

**SPECIFICATIONS FOR uPVC PIPES,
FITTINGS AND SPECIALS FOR WATER SUPPLY
APPLICATIONS**

- **GENERAL**
- **TECHNICAL REQUIREMENTS FOR uPVC
PIPES, FITTINGS AND SPECIALS**

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SPECIFICATIONS FOR PIPES, FITTINGS AND SPECIALS

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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° 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.

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 Inspection and Testing

During manufacture and before dispatch from the place of manufacture the Supplier shall allow inspection of all pipes, fittings, and specials, etc., by the Engineer. The inspection shall include attendance at all pressure, performance and material tests, execution of dimensional checks, inspection of the workmanship and standard of manufacture with scrutiny of evidence of the materials used in the manufacturing/production of all items.

The manufacturer/supplier shall arrange for such testing as may be required to be carried out at the place of manufacture according to this Specification. If there are no facilities at the place of manufacture for execution of the prescribed tests the Supplier shall bear the cost of carrying out those tests elsewhere at no extra cost to the purchaser.

The manufacturer/supplier shall supply, furnish and prepare the necessary test pieces and samples and shall supply and provide all test rigs, equipment, appliances, labour and any other facilities required for inspection and testing.

The Engineer and his inspectors shall be allowed full access to all areas at the place of manufacture or elsewhere, where testing, furnishing or preparation of materials for the performance and testing of work under this Specification is taking place.

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

The supplier shall supply to the Engineer a certificate stating that the supply items have been subjected to the tests herein and that they conform to all aspects of this Specification.

1.5 Marking of Pipes, Fittings and Specials

uPVC Pipes & Fittings

Each pipe shall be legibly and indelibly marked at intervals not more than 3m with the following;

Each fittings shall have the manufacturer's name or registered trade mark cold stumped with indelible ink on it. Each bend shall have the angle in degrees cold stumped with indelible ink on it.

Specifications require at least the following information to be included.

- a) Manufacturer's name or registered trade mark
- b) Material
- c) Nominal outside diameter, d_n x wall thickness
- d) Maximum allowable pressure at 30 °C, PN_T
- e) Batch number; and
- f) Intended use (eg: W/P)
- g) Angle of bending of bends
- h) Diameter of both ends in reducers and specials

DI Fittings and Specials for uPVC Pipes

If supplier intend to provide DI fittings and specials in place of uPVC fittings, all markings described below shall be legible and durable unless otherwise specified. All fittings shall be mark with the information specified in EN 12842:2012.

The mark of the manufacturer shall be embossed on all fittings. PN rating shall be embossed or engraved on fittings. Other markings shall be cast on, cold stamped or painted with an indelible paint.

In addition to what is specified above, all fittings and specials shall be legibly and indelibly marked with information given in the following tables;

Table 1 – Markings For DI Pipes & Fittings

Item	Diameter (mm)	Details required	Lettering Heights Details (mm)
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")	10
		"NWSDB"	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

Table 2 – Markings For PVC Pipes & Fittings

Item	Diameter (mm)	Details required	Lettering Heights of Details (mm)
Pipe Lengths (at intervals not more than 3m)	Above 350	NWSDB"; "WATER" (at 3m intervals) "SDR" Production date, PN, outside diameter, nominal wall thickness and other (at 3m intervals)	50
	150 to 350 (both inclusive)	as above	25
	50 to 150	as above	10
	below 50	as above (except "NWSDB")	05
Fittings and Specials		"NWSDB"	10
	Above 350	NWSDB"; "WATER" "SDR", Production date, PN, outside diameter and other	25
	150 to 350 (both inclusive)	as above (except "NWSDB")	10
		"NWSDB"	25
	50 to 150	as above	10
	below 50	as above (except "NWSDB")	05
		"NWSDB"	10

The supplier shall label and clearly mark all pipes, fittings, 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 the number specified by the Engineer.

1.6 Protection During Delivery

The Supplier shall provide protection, to the approval of the Engineer, for the ends of all pipes and fittings shall be covered with plastic end caps 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, 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. 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 bidding.

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

1.7 Storing, Handling and Hauling of Pipes, Fittings and Accessories

The storage of pipes and fittings and accessories shall be in accordance with the manufacturer's recommendation but the pipe stacking shall not exceed four tiers height unless otherwise approved by the Engineer. In case of outdoor storage, the pipes shall be kept fully covered by a net which protects pipes from sun light as well as allow to pass water through the net to avoid stagnation of water or any other approved sheeting in order to protect pipes from direct sunlight and avoid stagnation of water on the sheeting.

The fittings shall be stored indoors with packing intact. Solvent cement shall be stored in a dark cool place (away from fire) with containers tightly closed.

The Engineer will reject any pipes, fittings & specials which have been damaged. The supplier shall comply with the following requirements:

- a) Pipes, fittings & specials shall not be dropped, or allowed to land on sharp or other objects which will cause to bend, or dent, or damage to the coating.
- b) When lifting pipes and fittings special lifting hooks with curved saddles to fit the curvature of the pipes or fitting shall be used. Alternative types of lifting hooks, clamps, or slings may be used subject to the Engineer's approval.
- c) When pipes are being transported suitable pillow shall be used to protect pipes and fittings under securing chains or other lashings and **no unsupported over hangings of more than 1 m will be allowed**., When transporting, only 4 tiers high stacking in the lorry will be allowed.
- d) uPVC pipes fittings and specials shall be protected from direct sunlight.

- e) In case of uPVC pipes, fittings and specials are imported uPVC pipes, fittings and specials shall be protected from direct sunlights and shall not be shipped as deck cargo.

1.8 Packing and Protection

All items shall be adequately crated or packaged to withstand damage and deterioration due to shipping, handling and storage. Protection shall be provided to prevent ingress of foreign matter. The methods of protection and shipping shall be to the approval of the Engineer.

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. Description of rings or gasket shall be marked on the box.

All fittings shall be packed in open sided crates.

The supplier shall supply at his own cost all necessary pipes, fittings and specials to replace any damage pipes, fittings and specials.

1.9 Manufacturer's Certificate

The supplier shall provide certificates stating that each item supplied has been subjected to the tests laid down herein and confirms in all respects to this Specification or such other Specification which has been submitted to and approved by the Engineer.

1.10 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, Nuts & Bolts, and accessories, etc.

1.11 Final Acceptance at site

All pipes, fittings, specials & accessories shall conform to the specification at site. Engineer shall carryout necessary inspections at site prior to final acceptance. Any pipes, fittings, specials & accessories which do not conform to the specification shall not be accepted.

2.0 TECHNICAL REQUIREMENTS FOR uPVC PIPES AND FITTINGS

2.1 Scope

Socket and Spigot uPVC pipes shall be of the type specified, comply with Sri Lanka Standards 147: 2013 together with additional clauses set out in this Specification. The pipes shall bear the SLS marking as well as markings as per clause 1.5 of General Section of this Specification herein and shall be supplied in lengths not exceeding 6 meters.

uPVC fittings and specials shall be of the type specified comply with Sri Lankan Standards 659:2015.

Depending on the jointing method, this standard is applicable to the following types of fittings.

- Fittings for solvent cement
- Elastometric ring seal fittings

uPVC fittings can be manufactured by injection mouldings.

uPVC pipe & fittings for non pressure underground drainage and sewerage shall be of the type specified, comply with EN 1401:-2019 or ISO 4435:2003.

This specification covers unplasticized polyvinyl chlorides (uPVC) pipes and fittings for the use of cold drinking water or drainage and sewerage.

2.1.1 Reference Standards

- | | | |
|-----------------------|---|--|
| SLS 147:2013 | - | Unplasticized poly (vinyl chloride) pipes for water supply and for buried and above ground drainage and sewerage under pressure |
| SLS 935: 1991 | - | Solvent cement for polyvinyl chloride (PVC) pipes and fittings |
| SLS 659: 2015 | - | Unplasticized poly (vinyl chloride) fittings for water supply and for buried and above ground drainage and sewerage under pressure |
| BS EN ISO 1452-1:2009 | - | Plastic piping systems for water supply and for buried and above ground drainage and sewerage under pressure - Unplasticized poly (vinyl chloride) (PVC-U) - Part 1: General |
| BS EN ISO 1452-2:2009 | - | Plastic piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly (vinyl chloride) (PVC-U) - Part 2: Pipes |

- BS EN ISO 1452-3:2010 - Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. - Unplasticized poly (vinyl chloride) (PVC-U). Part 3: Fittings
- BS EN ISO 1452-5:2009 - Plastic piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly (vinyl chloride) (PVC-U) - Part 5: Fitness for purpose of the system
- BS EN ISO 4435:2003 - Plastics piping systems for non-pressure underground drainage and sewerage - Unplasticized poly (vinyl chloride) (PVC-U)
- BS EN 1401:-2019 - Plastic piping systems for non-pressure underground drainage and sewerage. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system
- BS EN ISO 9001: 2015 - Quality management systems
- BS EN 681-1:1996 - Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanized rubber
- BS EN ISO 4633:2015 - Rubber seals – joint rings for water supply, drainage and sewerage pipe lines
- BS EN 744:1996 - Plastic piping and ductile systems. Thermoplastics pipes. Test method for resistance to external blows by the round-the-clock method.
- BS EN 12842:2012 - Ductile Iron fittings for PVC-U or PE piping systems – requirements and tests methods
- 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 EN ISO 3506:2020 | - | Fasteners. Mechanical properties of corrosion-resistant stainless steel fasteners Bolts, screws and studs with specified grades and property classes |

2.1.2 Definition

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

2.1.3 Material

2.1.3.1 General requirements for compounds or formulations

The material from which the pipes are made shall be an unplasticized poly (Vinyl chloride) compound or formulation. This compound or formulation shall consist of PVC-U resin/powder, to which shall be added those additives which are needed to facilitate the manufacture of pipes conforming to this standard.

2.1.3.2 Use of reprocessable and recyclable material

In addition to the use of virgin material, the use of the manufacturer's own reprocessable material obtained during the production and testing of product conforming to this standard is permitted. Reprocessable material obtained from external sources and recyclable material shall not be used.

2.1.3.3 Density

The density, ρ , of the pipe, at 23⁰C when measured in accordance with clause 7.1 of SLS 147:2013, shall be within the following limits:

$$1350\text{kg/m}^3 \leq \rho \leq 1460 \text{ kg/m}^3$$

2.1.3.4 MRS value

The pipe material shall have a minimum required strength, MRS of at least 25 MPa.

2.1.3.5 Effect of materials on water quality

Material shall not adversely affect the quality of the drinking water and when tested in accordance with clause 7.2 of SLS 147:2013. The extracted quantities of lead, tin, cadmium and mercury levels as metals shall not exceed the levels specified in Table 1 of SLS 147:2013.

2.1.3.6 Wall thickness and their tolerances

The nominal wall thickness e_n , is classified with the pipe series S. The nominal wall thickness corresponds to the minimum allowable wall thickness. The nominal wall thickness shall conform to Table 3 of SLS 147:2013 as appropriate to the pipe series. The tolerance for wall thickness e , shall conform to the Table 4 of SLS 147:2013.

The minimum wall thickness of the sockets and spigots at any point, except the sealing ring groove shall be not less than the minimum wall thickness specified for the connecting pipe in SLS 147:2013.

A bend made from pipe shall have a wall thickness at the bent area not less than the minimum wall thickness specified for the corresponding pipe.

2.2 Classification of pipes & Fittings

2.2.1 Classification

Pipes shall be classified according to their nominal pressure, PN and the pipe series S.

The allowable operating pressure (PFA), for temperatures up to and including 25⁰C shall be equal to the nominal pressure, PN.

To determine the allowable operating pressure (PFA) for temperatures between 25⁰C and 45⁰C, a supplementary de-rating factor, (f_T), shall be applied to the nominal pressure, PN as given below:

$$PFA = f_T \times PN$$

f_T is given in Figure 1 of SLS 147:2013

In this specification, maximum allowable operating pressure at 30⁰C is calculated using a de-rating factor and expressed as PN_T . For other service temperatures, the de-rating factor (f_T) shall be taken from Figure 1 of SLS 147:2013.

2.3 Manufacture of uPVC Pipes

The supplier shall furnish copies of certificates of quality control tests carried out during manufacture of the pipes and fittings in accordance with section 7.0 of SLS 147:2013 and shall if required by the Engineer undertake such additional tests as he considers necessary.

The supplier shall, when required, disclose to the Engineer particulars of all toxic substances present as the result of tests carried out by the methods described in section 7.2 of SLS 147:2013.

2.4 Jointing of uPVC pipes and Joint Rings, Sealing Rings and Gaskets

uPVC pipes of diameters 63mm and above shall be jointed by means of mechanical joints with joints rings, in accordance with ISO 1452 Part 2: 2009 (with latest amendments) Solvent cement joints are only acceptable for pipes below 50 mm diameter.

All rubber joint rings, rubber gaskets requiring for jointing uPVC socket and spigot pipes and specials and flanged pipes and specials shall conform to EN 681-1:1996 (Potable Water Application) in Table 2 or ISO 4633:2015–in Table 2. The Solvent cement shall comply with SLS 935:1991.

The joint rings and gasket material shall be EPDM. The hardness Range of the material for joint rings & sealing rings shall be preferably 50-60 IRHD and the hardness range of the material for gaskets shall be preferably 70-80 IRHD. All gaskets shall be of the inside bolt circle type.

Lubricant proposed for jointing mechanical joints of uPVC pipe shall not impart any taste, affect the quality of the water or be conducive to the growth of organisms.

The supplier shall provide certificates to the effect that rubber joint rings and rubber gaskets provided under this Contract have been designed and manufactured considering the following aspects so as not to render leaky joints at pressures not less than 15 bars when in use.

- i. Material of joint ring/ gasket
- ii. Hardness of bulb and heel of joint ring and hardness of gasket
- iii. Cross sectional dimensions
- iv. Peripheral length
- v. Smooth surface finish without any blemishes, depressions, protrusions etc.
- vi. Gaskets shall be moulded type without any joints.

The Contractor shall provide written instructions on the method of forming the chamfer on cut end of pipe for jointing.

2.5 Flanges, Nuts and Bolts and Washers

uPVC flanges of pipeline fittings shall comply with EN 1092:Part 2:1997 for PN 10 or PN 16 nominal pressure rating, whichever is stated in the Bill of Quantities.

The flanges shall be of raised faced type.

The nuts, bolts and washers for PVC flanged joints shall be of Hot Dipped Galvanized steel, Property class 4.8, 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 4.8), BS EN ISO 898-2: 2022, and BS EN ISO 898-3: 2018; general dimensions and tolerances by BS 4190:2014; and hot dip galvanizing by BS EN ISO 10684:2004.

Low-friction or lubricated fastener materials are only permitted. Hence, Molybdenum Disulfide (MoS₂) technical grade anti-seize lubricant thread compound that has an extremely low coefficient of friction shall be applied on threads.

In order to achieve permanent engagement, two threads beyond the nut should be exposed when hand-tightened.

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

If the flange bolts expose to corrosive environment, the nuts and bolts should be stainless-steel meet the requirements of BS EN ISO 3506: 2020 and shall be coated with suitable anti-seizing material to prevent galling during tightening.

2.6 Sampling and Testing

The number of samples to be tested for mechanical characteristics of uPVC pipes shall be selected at random in proportion to the total number of pipes and specials of each diameter in the delivery as follows;

For deliveries of lots of 50 to 150	-	2%
For deliveries of lots of 151 to 250	-	1%
For deliveries of lots of over 250	-	0.5%

The supplier shall, if required, undertake a reasonable number of tests on pipes or specials where the delivery is less than 50 in number.

Supplier, on the request of the Engineer, shall arrange the manufacturer to test samples from the production line in the presence of the Engineer or a nominated agency and ensure that the pipes and fittings produced are in conformity with the standards specified in SLS 147:2013 and BSEN ISO 1452 - 3:2010.

Hydrostatic test certificates in respect of pipes and fittings manufactured in accordance with, or to a standard not inferior to SLS 147:2013 and EN 1452: Part 1, 2 :2009 shall be supplied for pipe and fittings separately.

The Engineer shall have free access at all reasonable times to those parts of the works engaged on the manufacture and testing of pipes and fittings. If there are no facilities at the works the supplier shall make arrangements for the prescribed test to be carried out elsewhere without any delay at suppliers cost.

2.7 uPVC Fittings

uPVC fittings shall be injection moulded except for bends and repair sockets which shall either be injection moulded or formed from pipe complying with SLS 147 : 2013 and shall be compatible with the uPVC pipes offered. Solvent welded fittings, shall comply with SLS 659: 2015 and/or ISO 1452-3 : 2010 together with additional clauses set out in this Specification. In case of mechanical jointed fittings, the fittings shall comply with SLS 659:2015 or ISO 1452-3 : 2010 as providing better quality of materials and workmanship than specified above, together with additional clauses set out herein.

The fittings and specials, if imported shall be accepted subject to the temperature correction in accordance with the following equation.

$$PFA = f_T \times P_N$$

PFA is the allowable operating pressure. f_T , the derating factor is taken from the Fig. 1 of SLS 147:2015.

Table 1 : Temperature Correction

<i>Type of Fittings Specified in BOQ PN_T pressure class as per SLS 147 : 2013</i>	<i>Type/Class of Fittings to be Supplied, as per ISO 1452-3:2009 if imported to suit Sri Lanka Temperatures corresponding to PN_T pressure class</i>
PN _T 7 PN _T 9 PN _T 11 PN _T 14	PN 8 PN 10 PN 12.5 PN 16

Note: The SLS 147 has classified the uPVC pipes according to the allowable working pressure at 30°C while *ISO 1452 -2:2009* classifies uPVC pipes by allowable sustained working pressure at 20°C. Hence, imported fittings which comply with *ISO 1452-3:2010*, shall be supplied in conformity with the temperature correction as specified in the ISO 1452-1:2009.

The Contractor shall be responsible for the compatibility of fittings with the uPVC pipes offered; and satisfy the hydrostatic pressure requirements as set out in SLS 147:2013 or ISO 1452-2:2009.

Tapping saddles

Tapping saddles, with or without a shut-off device, shall be fixed into the water supply mains by solvent cementing or mechanical fixing with elastomeric scaling. Their dimensions shall conform to Table 10 in SLS 659:2015.

Flange Adapters & flanges

- Adapters for backing flange
Adapters for PN_T9 (PN 10) and PN_T14 (PN 16) flanges shall conform to the dimensions given in Table 11 in SLS 659:2015.
- Flanges
The maximum allowable operating pressure, PN_T of a flange shall be not less than the PN_T of the connecting pipe. The flange dimension requirements shall conform according to the Table 12 of SLS 659:2015 for PN_T9 and PN_T14.

2.8 Acceptance or Rejection of Consignments

Any pipe or fitting which fails to satisfy the requirements of the Specification shall be rejected.

However the pipe or fitting which fails to satisfy any of the tests specified in the relative clauses of this specification, the test in question shall be repeated on two further samples. Such samples shall be selected from the same pipes lot and should either of these further samples fail any of the tests, the pipes or fittings represented shall be deemed not to comply with these tests in which the samples failed and the whole lot of such pipes or fittings so represented shall be rejected.

One set of "Go/No Go" gauges shall be provided by the supplier for checking the circularity of each size of uPVC pipes and specials on arrival at the final destination of supply.

2.9 uPVC Clamp Saddles

General

uPVC Clamp/Tapping saddles shall be of uPVC in moulded type for uPVC pipes and be of the bolted type. The bolts and nuts shall be of stainless steel. Internal pipe thread of the socket of the saddle shall be a female taper thread. All Clamp/Tapping Saddles shall be leak proof on completion of tapping for water connections.

Standards

uPVC Clamp/Tapping saddles shall be of uPVC, conforming to ISO 1452:2009.

SLS 147:2013 and SLS 659:2015 is applicable for materials and testing if specified in these two Sri Lanka Standards

In addition to general material tests for uPVC, following specific tests shall be carried out for Clamp/Tapping Saddles to the satisfaction to relevant standards as given below;

1. Flattening test-SLS 659:2015
2. Stress relief test (Oven method) -SLS 659:2015 or ISO 580:2005

3. Vicat softening temperature -SLS 659:2015 or ISO 2507:1, 2:1995

4. Resistance of bodies to internal pressure- Table 5, ISO 1452:4-2009

Internal pipe thread of the socket of the saddle shall be a female taper thread complying with BS21/ISO 7/1.

The “O” ring/gasket material shall be of elastomeric materials of EPDM and shall conform to EN 681-1: 1996 or ISO 4633:2015–and material properties conforming to Table 2 of EN 681-1 or ISO 4633:2015.

The bolts and nuts shall be of stainless steel grade 316.

Representatives of National Water Supply and Drainage Board (NWSDB) may visit the factory during production and all facilities shall be provided by the manufacturer for inspection and testing of Clamp/Tapping Saddles. Result of the tests carried during production shall also be available for scrutiny if requested by NWSDB.

Tests shall be carried out in Laboratories of Sri Lanka Standards Institute, Industrial Technology Institute or any other institute acceptable to National Water Supply and Drainage Board and test certificates shall be forwarded to the Engineer with the delivery of Clamp/Tapping saddles.

Details of the Saddles should be given in schedule of particulars during the bidding.

Dimensions

Dimensions of Clamp/Tapping Saddles shall comply with Table-4 of ISO 1452-2009

The Bolt lengths shall be sufficient to ensure that nuts are fully threaded when tightened in their final position with two threads visible.

Markings

Markings (except date or code) of the Saddle should include the information listed in table-8 of ISO 1452-2009

2.10 uPVC Couplings

uPVC couplings shall be injection moulded, slip over or similar type, suitable for working pressure of 12 bars, unless otherwise specified.

Joint rings shall be of material EPDM conforming to EN 681-1:1996 type WA as per Table 4 or ISO 4633:2015–type WA as per Table 03.

2.11 Ductile Iron Fittings for uPVC Piping

2.11.1 Scope

This section covers the requirements for the supply of Ductile Iron Fittings for uPVC Piping Systems.

2.11.2 Reference Standards

EN 12842 : 2012 : Ductile Iron Fittings for uPVC or PE Piping Systems- requirements and tests methods.

2.11.3 Definition

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

2.11.4 Dimensions of Fittings

Standardized sizes

Standardized sizes of fittings, corresponding to the nominal outside diameter d_n of the pipes to which they have to be connected, are as follows: 40,50,63,75,90,110, 125, 140, 160, 180, 200, 225, 250,280,315.

2.11.4.1 Minimum wall thickness

The minimum wall thickness of the ductile iron, at any point, shall be as given in Table 1.

Table 1 – Minimum wall thickness

d_n	Minimum Wall Thickness mm
$d_n \leq 225$	4.0
$225 < d_n \leq 315$	5.0

2.11.4.2 Dimensions of Sockets

The Minimum internal diameter of sockets and the minimum depth of engagement of sockets shall comply with the values given in Tables 5 and 6 of EN 12842: 2012.

2.11.5 Leak Tightness of Joints

2.11.5.1 Leak tightness of joints shall be in accordance with the Table 3 of EN 12842: 2012.

Table 3 - Summary of test conditions.

Test	Test requirements	Test conditions uPVC Pipes
Internal hydrostatic Pressure	- test pressure 1.5 x PFA + 5 bar - test duration : 2h - no leakage during test period.	- joint of maximum annulus, aligned withdrawn and subjected to shear load - temperature between 15°C and 25° C
		- joint of maximum annulus, deflected - temperature between 15°C and 25° C
Negative internal pressure	- test pressure : 0.8 bar - test duration : 2h - maximum pressure change during test period : 0.08 bar	- joint of maximum annulus, aligned, withdrawn, and subjected to shear load - temperature between 15°C and 25° C
		- joint of maximum annulus, deflected - temperature between 15°C and 25° C
Cyclic internal hydraulic pressure :	- test pressure : between 0.5 PFA and PFA - test period : 24 000 cycles	- joint of maximum annulus, aligned, withdrawn and subjected to shear load - temperature between 15°C and 25° C

PFA = Allowable Operating Pressure of the joint declares by the manufacture.

2.11.5.2 Hydrostatic Pressure Test

When the hydrostatic pressure test is carried out, it shall be with the following minimum test pressure :

- dn 40 to dn 315 : 16 bar

The internal : hydrostatic pressure shall be raised steadily, until it reaches the test pressure which shall be maintained for a sufficient time to allow visual inspection. The total duration of the pressure cycle shall be not less than 15s, including 10 s at test pressure.

2.11.6 Hardness

The Brinal Hardness, shall not exceed 250 HB

2.11.7 Tensile Properties

Ductile iron fittings shall have a minimum tensile strength of 420 MPa and a minimum elongation after fracture of 5%. The tensile strength shall be tested in accordance with 6.1 of EN 12842: 2012.

2.11.8 Joint Rings & Gaskets

Rubber rings and gasket materials shall comply with the requirements of EN 681-1:1996 or ISO 4633:2015-for the type WA.