

SPECIFICATION FOR DI PIPES AND FITTINGS FOR WATER SUPPLY APPLICATIONS

- **GENERAL**
- **TECHNICAL REQUIREMENTS FOR DI
PIPES & FITTINGS FOR WATER
SUPPLY APPLICATIONS**

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FOR WATER SUPPLY APPLICATIONS**

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1.0 GENERAL

1.1 Ambient Conditions

All items of materials and equipment shall be in every respect suitable for storage, installation, use and operation in the conditions of temperature and humidity appertaining in Sri Lanka.

The annual average temperature is 35 °C while the relative humidity varies generally from 70% during the day to 90% at night.

The temperature of potable water to be conveyed in the pipelines will be about 32 °C at the depth of 1.5m.

1.2 Suitability for Potable Water

Pipes and pipeline components, including their protective coatings and joint materials, that will or may come into contact with potable water shall not constitute a toxic hazard; shall not support microbial growth; shall not cause taste or odour, cloudiness or discolouration of the water shall not cause to change to pH.

1.3 Definitions

The definitions given in the relevant standards which are referred to in the specification shall apply for the terms used in this specification.

1.4 Non-metallic Materials

All non-metallic materials supplied shall be listed in the current "Water Fittings and Materials Directory" published by the Water Research Centre, UK, or approved equivalent publication, as a recognized certifying authority having passed full tests of effect on water quality under the requirements for the testing of non-metallic materials for use in contact with potable water.

1.5 Flanges

All flanges dimensionally shall be in accordance with EN 1092-2 : 1997 Specification for Steel Flanges - Metric Series. The screw threads in all pipes and fittings shall comply with ISO Metric Screw Threads.

1.6 Inspection and Testing

The Contractor shall supply, furnish and prepare the necessary test pieces and samples of all materials and supply the labour facilities and appliances for such testing as may be required to be carried out on his premises according to this specification. If there are no facilities at his own works for making the prescribed tests the Contractor shall bear the cost of carrying out the tests elsewhere.

The Engineer or nominated Inspection authority shall have full access to all parts of the plant that are concerned with the testing, furnishing or preparation of materials for the performance and testing of work under this Specification.

The Contractor shall furnish the Engineer with reasonable facilities and space (without charge) for the inspection, testing and obtaining of such information, as he desires regarding the character of material in use and the progress and manner of the work.

The format for test certificate shall be in accordance with the format given in the schedule of particulars.

1.7 Marking of Pipes, Fittings, and Specials

All markings described below shall be legible and durable unless otherwise specified.

All pipes and fittings shall be marked with the information specified in clause 4.7 of EN 545 : 2010, or clause 4, 6 of ISO 2531:2009. The mark of the manufacturers and class of pipe shall be embossed or cold stamp on all pipes and fittings. Other markings may be cast on, cold stamped or painted with an indelible paint.

In addition to what is specified above the additional markings and the lettering sizes shall be made with details as per the **Table 1** hereof.

Table 1 – Additional Markings

Item	Diameter (mm)	Details required	Lettering Heights Details (mm)
Pipes	above 350	"NWSDB"; Pipe standard (EN or other); Class or type ; Nominal dia., Manufacture's name & Year of manufacture (at intervals not more than 3 m)	50
	150 to 350 (both inclusive)	as above	25
	50 to 150	as above	10
Fittings and Specials	above 350	"NWSDB"; Pipe standard (EN 545 or ISO 2531; Class or type (C class); Nominal dia., Manufacture's name & year of manufacture, PN (for flanges)	25
	150 to 350 (Both inclusive)	as above (except "NWSDB") "NWSDB"	10 25
	50 to 150	"NWSDB"; Pipe standard (EN 545 or ISO 2531; Class or type (C class); Nominal dia., Manufacture's name & year of manufacture, PN (for flanges) Bend angle for bends	10

The Contractor shall label and clearly mark all crates and boxes in indelible paint as specified in the notes forming a part of this Specification.

In addition, all fittings shall be marked with the corresponding item number in the Bills of Quantities or other number specified by the Engineer.

1.8 Protection during Delivery

The Contractor shall provide protection, to the approval of the Engineer, for the ends of all pipes and fittings prior to the pipes and fittings leaving the place of manufacture and shall maintain such protection until the items reach their destination in order to guard effectively against damage during transit and storage and the ingress of foreign matter inside the pipes and fittings.

All fittings shall be securely packed in crates and boxes to prevent damage during delivery. The cost of packing shall be deemed to be included in the Contract Rates and crates will not be returned.

Each box and package therein shall be clearly labeled stating the number, size and description of the contents.

All details of the proposed method of providing such protection shall be submitted at the time of tendering.

The cost of providing protection to the ends of pipes and fittings shall be included in the unit prices tendered in the Bills of quantities.

1.9 Storing, Handling and Hauling of Pipes, Fittings, and Specials

All materials shall be stored in an approved location and in such a manner as to preserve their quality and condition.

Storage shall be in accordance with the manufacturers recommendation.

Materials and components shall be handled in such a manner as to avoid any damage or contamination and in accordance with all applicable recommendations of the manufacturers.

The Contractor shall give instructions to the shipper on precautions to be taken in the handling of the pipes, and other components during loading, towage and unloading, and shall give particulars of these instructions to the purchaser. Also particular attention shall be paid when handling pipes and fittings, to avoid damages to external and internal coatings.

1.10 Packing of Bolts, Joint Rings and Gaskets

Bolts of the same length and size (and their accompanying nuts and washers) shall be packed together in boxes not exceeding gross weight of 100 kg.

Joint rings and gaskets shall be packed in boxes and separate packages shall be provided for each size and description of ring or gasket.

1.11 Manufacturer's Certificate

The Contractor shall supply to the Engineer a certificate stating that each item supplied has been subjected to the tests laid down herein and conforms in all respects to this Specification or such other Specification which has been submitted to and approved by the Engineer.

1.12 Quality and Workmanship

The Bidder shall provide ISO 9001 : 2015 Quality Management System requirement certificate for Quality Assurance for the goods manufacturing factory from an accredited agency for all pipes, fittings, Nuts & Bolts, and accessories. Accredited Agency shall be a member of International Accredited Forum (IAF) and shall have the authority for the accreditation of mentioned goods in their scope of accreditation. Scope of the production shall be clearly specified in the certificate. Manufacturer shall maintain the validity of this certificate during the supply and delivery of the materials for contract Period. If the supply is made from several factories, ISO 9001 : 2015 certificates for quality management system requirement shall be submitted for each factory. This certificate shall clearly indicate the location of the place of manufacture of pipes, fittings, and accessories including nuts & bolts, etc

1.13 Certificate of Independent Inspection Authority

Contractor shall submit to the Engineer a certificate issued by a nominated Independent Inspection Agency that has been subjected to the tests laid down here and conforms in all respect to the specification.

1.14 Flanged Joint Protection

All flanged pipes shall be supplied with complete 'Corrosion' protection materials in accordance with the manufacturer's recommendation. The complete joint protection includes the materials, namely profiling mastic or primer, paste, tape and PVC or polyethylene outer wrapping. The quantity of materials required for each diameter joint shall be calculated in accordance with the manufacturer to cover the whole joint including nuts and bolts. The supplier shall provide the required details of quantities in the schedule of particulars.

1.15 Final Acceptance at site

All pipes, fittings and accessories shall conform to the specification at site. Engineer shall carryout necessary inspections at site prior to final acceptance.

2.0 TECHNICAL REQUIREMENTS FOR DUCTILE IRON PIPES AND FITTINGS FOR WATER SUPPLY APPLICATIONS

2.1 Scope

This section covers the requirement for the supply of Ductile Iron pipes and fittings. In addition to the contents of the following standards, this particular specification shall apply.

2.2 Reference Standards

The following standards are referred to ;

BS ISO 2531 : 2009	Ductile iron pipes, fittings, accessories and their joints for water applications.
BS EN 545 : 2010	Ductile Iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods.
BS 7874 : 1998	Method of tests for microbiological deterioration of Elastomeric scales for Joints in pipe work and pipe lines.
EN 681 -1 : 1996 (with Amendments)	Elastomeric seals- material requirement for pipe joint seals used in water and drainage application. (Vulcanized rubber)
ISO 4633:2015	Rubber seals – Joint rings for water supply drainage and sewerage pipe lines – specification for materials.
BS 3416:1991	Bitumen based coatings for cold application, suitable for use in contact with potable water.
BS EN 10300 : 2005	Steel tubes & fittings for onshore and offshore pipe lines. Bitumen hot applied material for external coating.
BS EN 1092-2 : 1997	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN Designated, Cast iron flanges.
BS EN ISO 898-1:2013	Mechanical properties of fasteners made of carbon steel and alloy steel Bolts, screws and studs with specified property classes. Coarse thread and fine pitch thread.
BS EN ISO 898-2:2022	Fasteners. Mechanical properties of fasteners made of carbon steel and alloy steel Nuts with specified property classes.
BS EN ISO 898-3: 2018	Fasteners. Mechanical properties of fasteners made of carbon steel and alloy steel Flat washers with specified property classes.
BS 4190:2014	ISO metric black hexagon bolts, screws and nuts Specification.

BS EN ISO 10684:2004	Fasteners. Hot dip galvanized coatings.
BS 1514: Part 1:1997	Dimensions of non-metallic Flanges and their joints. Dimensions of gaskets for PN designated flanges. Non metallic flat gasket with or without inserts gaskets for pressures up to 64 bar.
ISO 9001 : 2015	Quality Management System Requirement.
ISO 4179 : 2005	Ductile iron pipes for pressure and non pressure pipelines Centrifugal cement mortar lining.
ISO 18468:2017	Ductile iron fittings, accessories and their joints and valves - Epoxy coating.
JIS G 5528: 2006	Epoxy powder coating for interior of DI pipes and fittings.
ANSI A214	Cement Mortar lining for cast iron and Ductile iron pipes and fittings for water.
ISO 8179: 2017: Part 1	Ductile iron pipes, fittings, accessories and their joints. External zinc-based coating Metallic zinc with finishing layer
ISO 8179: 2018: Part 2	Ductile iron pipes, fittings, accessories and their joints - External zinc-based coating Part 2: Zinc-rich paint
ISO 2081: 2008	Metallic and other inorganic coatings. Electro plated coatings of zinc with supplementary treatments on iron or steel.
EN 14161: 2011	Petroleum and natural gas industries. Pipeline transportation systems.
EN 10088: Part 2: 2014	Stainless steel – Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes.
BS 6076:1996	Polymeric film for use as a protective sleeving for buried iron pipes and fittings (for site and factory application).
ISO 8180: 2020	Ductile Iron pipes – polyethylene sleeving for site application.
ISO 10804: 2018	Restraint Joint System for DI Pipe lines.

The year of publication of the standards referred to in the following clauses shall be the year as given above.

2.3 Definitions

The definitions given in the relevant standards which are referred to in the specification, shall apply for the terms used in this specification.

2.4 Classes of Pipes & fittings and Pressure Ratings

The class of Ductile iron pipes and fittings shall be in accordance with ISO 2531:2009 or with EN 545:2010. The standard pressure class designation of Ductile Iron pipes and pipes and fittings shall be as given in the Table 14 of ISO 2531:2009 or Table 16 of EN 545:2010, the preferred pipe pressure class. Pipes are classified based on the pressure class and denoted by “C”.

Socket and spigot pipes

- Up to and including 300 mm C40
- 350 mm to 600 mm (including both) C30
- Above 600 mm C25

If higher pressure class is required, it shall be mention specifically in the Bills of Quantities.

Flanged pipes shall be classified by PN Number, the pressure class of the barrel of the Flanged pipe shall be equal to or greater than a value in bar equal to the PN of the flanges.

Pressure class of PN member is given in Table 2 of ISO 2531:2009 or Table – A-2 of Annex-A of EN 545:2010.

Flanged pipes shall be of two types namely either integrally cast or welded.

Flanged tees shall be according to the Table 30 to 32 of EN 545:2010 or Table 26 to 28 of ISO 2531:2009.

The allowable operating pressures shall comply with section A2 Tables – A.1 and Table – A.2 of EN 545:2010 or Table1, Table 2 and Table 3 of ISO 2531:2009.

2.5 Dimensions of Pipes and Fittings

Dimensions of standard pipes and fittings shall be to ISO 2531 : 2009 or BSEN 545 : 2010 unless otherwise shown on the Drawings or required for special purposes. Where pipes or fittings are required in dimensions other than those specified in ISO 2531 : 2009 or EN 545 : 2010, they shall be of the same classes as listed above and shall be designed for the works proof test pressures specified in Table 13 of ISO 2531 or Clause 6:5:2 and Clause 6:5:3 of EN 545 : 2010 for the relevant nominal diameter.

Manufacturer's product catalogue, showing dimensions, mass and other details of all standard fittings shall be submitted to the Engineer for his approval prior to manufacture.

Manufacturer's detailed drawings of all special fittings shall be submitted to the Engineer for his approval prior to manufacture.

Standard pipe lengths shall comply with Table 4 and 5 of EN 545 : 2010 for socket and spigot and flanged pipes respectively or Table 4 & 5 of ISO 2531 : 2009 or their latest revision for socket and spigot pipes and flanged pipes unless otherwise stated.

2.6 Method of Manufacture of Pipes and Fittings

All straight pipes shall be spun or centrifugally cast and fittings and joint components shall be cast in sand moulds or lost foam method. Prior approval of the Engineer shall be required for any alternative casting methods.

At all stages of manufacture, rigid control shall be exercised and the pipes and fittings shall be sound and free from surface or other defects.

Foundries shall comply with the requirements of ISO 9001:2015 Quality Management Systems.

Manufacturing process of Pipes and Fittings shall comply with the ISO 9001: 2015 Quality Management System requirements and such quality management system possessed by the manufacturer should be from an organisation accredited to issue such certification. Documentary evidence regarding accreditation together with the scope of certification should be provided. Certificate shall clearly indicate the name and address of the location of factory.

The Bidder shall also submit full details of the manufacturing process he intends to use with his tender. Such details shall include but not be confined to;

- (1) Casting and heat treatment processes.
- (2) Cleaning process and preparation of surface of iron before application of coating and lining.
- (3) Specification of all lining and coating materials, their thickness and application procedures.
- (4) Ductile Iron Pipes and Fittings shall be from the same manufacturer.

2.7 Coating and Lining

All ductile iron pipes and fittings shall be protected internally and externally against corrosion. The external protection shall comprise a coating of metallic zinc or zinc rich paint complying with clause 4.5.2.2 of EN 545:2010. The mean mass of zinc per unit area shall be not less than 200 mg/m². The mean thickness of finishing layer shall be not less than 70 µm and the local minimum thickness not less than the 50 µm. The internal protection shall be a cement-mortar lining complying with specified

thickness in Table 9 of EN 545:2010 or Table 01 in ISO 4179:2005 or ISO 6600:1980.

All such coatings and linings shall be applied under factory conditions, in complying with EN 545 : 2010 or ISO 4179 : 2005.

2.8 Socket and Spigot Joints

Standard pipes and fittings for pipelines of ductile iron shall be supplied with push-in socket and spigot joints similar to joint Type A.1 illustrated in EN 14161: 2011.

2.9 Joint Rings and Lubricants

The physical properties of elastomeric joint rings shall comply with Table 2 of EN 681-1 : 1996. The joint rings shall also comply with the relevant provisions in EN 681-1 :1996 for effects on water quality and resistance to microbiological deterioration.

The material of joint rings shall be of EPDM and shall be dual hardness punching type with preferably 76-84 IRHD at the heel of the ring and 46-55 IRHD at the bulb of the ring.

Joint rings shall be supplied by the pipe manufacturer.

Each joint ring shall be marked clearly and durably in accordance with the following information in a manner that does not interfere with the sealing function of the ring, in complying with clause 10 of EN 681-1 :1996.

- a) The nominal size.
- b) Manufacturer's identification.
- c) The number of the BS or BS EN or EN with seal type designation.
- d) Abbreviation for the elastomer.

Joint Lubricants for sliding joints have no deleterious effects on either the joint rings or pipes, and be unaffected by the liquid to be conveyed. Lubricants shall not impart to water taste, colour or any effect known to be injurious to health and shall be resistant to bacterial growth.

2.10 Flanged Joints for Pipes and Pipeline Fittings

Flanges for pipes and pipeline fittings shall unless otherwise stated comply with EN 1092 – 2: 1997 . Flanges shall be of PN 16 nominal pressure rating and shall be raised faced, unless otherwise stated.

Note: Flanges in accordance with EN 545:2010 and ISO 2531:2009 are dimensionally compatible with EN 1092-2 : 1997.

Flanged joints shall be completed with all nuts, bolts, gaskets and two washers per bolt. All bolts shall be of high tensile steel.

The flanges of all fittings shall be integrally cast. The flanges of flanged pipes shall either be integrally cast or factory welded unless otherwise stated. 'Factory welded' means that the flanges are welded to the pipes at the point of manufacture under factory conditions with inspection agency certification.

The supplier/Manufacturer shall be responsible for checking and ensuring that mating flanges are compatible in all cases, including where connections are required to pipe work and valves associated with pumping plant and inlet/outlet pipe work at service reservoirs or other structures.

2.11 Gaskets for Flanged Joints

Gaskets for flanged pipe joints shall be of type B (raised face) and the inside bolt circle type and the dimensions shall comply with BS 1514 – Part 1 : 1997.

The physical properties of gaskets shall comply with Table 2 of EN 681-1:1996. The Gaskets shall also comply with the relevant provisions in EN 681-1:1996 for effects on water quality and resistance to microbiological deterioration.

The Gasket material shall be EPDM and shall be of hardness preferably 76-84 IRHD.

The Gaskets shall be supplied by the manufacturer and shall suit for PN 16 flanges unless otherwise stated.

Each gasket shall be marked clearly and durably in accordance with the following information in a manner that does not interfere with the sealing function of the gasket, in complying with clause 10 of BS 1514 – Part 1: 1997.

- a). The nominal size.
- b). Manufacturer's identification.
- c). The number of the BS or BS EN with seal type designation.
- d). Abbreviation for the elastomer.

2.12 Restrained Self Anchoring Joints

The design of restrained joints shall comply with ISO 10804:2010 or equivalent. The joint may be either internally or externally restrained, however in the case of internally restrained joints the locking system and the rubber gaskets shall not be combined together (gasket and the system taking the axial load to be separate pieces).

The spigot of the restrained joint pipes shall be compatible, with or without modification at site, with the standard and restrained joint fittings.

These joints shall be designed by the pipe manufacturer to transmit axial pipe to pipe forces generated due to change in direction of the pipeline and possible pipe line settlement in weak soil areas without thrust blocks. Rubber gasket shall be of EPDM. Locking ring and possible set bolts shall be ductile iron.

2.13 Nuts, Bolts and Washers

The bolts, nuts and washers for D.I. flanged joints shall be of Hot Dipped Galvanized steel, Property Class 8.8, hexagonal head bolts and shall comply with the specified standards: product markings, materials, and mechanical properties for bolts, nuts, and washers respectively by BS EN ISO 898-1:2013 (Property Class 8.8), BS EN ISO 898-2:-2022, and BS EN ISO 898-3: 2018; dimensions and tolerances by BS 4190:2014; and hot dip galvanizing by BS EN ISO 10684:2004.

For general dimensions and tolerances of black hexagon bolts, screws and nuts with ISO metric threads, in diameters from 5 mm to 68 mm, refer BS 4190:2014.

The bolting shall comply with the relevant provisions of EN 1092-2: 1997.

The lengths of the bolts shall be sufficient to ensure that nuts are full threaded when tightened in their final position with two threads showing.

Two washers per each bolt shall be supplied for providing under the head of the bolt and under the nut.

2.14 Polyethylene Sleeving for DI pipes & Fittings

Where specified Tubular polyethylene protective sleeving for buried DI pipes & fittings shall comply with the relevant provisions of BS 6076: 1996 and shall be in accordance with ISO 8180: 2006.

The polyethylene sleeving shall be coloured blue.

2.15 Tolerances

Tolerances on wall thickness weights and lengths shall be in accordance with EN 545:2010 and/or ISO 2531:2009, and the specific references for compliance are as follows.

	EN 545 : 2010	ISO 2531 : 2009
Wall thickness	Table 17	Table 14
Weights	-	
Lengths	Table 4 & 5	Table 4 & 5

The tolerances on flange thickness and flange diameter shall be in accordance with EN 1092-2 : 1997.

2.16 Tensile properties of pipes and fittings

The tensile properties and testing methods shall be in accordance with EN 545:2010 or ISO 2531:2009 and the specific references for compliance are as follows:

	EN 545:2010	ISO 2531 : 2009
Tensile Properties Test methods	Table 8 Clause 6.3	Table 8 Clause 4.3.1 Clause 6.3

2.17 Hardness of Pipes and Fittings

The Hardness of pipes and fittings shall not exceed the following superficial values, when tested in accordance with Brinell hardness tests complying with clause 6.4 of EN 545 : 2010 or clause 4.3.2. of ISO 2531 : 2009.

	Superficial Hardness
Pipes	230 HB
Fittings & accessories	250 HB

2.18 Works Leak Tightness Test for Pipes and Fittings

All pipes and fittings shall comply with works leak tightness requirements of EN 545 : 2010 and ISO 2531 : 2009 and the specific references for compliance are as follows:

	EN 545 : 2010	ISO 2531 : 2009
Method of testing	Clause 6.5.2 and Clause 6.5.3	Clause 6.5.2 and 6.5.3
Minimum work test pressures	Table 16 & 17 (For pipes not centrifugally cast, fittings & accessories)	Table 16 (for pipes not cast centrifugally and fittings)

2.19 Leak Tightness of Flexible Joint

Manufacturer shall carryout leak tightness of flexible joints for positive internal pressure, according to clause 7.2.2 of EN 545:2010, for negative internal pressure according to clause 7.2.3 of EN 545:2010 and for positive external pressure according to clause 7.2.4 of EN 545:2010.

2.20 Work Leak Tightness Test for Pipe Joints and Fitting Joints

Manufacturer shall carryout test for leak tightness and mechanical resistance of flange joint according to the clause 7.3 of EN 545:2010.