alumina cement
Min value of pH	6	5.5	4
Max. content (mg/L) CO <sub>2</sub>	7	15	no limit
Sulfates (SO <sub>4</sub> <sup>-</sup> )	400	3000	no limit
Magnesium (Mg <sup>++</sup> )	100	500	no limit
Ammonium (NH <sub>4</sub> <sup>+</sup> )	30	30	no limit

#### Advantages of Cement Mortar Lining (CML)

- Centrifugally applied CML provides a higher Hazen William's C value of 140 compared to 100 for bare metallic pipes.
- Reduces frictional head loss and pumping cost.
- CML passivates the pipe wall against corrosion through the alkaline reaction of cement.
- CML prevents pitting and tuberculation of pipes and stops the production of red water.

- CML helps to maintain the same for area and coefficient of friction over a long period of time.

#### b) Seal coat on cement mortar lining

Seal coats if specified are applied on the inside cement mortar lined surface of D.I. Pipes. Mainly two types of seal are offered :

- Bituminous seal coat**
- Epoxy seal coat**

The main purpose of providing seal coat is to stop leaching of cement compounds from the linings, affecting the water's pH and causing alkalinity to increase.

#### c) Ceramic Epoxy

Ceramic epoxy lining is a specialized lining which offers a hard and stable surface with high abrasion resistance. Mainly used for sewage conveyance or ash slurry conveyance or for conveying corrosive fluids.







## Recommendation For Internal Lining

Sl	Fluid Condition	Lining for Pipes
1	Potable Water/ Raw water with negative Langelier Index (alkalinity between 25 and 250 ppm CaCO <sub>3</sub> ) and pH between 5.5 and 13 content in the input water.	Cement Mortar Lining with Blast Furnace Slag Cement or Sulphate resistant Cement, depending on sulphate
2	Domestic Sewage High Sulphate content > 3%	Sulphate Resisting Cement Lining
3	Very Soft Water with negative Langelier Index (alkalinity below 25 ppm CaCO <sub>3</sub> ).	Sulphate Resisting Cement Lining or Blast Furnace Slag Cement with Seal Coat (Preferably with epoxy).
4	Sewage and Industrial Effluent having pH Minimum 3 to max 13 with aggressive CO <sub>2</sub> , Sulphates > 3000 mg/l, magnesium >500 mg/l, and ammonium >30 mg/l	High Alumina Cement Mortar Lining
5	Sea Water and Ash Slurry	High Alumina Cement Mortar Lining



## 2. Protection system for fittings

### a) Cement Mortar Lining

By agreement between manufacturer and purchaser, any one of the lining may be applied depending on the type of liquid transported:

- Blast furnace slag cement mortar
- Sulphate resistant cement mortar
- High alumina cement mortar. If required by the customer, Fittings with bituminous or epoxy seal coat over cement mortar is also available

### b) Fusion Bonded Epoxy

Normally Fusion bonded epoxy is applied both on the outer and inner surface of the fittings

### c) Ceramic Epoxy

Ceramic epoxy lining is also applied inside fittings which are to be used with ceramic epoxy lined pipes.

All material coming in contact with potable water are certified by various approving agencies like WRAS, DWI, WRc, DVGW etc.





## RELEVANT STANDARDS

Please note that the recommendations in this catalog only highlights the important points of the standards. Customers should study the following standards thoroughly for the selection specification, installation and testing. They must also refer to our User Guide for details regarding do's and don't's, handling, laying and installation.

Sl	Standard	Description
I	EN 545	Ductile iron pipes, fittings, accessories and their joints for water pipelines - requirements and test methods.
2	ISO 2531	Ductile iron pipes, fittings, accessories and their joints for water or gas applications.
3	EN 598	Ductile iron pipes, fittings, accessories and their joints for sewerage application- requirements and test methods.
4	ISO 7186	Ductile iron products for sewerage applications.
5	BS 3416	Specification for bitumen based coatings for cold application suitable for use in contact with potable water.
6	ISO 8179	Ductile iron pipes: external zinc coating. Part 1: Metallic Zinc with finishing layer. Part 2: Zinc rich paint with finishing layer.
7	ISO 4179	Ductile iron pipes for pressure and non-pressure pipelines - centrifugal cement mortar lining -General requirements.
8	BS 2494	Specification for elastomeric seals for joints in pipe-work and pipelines.
9	ISO 4633	Rubber seals-joint rings for water supply, drainage and sewerage pipelines-specification for materials.
10	BS 6076	Specification for tubular polyethylene film for use as protective sleeving for buried iron pipes and fittings.
11	ISO 8180	Ductile iron pipes-polyethylene sleeving.
12	BS 8010	Pipelines on land: design, construction and installation. Section 2.1 : Ductile iron.
13	ISO 10802	Ductile iron pipelines - hydrostatic testing after installation.
14	ISO 10803	Design method for ductile iron pipes.
15	EN 1092	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Part 2 : Cast iron flanges.
16	EN 1514	Flanges and their joints. Dimension of gaskets for PN-designated flanges. Part 1 : Non-metallic flat gaskets with or without inserts. Part 2 : Spiral bound gaskets for use with steel flanges. Part 3 : Non-metallic PTFE envelope gaskets. Part 4 : Corrugated, flat or grooved metallic and filled metallic gaskets for use with steel flanges.
17	ISO 7005	Metallic flanges - Cast iron flanges.
18	AWWA C151	Ductile Iron Pipe, Centrifugally Cast, for water.
19	AWWA C600	Installation of Ductile Iron Water Mains and their Appurtenances.



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