

**SPECIFICATIONS FOR SUPPLY AND DELIVERY
OF PRESSURE/ NON- PRESSURE uPVC PIPES &
FITTINGS FOR SEWERAGE WORKS**

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

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 ambient temperature is considered as 35°C while the relative humidity varies generally from 70% during the day to 90% at night.

The temperature of Sewage to be conveyed in the pipelines shall be 35°C except for Industrial Sewerage which 40°C.

1.2 Suitability for Sewerage Applications & Chemical Resistance

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 support microbial growth; Shall not react with sewage and cause odour, cloudiness or discolouration of Sewage.

General Characteristics of uPVC pipe and fittings shall be conformed to the requirement given in Sri Lankan Standard 147: 2013 and Sri Lankan Standard 659: 2015 (for buried and above ground drainage and sewerage under pressure) or Sri Lankan Standard 1286: 2006 and Sri Lankan Standard 1285: 2006 (for buried and above ground drainage and sewerage non pressure) which ever relevant.

Chemical Resistance of uPVC pipe shall be conformed to the requirement given in Annex B of EN 1401-1:2009.

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 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/Manufacturer 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 fitting 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.

For buried and above ground drainage and sewerage non pressure;

- a) Manufacturer's name / Registered trade mark;
- b) Nominal size;
- c) Minimum wall thickness or SDR;
- d) Type of application as "Drainage/SWE"
- e) Nominal ring stiffness;
- f) Material;
- g) Angle of bending of bends;
- h) Diameter of both ends in reducers and specials; and
- i) Allowable pressure for leak proof;
- j) Manufacturer's identification code to trace date of production, factory location etc.

For buried and above ground drainage and sewerage under pressure;

- a) Manufacturer's name /Registered trade mark
- b) Registered trade mark
- c) Material
- d) Nominal outside diameter, dnx wall thickness

- e) Maximum allowable pressure at 30 °C, P_NT
- f) Batch number; and
- g) Intended use (eg: W/P)
- h) Angle of bending of bends
- i) Diameter of both ends in reducers and specials

DI Fittings and Specials for uPVC Pipes

If supplier intends 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 12842:2000.

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 of DI Fittings suited for uPVC pipes

Diameter (mm)	Details required	Lettering Heights Details (mm)
50 to 150	NWSDB	10 mm
	Pipe Manufacturing standard (EN or ISO)	10 mm
	Class or type	10 mm
	Nominal dia.,	10 mm
	Manufacture's name	10 mm
	Year of manufacture	10 mm
	PN (for flanges)	10 mm
	Bend angle for bends	10 mm
150 to 350 (both inclusive)	NWSDB	25 mm
	Pipe Manufacturing standard (EN or ISO)	10 mm
	Class or type	10 mm
	Nominal dia.,	10 mm
	Manufacture's name	10 mm
	Year of manufacture	10 mm
	PN (for flanges)	10 mm
	Bend angle for bends	10 mm

Diameter (mm)	Details required	Lettering Heights Details (mm)
above 350	NWSDB	25 mm
	Pipe Manufacturing standard (EN or ISO)	25 mm
	Class or type	25 mm
	Nominal dia.,	25 mm
	Manufacture's name	25 mm
	Year of manufacture	25 mm
	PN (for flanges)	25 mm
Bend angle for bends	25 mm	

Table 2 – Markings for uPVC Pipes

Diameter (mm)	Markings	Lettering Heights Details (mm)
Below 160	NWSDB	10 mm
	Pipe Manufacturing standard (EN or ISO)	5 mm
	Class or type	5 mm
	Nominal dia.,	5 mm
	Manufacture's name	5 mm
	Year of manufacture	5 mm
above 160	NWSDB	25 mm
	Pipe Manufacturing standard (EN or ISO)	25 mm
	Class or type	25 mm
	Nominal dia.,	25 mm
	Manufacture's name	25 mm
	Year of manufacture	25 mm
	Intervals of markings at 3 m	

Table 3 – Markings for uPVC Fittings & Specials

Diameter (mm)	Details required	Lettering Heights Details (mm)
Below 160	NWSDB	10 mm
	Pipe Manufacturing standard (EN or ISO)	5 mm
	Class or type	5 mm
	Nominal dia.,	5 mm
	Manufacture's name	5 mm
above 160	Year of manufacture	5 mm
	NWSDB	25 mm
	Pipe Manufacturing standard (EN or ISO)	25 mm
	Class or type	25 mm
	Nominal dia.,	25 mm
Manufacture's name	25 mm	
Year of manufacture	25 mm	

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 labelled 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 sunlight 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 100 kg gross weight.

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

All pipes, fittings, specials & accessories shall be manufactured in compliance with the ISO 9001: 2015 Quality Management System requirements. ISO 9001: 2015 Quality Management System Certificate issued to the manufacturing factory shall be from an organization accredited to issue such certification and the manufacturer shall have this certificate valid during the supply and delivery of the materials. This certificate shall clearly indicate the location or the place of manufacture of goods. (Manufacturing factory)

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 1286: 2006 (for buried and above ground drainage and sewerage non pressure) or Sri Lankan Standard 147: 2013 (for buried and above ground drainage and sewerage under pressure) whichever relevant, 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 relevant Sri Lankan Standards given below, together with additional clauses set out in this Specification.

uPVC fittings can be manufactured by injection mouldings method.

Bends may be formed by the pipes.

This specification covers unplasticized polyvinyl chlorides (uPVC) pipes and fittings for the use of drainage and sewerage applications.

2.1.1 Reference Standards

- | | |
|-----------------------|--|
| SLS 1286:2006 | - Unplasticized poly (vinyl chloride) (uPVC) pipes for non-pressure underground drainage and sewerage. |
| SLS 147:2013 | - Unplasticized poly (vinyl chloride) pipes for water supply and for buried and above ground drainage and sewerage under pressure. |
| SLS 1285:2006 | - Unplasticized poly (vinyl chloride) (uPVC) pipe fittings for Non Pressure underground drainage and sewerage. |
| SLS 659 : 2015 | - Unplasticized poly (vinyl chloride) fittings for water supply and for buried and above ground drainage and sewerage under pressure. |
| BS EN 1401-1:2009 | - Plastic piping systems for non-pressure underground drainage and sewerage - Unplasticized poly (vinyl chloride) (uPVC). |
| 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) (uPVC). 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) (uPVC). Part 2: Pipes |
| BS EN ISO 1452-3:2010 | - Plastic piping systems for water supply and for buried and above ground drainage and sewerage under pressure - Unplasticized poly (vinyl chloride) (uPVC). Part 3: Fittings |
| ISO 4435:2003 | - Plastics piping systems for non-pressure underground drainage and sewerage - Unplasticized poly (vinyl chloride) (uPVC). |
| 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) (uPVC) - Part 5: Fitness for purpose of the system. |
| ISO 9001: 2015 | - Quality management systems. |
| EN 681-1:1996 | - Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanized rubber. |
| ISO 4633 | - Rubber seals - joint rings for water supply, drainage and sewerage pipe lines |
| EN 744:1996 | - Plastic piping and ductile systems. Thermoplastics pipes. Test method for resistance to external blows by the round-the-clock method. |
| EN 12842:2000 | - Ductile Iron fittings for uPVC or PE piping systems - requirements and tests methods. |
| SLS 935 : 1991 | - Solvent cement for polyvinyl chloride (PVC) pipes and fittings. |
| ISO 3126: 2005 | - Plastics piping systems- -Plastics components- - Determination of dimensions |

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

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 uPVC resin/powder, to which shall be added those additives which are needed to facilitate the manufacture of pipes conforming to standard of SLS 1286:2006 or SLS 147:2013 whichever relevant according to condition of non-pressure and pressure pipes of sewerage and drainage works.

2.1.3.1 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.

2.1.3.2 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:

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

2.1.3.3 MRS value

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

2.1.3.4 Reaction of materials with sewage and wastewater.

uPVC piping system material shall resistant to corrosion by water with a wide range of pH values such as domestic wastewater, rainwater, surface water and ground water.

Chemical resistance shall be compliance with Annex B.5 of BSEN 1401-1:2009.

2.1.3.5 Wall thickness and their tolerances

For Non-Pressure Pipes

The wall thickness e shall be as specified in Table 3, of SLS 1286:2006, although a localized maximum wall thickness at any point of $1.2e_{\min}$ is permitted provided that the mean wall thickness e_m is less than or equal to the specified $e_{m, \max}$

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 1286:2006.

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

For Pressure Pipes

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.

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

2.1.3.6 Colour

For Non-Pressure Pipes

Pipes shall be coloured through the whole wall.

The colour should preferably be orange-brown (approximately RAL 8023).

For Pressure Pipes

The colour of pipes shall be brown. The colour of the pipes shall be coloured through the whole wall.

2.1.3.7 Appearance

Appearance of uPVC pipes shall meet the requirement as given in section 6.1 of SLS 1286:2006 or section 5.2.1 of SLS 147:2013 whatever applicable.

2.2 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 25°C shall be equal to the nominal pressure, PN.

To determine the allowable operating pressure (PFA) for temperatures between 25°C and 45°C, 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 35°C is calculated using a de-rating factor and expressed as PN_T .

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 160mm and above shall be joined by means of mechanical joints with joints rings, in accordance with ISO 1452 Part 2:1999 (with latest amendments) Solvent cement joints are only acceptable for pipes below 160mm 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 in Table 2 or ISO 4633:2002 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 on microbiological characteristic of sewage 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 chamber 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.

All nuts, washers and bolts to be supplied with flanges shall be of high tensile steel complying with EN 14399-1-8:2015.

The screw threads in all pipes and fittings shall comply with ISO metric screw threads.

The bolt lengths shall be sufficient to ensure that nuts are full threaded when tightened in their final position with two threads showing. Washers shall be provided under the head of the bolt and under the nut.

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 1286:2006, SLS 1285:2006, BSEN 1401-1:2009 or 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 1286:2006 or SLS 147:2013 whichever relevant according to non-pressure or pressure pipe applications and shall be compatible with the uPVC pipes offered. Solvent welded fittings, shall comply with SLS 1285:2006 or SLS 659: 2015 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</i>	<i>Type/Class of Fittings to be Supplied, as per ISO 1452-2:2009 if imported</i>
PN _T 7	PN 8
PN _T 11	PN 12.5

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.

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 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 WC as per Table 4 or ISO 4633: 2002 type WC as per Table 03.

2.10 Ductile Iron Fittings for uPVC Piping

2.10.1 Scope

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

2.10.2 Reference Standards

EN 12842: 2000: Ductile Iron Fittings for uPVC or PE Piping Systems.

2.10.3 Definition

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

2.10.4 Dimensions of Fittings

Standardized sizes

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

2.10.4.1 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

2.10.4.2 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: 2000.

2.10.5 Leak Tightness of Joints

2.10.5.1 Leak tightness of pipe system shall be in accordance with the Table 3 of EN 12842: 2000.

Table 3 - Summary of test conditions.

Test	Test requirements	Test conditions uPVC Pipes
Internal hydrostatic Pressure	<ul style="list-style-type: none"> - test pressure 1.5 x PFA + 5 bar - test duration : 2h 	<ul style="list-style-type: none"> - joint of maximum annulus, aligned withdrawn and subjected to shear load - temperature between 15°C and 25° C
		<ul style="list-style-type: none"> - joint of maximum annulus, deflected - temperature between 15°C and 25° C
Negative internal pressure	<ul style="list-style-type: none"> - test pressure : 0.8 bar - test duration : 2h 	<ul style="list-style-type: none"> - joint of maximum annulus, aligned, withdrawn, and subjected to shear load - temperature between 15°C and 25° C
		<ul style="list-style-type: none"> - joint of maximum annulus, deflected - temperature between 15°C and 25° C
Cyclic internal hydraulic pressure :	<ul style="list-style-type: none"> - test pressure : between 0.5 PFA and PFA - test period : 24 000 cycles 	<ul style="list-style-type: none"> - 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.

2.10.5.2 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.

2.10.6 Hardness

The Brinal Hardness, shall not exceed 250 HB

2.10.7 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: 2000.

2.10.8 Joint Rings & Gaskets

Rubber rings and gasket materials shall comply with the requirements of EN 681-1:1996 or ISO 4633: 2002 for the type WC.