

**SPECIFICATION FOR DI PIPES & FITTINGS AND
SPECIALS FOR SEWERAGE APPLICATIONS**

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SPECIFICATIONS FOR DI PIPES, FITTINGS, SPECIALS AND ACCESSORIES FOR SEWERAGE APPLICATIONS

TABLE OF CONTENTS	PAGE NUMBER
1.0 GENERAL	
1.1 Ambient Conditions	8bb-3
1.2 Suitability for waste Water	8bb-3
1.3 Definitions	8bb-3
1.4 Non-metallic Materials	8bb-3
1.5 Flanges	8bb-3
1.6 Inspection and Testing	8bb-3
1.7 Marking of Pipes, Fittings and Specials	8bb-5
1.8 Protection during Delivery	8bb-6
1.9 Storing, Handling and Hauling of Pipes, Fittings and Specials	8bb-6
1.10 Packing of Bolts, Joint Rings and Gaskets	8bb-6
1.11 Manufacturer's Certificate	8bb-6
1.12 Independent Inspection Authority's Certificate	8bb-6
1.13 Quality and Workmanship	8bb-7
1.14 Flanged Joint Protection	8bb-7
1.15 Final Acceptance at Site	8bb-7

TABLE OF CONTENTS	PAGE NUMBER
2.0 DUCTILE IRON PIPES AND FITTINGS - TECHNICAL REQUIREMENTS	8bb-8
2.1 Scope	8bb-8
2.2 Reference Standards	8bb-10
2.3 Definitions	8bb-10
2.4 Classes of Pipes & fittings and Pressure Rating	8bb-10
2.5 Dimensions of Pipes and Fittings	8bb-11
2.6 Method of Manufacture of Pipes and Fittings	8bb-11
2.7 Coating and Lining	8bb-12
2.8 Socket and spigot joints	8bb-12
2.9 Joint Rings and Lubricants for socket and spigot joints	8bb-12
2.10 Flange Joints for pipes and pipeline fittings	8bb-13
2.11 Gaskets for flanged joints	8bb-13
2.12 Restrained self anchoring joints	8bb-14
2.13 Nuts, bolts and washers	8bb-14
2.14 Polyethylene sleeving for DI pipes and fittings	8bb-14
2.15 Tolerances	8bb-14
2.16 Tensile properties of pipes and fittings	8bb-15
2.17 Hardness of pipes and fittings	8bb-15
2.18 Works Leak Tightness Test for pipes and fittings	8bb-15
2.19. Leak tightness of flexible joint	8bb-15
2.20. Work leak tightness test for pipe joints and fittings joints	8bb-15

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 the sewage to be conveyed in the pipelines shall be within 25 - 40 deg C.

1.2 Suitability for Wastewater/ Sewerage

Pipes and pipeline components, including their protective coatings and joint materials, that will or may come into contact with sewage shall not constitute a toxic hazard; shall not act as inhabitants to microbial growth and shall be approved by a recognized certifying authority as being suitable for use in sewage collection/pumping systems.

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 pass full tests of effect on sewage applications under the requirements for the testing of non-metallic materials for use in sewerage systems.

1.5 Flanges

All flanges dimensionally shall be in accordance with BSEN 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 his representatives 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 or his representatives or nominated Inspection Authority 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, testing 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

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

All pipes and fittings shall be marked with the information specified in BS EN 598:2007+A1:2009. The mark of the manufacturer shall be embossed 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. Details as per Table 1.

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 Bill of Quantities or other number specified by the Engineer.

Table 1 – Additional Markings

Item	Diameter (mm)	Details required	Lettering Heights Details (mm)
Pipes	above 350	"NWSDB"; Pipe standard (BS EN or ISO); 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 598 or ISO 7186; 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 598 or ISO 7186; Class or type (C class); Nominal dia., Manufacture's name & year of manufacture, PN (for flanges) Bend angle for bends	10

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.

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 pipes, fittings and specials, rubber rings, gaskets etc. 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 manufacturer's 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, fittings and specials 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.

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

1.11 Manufacturer's Certificate

The Contractor shall supply to the Engineer a certificate issued by the manufacturer 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 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.

1.13 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.

1.14 Flanged Joint Protection

All flanged pipes, fittings, specials and accessories shall be supplied with complete 'Corrosion' protection materials in accordance with the manufacturers 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, specials and accessories shall conform to the specification at site. Engineer shall carryout necessary inspections at site prior to final acceptance.

2.0 DUCTILE IRON PIPES AND FITTINGS - TECHNICAL REQUIREMENTS

2.1 SCOPE

This section covers the requirement for the supply of Ductile Iron pipes, fittings, specials, accessories and their joints for sewerage applications.

2.2 Reference Standards

The following standards are referred to;

ISO 7186:2011	Ductile Iron Products for Sewerage Applications
BS EN 598: 2007+A1:2009	Ductile Iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods.
BS 7874:1998	Method of tests for microbiological deterioration of Elastomeric scales for Joints in pipe work and pipe lines.
BSEN 681 -1: 1996	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.
BSEN 10300:2005	Steel tubes & fittings for onshore and offshore pipe lines. Bitumen hot applied material for external coating.
BSEN 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.
ISO 4179:2005	Ductile iron pipes and fittings for pressure and non-pressure pipelines -- Cement mortar lining
ISO 2531:2009	Ductile iron pipes, fittings, accessories and their joints for water applications
JIS G 5528:2006	Epoxy powder coating for interior of DI pipes and fittings.
ISO 8179-1:2017	Ductile iron pipes, fittings, accessories and their joints -- External zinc-based coating - Part 1: Metallic zinc with finishing layer
ISO 8179:2017: Part 2	Ductile iron pipes, fittings, accessories and their joints - External zinc-based coating Part 2: Zinc-rich paint
BS EN ISO 2081:2018	Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel
BSEN14161:2011+A1:2015	Petroleum and natural gas industries. Pipeline transportation systems
BS EN 10088-2:2014	Stainless steels. 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.
BS EN 14901:2014	Ductile iron pipes, fittings and accessories. Epoxy coating (heavy duty) of ductile iron fittings and accessories. Requirements and test methods.
BS EN 196-1:2016	Methods of testing cement. Determination of strength.
BS EN ISO 6892-1:2019	Metallic materials. Tensile testing. Method of test at room temperature
ISO 6506-1:2014	Metallic materials - Brinell hardness test -- Part 1: Test method.
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
EN 14628: 2005	Ductile iron pipes, fittings and accessories. External Polythene coating for pipes. Requirements and test method.
BS EN 15189 :2012	Ductile iron pipes, fittings and accessories - External polyurethane coating for pipes - Requirements and test methods
ISO 10804:2018	Restrained joint systems for ductile iron pipelines -- Design rules and type testing.

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 7186:2011 or with BS EN 598:2007+A1:2009. The standard pressure class designation of Ductile Iron pipes and fittings for pressure sewers shall be as given in the Annex C of ISO 7186:2011 or Table A-1 of BS EN 598:2007+A1:2009.

- Upto and including 200 mm C40
- 250 mm to 400 mm (including both) C30
- Above 400 mm C25

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

For Gravity sewers, pressure shall be as stated in Table 6 of ISO 7186:2011 or Table 5 of BS EN 598: 2007+A1:2009.

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 number for flange pipes fittings for flanged joints 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 BS EN 545:2010 or Table 26 to 28 of ISO 2531:2009.

The allowable operating pressures shall comply with Table A.1 of BS EN 598: 2007+A1:2009 or Table C1 of ISO 7186:2011.

2.5 Dimensions of Pipes and Fittings

Dimensions of standard pipes and fittings shall be to ISO 7186:2011 or BS EN 598: 2007+A1:2009 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 7186:2011 or BS EN 598:2007+A1:2009, they shall be of the same classes as listed above and shall be designed for the works test pressures specified in Table 10 of ISO 7186:2011.

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 2 of BS EN 598: 2007+A1:2009 and Table 5 of BS EN 545:2010 for socket and spigot and flanged pipes respectively or Table 1 & 2 of ISO 7186:2011 for Socket & spigot pipes and flanged pipes respectively or their latest revision 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. 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 organization 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 as per Annex A of ISO 7186:2011. The external protection shall comprise a coating of metallic zinc or zinc rich paint complying with ISO 8179 Part 1 and ISO 8179 Part II followed by two coats of bituminous based black paint complying with BS 3416:1991 Type II or an approved coat of epoxy. The internal protection shall comply to Annex B of ISO 7186:2011 or BS EN 598:2007+A1:2009, suitable for sewerage application.

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 BS EN 14161:2011+A1:2015.

2.9. Joint Rings and Lubricants

The physical properties of elastomeric joint rings shall comply with Table 2 of BS EN 681-1: 1996. The joint rings shall also comply with the relevant provisions in BS 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 preferably 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 BS 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.

2.10 Flanged Joints for Pipes and Pipeline Fittings

Flanges for pipes and pipeline fittings shall unless otherwise stated comply with BS 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 BS EN 598 dimensionally compatible with BS EN 1092-Part 2:1997

Flanged joints shall be complete with all nuts, bolts, gaskets and two washers per bolt.

The flanges of all pipes and fittings shall be integrally cast. The flanges of flanged pipes shall either be integrally cast or screwed 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 Contractor 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 the inside bolt circle type and the dimensions shall comply with BS EN 1514 – Part 1: 1997.

The physical properties of gaskets shall comply with Table 2 of BS EN 681-1:1996.

The Gaskets shall also comply with the relevant provisions in BS EN 681-1:1996 for effects on water quality and resistance to microbiological deterioration.

The Gasket material shall be EPDM/SBR and shall be of average hardness of 76-84.

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 EN 681-1:1996.

- 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 10804:2018 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 neoprene rubber. 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 black.

2.15 **Tolerances**

Tolerances on wall thickness weights and lengths shall be in accordance with BS EN 598:2007+A1:2009 and/or ISO 7186:2011.

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

2.16 Tensile properties of pipes and fittings

The tensile properties and testing methods shall be in accordance with BS EN 598:2007+A1:2009 and the specific references for compliance as follows.

	BS EN 598:2007+A1:2009	ISO 7186:2011
Tensile Properties	Table 3	Table 5
Test methods	Clause 6.3	Clause 6.3

2.17 Hardness of Pipes and Fittings

When Brinell hardness tests are carried out, they shall be performed either on the casting in dispute or on a sample cut from the casting. The surface to be tested shall be suitably prepared by slight local grinding and the test shall be carried out in accordance with ISO 6506-Part 1:2014 using a steel ball of 2.5mm or 5mm or 10mm diameter.

2.18 Works Leak Tightness Test for Pipes and Fittings

Works leak tightness for pipes and fittings shall be tested in accordance with BS EN 598:2007+A1:2009 and ISO 7186:2011. The test shall be carried out on all pipes and fittings before the application of their external and internal coatings, except for the metallic zinc coating of pipes which may be applied before test. The test apparatus shall be suitable for applying the specified test pressures to the pipes and / or fittings it shall be equipped with an industrial pressure gauge with an accuracy of + or – 3%.

2.19. Leak tightness of Flexible Joint

Manufacturer shall carryout leak tightness of flexible joints for positive internal pressure according to clause 7.5 of BS EN 598:2007+A1:2009, for negative internal pressure according to clause 7.6 of BS EN 598:2007+A1:2009 and for positive external pressure according to clause 7.7 of BS EN 598:2007+A1:2009.

2.20. Works Leak Tightness test for Pipe Joints and Fitting Joints for pressure application

Manufacture shall carryout test for leak tightness of joint according to the clause 6.5 of ISO 7186:2011 or clause 7.4, 7.5, 7.6, 7.7, and 7.8 of BS EN 598:2007+A1:2009.