

# **DUCTILE IRON PIPES AND FITTINGS**

## **DETAILED PRODUCTS SPECIFICATIONS**

### **General**

All Materials shall be EN, ISO or equivalent standard and shall be supplied from approved manufacturers. According to the International Standard ISO 9001:2000, the manufacturer must produce according to the latest version of the products Standards ISO and EN.

The Manufacturer or Supplier shall be specific as to the country of origin and the manufacturing firm of the materials he intends to supply under this contract. All pipes, fittings and valves shall be suitable for buried installation.

### **Coordination**

As per EN 545-2010, the Manufacturer or Supplier shall assume full responsibility for the complete compatibility of all elements of each piping system he will provide (this must be certified by an eligible Third Party). The Manufacturer or supplier shall furnish suitable transition pieces and special fittings acceptable to the Engineer where required to ensure compatibility of piping with valves, and other items of equipment he will supply.

### **APPLICABLE CODES AND STANDARDS**

The codes and standards generally applicable to the work under this section are listed below, equivalent standards are acceptable but internationally recognized standards will be preferred. Codes and standards current at the time of bid shall be used.

ISO 2531:2009:	Ductile iron pipes, fittings, accessories and their joints for water or gas applications
EN 545:2010:	Ductile iron pipes, fittings, accessories and their joint for water pipelines. Requirements and tests methods.
ISO 4179:2005:	Ductile iron pipes and fittings for pressure and non-pressure pipelines.- Cement mortar lining.
ISO 8179-1:2004:	Ductile iron pipes-External zinc based coating. Part 1- Metallic zinc with finishing layer.
ISO 4633:2002:	Rubber seals- joint rings for water supply, drainage and sewerage pipeline- specifications for material.
ISO 7005-2:1988:	Metallic Flanges - Flange Dimensions

EN 14910: 2006:	Ductile iron pipes, fittings and accessories-Epoxy coating (heavy duty) of ductile iron fittings and accessories-Requirement and tests methods.
EN 15542:2006:	Ductile iron pipes, cement mortar coating for pipes-Requirement and tests methods.
ISO 8180:	Polyethylene sleeve

## Ductile Iron Material Characteristics

The ductile iron materials shall meet the following requirements:

Material Characteristics	Pipes Centrifugally Cast	Pipes not Centrifugally Cast, Fittings, Accessories
Minimum Tensile strength (MPa)	420	420
Minimum elongation at break (%)		
DN 40 to 1000 mm	10	5
DN 1100 to 2000 mm	7	5
Maximum Brinell hardness (HB)	230	250

By agreement between manufacturer and purchaser, the 0.2% proof stress (Rp0.2) may be measured. It shall be not less than:

270 MPa when  $A \geq 12\%$  for DN 40 to DN 1000 or  $A \geq 10\%$  for DN > 1000.

300 MPa in other cases.

## Ductile Iron Pipes

Ductile iron pipes shall be centrifugally cast in accordance with the European Standard EN 545:2010.

Centrifugally cast pipes shall be subjected to a work hydrostatic test for duration of at least 10 seconds at a minimum pressure given in EN 545:2010 Standard, depending on the class of pipes.

Pipes, pipe-fittings and joints class adjusted by the contractor based on the final design for each segment must be able to withstand normal working conditions especially inner pressure, external strains, overloads and reactions from soil or supports taking into consideration the surge and test pressures.

Unless not specified in the specification, the manufacturer has to produce the pipes according to the following requirements:

*Useable cutting length:*

According to EN 545:2010 Standard, cutting of pipe DN  $\leq 300$  mm can be made anywhere along 2/3rds of the length of the pipe working from the spigot.

For other diameters the contractor shall clearly mention the number of pipes to be calibrated.

## Ductile Iron Fittings

Ductile iron fittings shall be sand cast in accordance with the European Standard EN 545:2010.

The dimensional requirements are indicated in the above mentioned Standards.

The fittings shall be submitted at the works to a leak-tightness test carried out either with air at a pressure of 1 bar or with water in accordance with EN 545:2010.

The fittings shall be designed and manufactured as automatic push-on joint type (Tyton and/or Standard or equivalent), flanged type and self-anchored automatic push-on joint type, mechanical joints shall be used for collars or couplings only.

Each socket joint shall be supplied with its EPDM gasket, (and glands and bolts when mechanical or anchored type).

Each flange joint shall be supplied with gasket and bolts (not less than zinc coated 15-20 microns in accordance to ISO 4014 and ISO 4032) for all sides and flange connection shall be in accordance with ISO 7005-2.

## JOINTS

### Flexible Joints

Flexible Joint shall be of spigot socket automatic push-on joint type (Tyton and/or Standard or equivalent), mechanical type (for collars or couplings only).

The joint shall be suitable for angular deflection.

Joints may permit angular deflection to accommodate ground movements and negotiate large radius bends. The angle deflection shall be as per the table below:

5 ° for DN 80 to 300
4° for DN 350 to 400
3 ° for DN 500 to 1000
1 ° 30 for DN 1200 to 2000

Higher angular deflection shall be accepted.

The material used for the rubber gaskets shall be an EPDM elastomer, in accordance with ISO 4633:2002 and duly certified as suitable for potable water up to 50°C.

### Flanged Joints

Flanged ended pipes and fittings shall be used when connecting to valves or other special fittings.

The flanges shall be raised face and integrally cast rotatable flanges may be used for fittings up to DN 600 mm.

The dimensions and the drilling of the flanges shall be in accordance with the International Standard ISO 7005-2 or the European Standard EN 1092 -2. The pressure rating of the flanges shall be as given in the particular specifications. Flanged joints shall be supplied complete with gaskets and bolts.

Rubber gasket shall be EPDM elastomer in accordance with the International Standard ISO 4633: 2002 and duly certified as suitable for potable water up to 50°C. The gasket shall be reinforced and suitable for a minimum pressure rating of 10 bars and higher.

## Anchored Joints

Ductile iron pipes and fittings may be anchored to be used where pipelines have to cross through existing ducts, in areas with restricted accessibility, when the use of concrete anchor blocks is prohibited or impossible, or when the pipes must be pulled during the installation and for mains on steep slopes (> 25%).

Anchored joint shall be designed to resist to the axial thrust forces but maintaining flexibility and angular deflection as mentioned in Table below. Anchored joints shall be designed to withstand the greater of the pressure or the service pressure + surge pressure or the site test pressure.

The socket ends of all pipes and fittings shall consist of two chambers: a sealing chamber for the gasket and a locking chamber for the restraining locks. The spigot ends of all pipes and fittings shall induce a factory applied welding bead to fit inside the restrained socket. No bolts, nuts, and glands shall be used as part of the locking joint. The locking mechanism shall be a resultant of the direct contact between the welding bead and the corresponding number of locking segments as shown in Table below. The locking segments shall be of ductile iron.

DN	Axial Deflection	Component Operating Pressure PFA (Bar)	Permitted Tractive Force (kN)
80	5°	100 / 1101)	115
100	5°	75 / 1001)	150
125	5°	63 / 1001)	225
150	5°	63 / 751)	200
200	4°	42 / 631)	350
250	4°	40 / 441)	375
300	4°	40	380
400	3°	30	650
500	3°	30	860
600	2°	32	1525
700	1.5°	25	1650
800	1.5°	25	1460
900	1.5°	16 / 252)	1845
1 000	1.5°	10 / 252)	1560
*All calculations are made based on K9 wall thickness for all pipes			
1) An additional high - pressure lock is installed in the joint. 2) Wall thickness class K10			

# WALL THICKNESS

## General

For pipes centrifugally cast, the minimum wall thickness,  $e_{min}$ , shall not be less than 3,0 mm. The nominal wall thickness,  $e_{nom}$ , is equal to the minimum wall thickness,  $e_{min}$  plus  $(1,3 + 0,001 DN)$ .

The thickness shall be as per Class 50, Class 40, Class 30 and Class 25 for pipes of DN 40 to DN 2000.

For fittings, the thickness is according to EN 545-2010. The nominal thickness corresponding to the main part of the body. The actual thickness at any particular point may be increased to meet localized high stresses depending on the shape of the casting (e.g. at internal radius of bends, at the branch-body junction of tees,...).

## Preferred Pressure Classes: Class 40, Class 30, Class 25

Pipes should be manufactured according to the preferred pressure class as per the final design provided by the contractor and approved by the engineer.

Pipes, pipe-fittings and joints class adjusted by the contractor based on the final design for each segment must be able to withstand normal working conditions especially inner pressure, external strains, overloads and reactions from soil or supports taking into consideration the surge and test pressures.

The nominal iron wall thickness of pipes DN 60 to DN 2000 is given as a function of the nominal size DN in the below table. Minimum preferred wall thicknesses shall be according to EN545:2010 as follows:

DN	External Diameter DE mm	Minimum Wall thickness (mm)		
		Class 40	Class 30	Class 25
60	77	3.0		
80	98	3.0		
100	118	3.0		
125	144	3.0		
150	170	3.0		
200	222	3.1		
250	274	3.9		
300	326	4.6		
350	378		4.7	
400	429		4.8	
450	480		5.1	
500	532		5.6	
600	635		6.7	
700	738			6.8
800	842			7.5
900	945			8.4

1000	1048			9.3
1100	1152			10.2
1200	1255			11.1
1400	1462			12.9
1500	1565			13.9
1600	1668			14.8
1800	1875			16.6
2000	2082			18.4

## LINING AND COATINGS

### Socket and Spigot Pipes (Including Welded Flanged Pipes)

#### 1. Internal Protection

Pipes will be internally lined with a sulphate resistant blast furnace slag cement mortar applied by a centrifugal process, in accordance with the International Standard ISO 4179:2005 and the European Standard EN 545:2010, with the following thicknesses:

DN	Thicknesses (mm)	
	Nominal	Tolerance
60-300	4	-1.5
350-600	5	-2
700-1200	6	-2.5
1400-2000	9	-3

#### 2. External Protection

Pipes will be externally protected with suitable coating with an Alloy of zinc and aluminium with or without other metals (85%Zn-15%Al) coating followed by a finishing layer in accordance with EN 545-2010.

The alloy of zinc and aluminium shall contain zinc at minimum 85% and aluminium at 15% and the mean mass of alloy zinc and aluminium coating shall not be less than 400 g/m<sup>2</sup> applied on the bare metal of the external surface of the pipe.

The finishing layer shall uniformly cover the whole surface of the metallic zinc aluminium alloy layer and be free from such defects as bare patches or lack of adhesion. The uniformity of the finishing layer shall be checked by visual inspection. When measured in accordance with EN545:2010 paragraph 6.7, the mean thickness of the finishing layer shall be not less than 70 µm and the local minimum thickness not less than 50 µm.

# Fittings

## Internal and External Protection

Fittings will be internally and externally protected depending on the corrosiveness of soils, with:

The fittings laid in non corrosive soils shall be internally and externally protected with a **fusion bonded epoxy coating** with a minimum dry film thickness of **250 microns**, according to the European Standard EN 14901:2006, for corrosive soil the thickness will be **300 microns**.

## MARKING

All pipes and fittings shall be legibly and durably marked and shall bear at least the following information:

1. The Manufacturing Unit.
2. The identification of the year of manufacture.
3. The identification as ductile iron.
4. The DN.
5. The PN rating of flanges when applicable.
6. The reference to the standard.
7. The C class designation of centrifugally cast pipes.

The first **five markings given above shall be cast-on or cold stamped**; the other markings can be applied by any method, e.g. painted on the casting or attached to the packaging.

## GASKETS AND SEALS

The material used for the rubber gaskets shall be an EPDM elastomer, in accordance with ISO 4633:2002 and duly certified as suitable for potable water up to 50°C, by one of the national regulations.

Sufficient lubricant as recommended by the pipe manufacturer shall be provided for pipe installation plus ten percent as surplus material. Lubricant containers shall be adequate for extended storage and the pipe manufacturer shall supply instructions for storage limitations and environment.

## FACTORY TESTING

Inspection for external appearance, shape and dimensions shall be carried out on each pipe and fitting. All pipes and fittings shall be sound and free from surface defects.

Each pipe centrifugally cast shall be subjected to the hydrostatic pressure test as specified in EN 545-2010. Hydrostatic pressure tests shall be performed before the pipes are coated or lined. Each fittings and accessory not centrifugally cast shall be subjected to a leak tightness carried out with water or air as specified in EN 545-2010.

Any pipe or fitting that leaks or does not withstand the test pressure shall be rejected.

Mechanical tests for hardness, tensile strength, and elongation shall be performed on pipes selected at random out of castings grouped in lots. Each lot shall comprise 200 pipes successively cast.

## **STORAGE OF THE MATERIALS**

The contractor shall be responsible for the handling, storage and well-being of all materials purchased under this contract, until the delivery defined as per the sales condition of the contract.

The Manufacturer or Supplier will provide to the Tenderer and the Engineer the best practices and advice to be followed regarding the transport, handling and storage of the offered products.

### **Product Handling**

Pipe, fittings, and appurtenances shall be transported, stored, and handled in a manner which prevents damages (protected hooks, textile straps...). As per the Manufacturer or supplier provided handling recommendations and best practices.