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SPECIFICATION FOR UNPLASTICIZED POLY (VINYL CHLORIDE) FITTINGS FOR WATER SUPPLY AND FOR BURIED AND ABOVE GROUND DRAINAGE AND SEWERAGE UNDER PRESSURE

(Second Revision)

SRI LANKA STANDARDS INSTITUTION

Sri Lanka Standard

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SLS 659 : 2015

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Gr. 14

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Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

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FOREWORD

This standard was approved by the Sectoral Committee on Materials, Mechanical Systems and Manufacturing Engineering and authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2015-04-09.

This Sri Lanka standard is the second revision of **SLS 659** Specification for Unplasticized polyvinyl chloride pipe joints and fittings for potable cold water supplies, Part 1 Socket fittings for solvent welding, published in 1993. In this revision the title, scope, requirements for materials and dimensions of fittings have been revised.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or an analysis, shall be rounded off in accordance with **SLS 102**. The number of significant figures to be retained in the rounded off value shall be the same as that of the specified value in this standard.

In the preparation of this standard, valuable assistance derived from the following publications of International Organization for Standardization is gratefully acknowledged.

ISO 1452 Plastics 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
Part 3: Fittings

1 SCOPE

This standard specifies the characteristics of fittings made from unplasticized poly (vinyl chloride) (PVC-U) for piping systems, intended for water supply for human consumption and for general purposes as well as for sewerage under pressure.

This standard specifies types and sizes of fittings and joints with components of PVC-U, other plastics and non plastics materials intended to be used for the following:

a) water mains and services buried in the ground;
b) conveyance of water above ground for both outside and inside buildings; and
c) buried and above-ground drainage and sewerage under pressure.

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

- Fittings for solvent cementing;
- Elastomeric ring seal fittings.

PVC-U fittings can be manufactured by injection moulding or fabricated from pipe.

This standard is also applicable to PVC-U flange adapters and to the corresponding flanges made from various materials.

2 REFERENCES

ISO 7-1	Pipe threads where pressure tight joints are made on the threads – Part 1: Dimensions, tolerances and designation
ISO 1452-1	Plastics 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
EN 802	Plastic piping and ducting systems - Injection moulded thermoplastics fittings for pressure piping systems - Test method for maximum deformation by crushing
SLS ISO 580	Plastic piping and ducting systems - Injection-moulded thermoplastics fittings – Methods for visually assessing the effects of heating
SLS ISO 1167-1	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure Part 1: General method
SLS ISO 1167-3	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure Part 3: Preparation of components
SLS ISO 1183-1	Plastics - Methods of determining the density of non-cellular plastics Part 1: Immersion method, liquid pyknometer method and titration method
SLS ISO 2507-1	Thermoplastics pipes and fittings - Vicat softening temperature, Part 1: General test method
SLS ISO 2507-2	Thermoplastics pipes and fittings - Vicat softening temperature, Part 2: Test conditions for unplasticized poly (vinyl chloride) (PVC-U) or chlorinated poly (vinyl chloride) (PVC-C) pipes and fittings and for resistance poly (vinyl chloride) (PVC-HI) pipes
SLS ISO 3114	Unplasticized polyvinyl chloride (PVC) pipes for potable water supply - Extractability of lead and tin - Test method
SLS ISO 3126	Plastics piping systems - Plastic components - Determination of dimensions
ISO/TR 4191	Unplasticized polyvinyl chloride (PVC-U) pipes for water supply-Recommended practices for laying
SLS 102	Rules for rounding off numerical values
SLS 147	Specification for Unplasticized poly (vinyle chloride) pipes for water supply and for buried and above ground drainage and sewerage under pressure
SLS 428	Random sampling methods
SLS 935	Solvent cement for polyvinyl chloride (PVC) pipes and fittings

3 TERMS AND DEFINITIONS

For the purposes of this standard, definitions given in **SLS 147** and the followings shall apply:

3.1 design length of bends (Z_d-length) : Length of an outlet, excluding any socket length or insert length of spigot.

3.2 laying length

3.2.1 ***socketed outlet*** **(**Z-length) : Distance from the inserted tube or spigot end to the intersection point of the fitting/valve axis (fitting or valve centre)

3.2.2 ***spigot outlet*****(**Z-length) : Distance from the outlet end to the intersection point of the fitting/valve axis (fitting or valve centre)

3.2.3 ***socket with parallel outlets*** **(**Z-length) : Distance between the ends of the inserted tubes or spigots.

3.2.4 ***one socket and one spigot with parallel outlet***s(Z-length) : Distance from the inserted tube or spigot end to the end of the spigot outlet.

3.3 Symbols

Z Laying length (Z-length)
Z_d Z design length (Z_d-length)
r Bend radius

4 CLASSIFICATION OF PIPE FITTINGS

4.1 Classification

Fittings shall be classified according to their nominal pressure, PN and the series S of the connecting pipe for which the fitting is designed.

The allowable operating pressure PFA, for temperatures up to and including 25 ^{0}C shall be equal to the nominal pressure, PN.

To determine the allowable operating pressure (PFA) for temperatures between 25 ^{0}C and 45 ^{0}C, a supplementary de-rating factor, f_T, shall be applied to the nominal pressure, PN as Clause **4.1** of **SLS 147:2013**. In this standard, maximum allowable operating pressure at 30 ^{0}C is expressed as PN_T.

If the fitting is made from pipe, the mechanical and physical characteristics of the pipe shall conform to **SLS 147**. The PN rating of fabricated fitting shall be derived from the PN_T of the pipes used. The manufacturer of fabricated fittings shall be responsible for the design and the pressure rating of the fittings.

5 REQUIREMENTS

5.1 Material

The fitting material used shall conform to Clauses **5.1.1** and **5.1.2** of **SLS 147:2013**.

5.1.1 *Density*

The density, ρ, of the fitting material, at 23 ^{0}C when measured in accordance with **7.1**, shall be within the following limits:

$$1\ 350\ kg/m^3 \leq \rho \leq 1\ 460\ kg/m^3$$

5.1.2 *MRS-value*

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

NOTE: *The manufacturer of the compound or formulation shall confirm the MRS value by testing in accordance with **ISO 1452-1**.*

5.1.3 *Effect of materials on water quality*

The fitting material shall not adversely affect the quality of the drinking water and shall conform to Clause **5.1.5** of **SLS 147:2013**.

5.2 General characteristics

5.2.1 *Appearance*

When viewed without magnification the internal and external surfaces of fittings shall be smooth, clean and free from scoring, cavities and other surface defects to an extent that would prevent conformity to this standard. Each end of a fitting shall be square to its axis.

5.2.2 *Colour*

The colour of injection-moulded fittings shall be grey throughout the wall for water supply, and grey or brown for drainage and sewerage pipes under pressure. The colour of fittings made from pipes shall be grey or blue for water supply, and grey or brown for drainage and sewerage pipes under pressure.

5.2.3 *Opacity of fittings intended for the above-ground conveyance of water*

The wall of fittings shall be opaque and shall not transmit more than 0.2 per cent of visible light when measured in accordance with **7.2**.

5.3 Geometrical characteristics

Dimensions shall be measured in accordance with **7.3**.

5.3.1 *Nominal diameters*

The nominal inside diameter(s), d_n, of a fitting shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe(s) for which the fitting is designed.

5.3.2 *Fittings for solvent cementing*

5.3.2.1 Socket and spigot dimensions

The socket dimensions of the fittings shall be the same as for sockets on pipes and shall conform to **SLS 147.**

The spigot length(s) shall be at least equal to the corresponding socket length(s).

The tolerance on the diameter of the spigot ends, d_2, reducing bushes (see Table **6** and Table **7**) shall always be positive and be as follows:

- maximum 0.2 mm for diameters equal to or less than 90 mm;
- maximum 0.3 mm for diameters 110 mm to 160 mm;
- maximum 0.4 mm or diameters 180 mm to 225 mm; and
- maximum 0.5 mm for diameters 250 mm to 315 mm.

5.3.2.2 Diameters, laying lengths, bend radii and angles

For the following types of injection-moulded fittings, the Z-lengths shall be calculated using one of the equations **(a)**, **(b)**, **(c)**, **(d)**, **(e)**, **(f)**, **(g)** or **(h)** as applicable, where α is the angle of the elbow and *r* is the radius of the bend.

a) 90^0 elbows, 90^0 tees (see Table **1**) $Z = \frac{d_n}{2} + 1$

b) 45^0 elbows (see Table **1**) $Z = \frac{d_n}{2} \tan \frac{\alpha}{2} + 1$

c) 45^0 tee (see Table **1**) $Z = \frac{d_n}{2} \cot \frac{\alpha}{2} + t$

with $d_n \leq 90$ mm, 110 mm, 125 mm,140 mm,160 mm and t=3 mm, 4 mm, 6 mm, 6 mm and 7 mm

$$Z_1 = \frac{d_n}{2} \tan \frac{\alpha}{2} + 1$$

d) bends (see Table **2**) $Z = r = 2\,d_n$

e) short bends (see Table **5**) $Z = r = 0.75 d_n$

f) reducing bushes, long (see Table **6**) $Z = 0.75 d_2 + 6$

g) reducing bushes, short (see Table **7**) $Z = [\frac{d_2}{2} + 6\,] - [\frac{d_1}{2} + 6\,]$

The calculated values are given in Table **1** to Table **7**. The calculated values may be adapted by the manufacturer.

The manufacturer shall state the exact values(s) of the Z-length(s) in their catalogues or any other technical documents.

The deviation from the calculated values are recommended to be not greater than the values given in Table **1**, Table **2**, Table **5**, Table **6** and Table **7** as applicable

For bends made from pipe, the z-design lengths, z_d, and the bend radii shall be equal to or greater than the values given in Table **3** and Table **4** as applicable.

NOTE : *The Z-lengths are always greater than the corresponding socket lengths.*

The followings are figures and tables for fittings for solvent cementing.

The types of fittings are shown in Figure **1**.

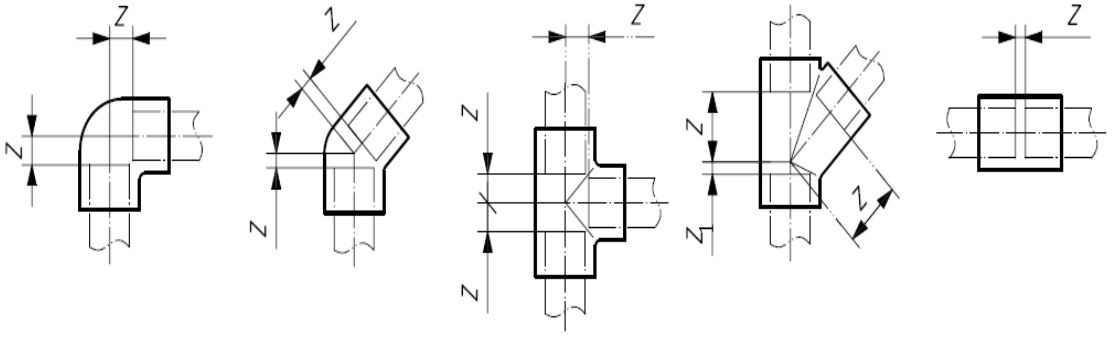


FIGURE 1 – Types of fittings: Typical elbows, tees and double-socket

TABLE 1 – Calculated Z-lengths and recommended deviations for elbows, tees and double sockets

Nominal diameter d_n	Calculated Z-length and recommended deviations					
	90^0 elbow	45^0 elbow	90^0 tee	45^0 tee		Double socket
	Z	Z	Z	Z	Z_1	Z
20	11±1	5±1	11±1	27±3	6^{+2}_{-1}	3±1
25	$13.5^{+1.2}_{-1}$	$6^{+1.2}_{-1}$	$13.5^{+1.2}_{-1}$	33±3	7^{+2}_{-1}	$3^{+1.2}_{-1}$
32	$17^{+1.6}_{-1}$	$7.5^{+1.6}_{-1}$	$17^{+1.6}_{-1}$	42^{+4}_{-3}	8^{+2}_{-1}	$3^{+1.6}_{-1}$
40	21^{+2}_{-1}	9.5^{+2}_{-1}	21^{+2}_{-1}	51^{+5}_{-3}	10^{+2}_{-1}	3^{+2}_{-1}
50	$26^{+2.5}_{-1}$	$11.5^{+2.5}_{-1}$	$26^{+2.5}_{-1}$	63^{+6}_{-3}	12^{+2}_{-1}	3^{+2}_{-1}
63	$32.5^{+3.2}_{-1}$	$14^{+3.2}_{-1}$	$32.5^{+3.2}_{-1}$	79^{+7}_{-3}	14^{+2}_{-1}	3^{+2}_{-1}
75	38.5^{+4}_{-1}	16.5^{+4}_{-1}	38.5^{+4}_{-1}	94^{+9}_{-3}	17^{+2}_{-1}	4^{+2}_{-1}
90	46^{+5}_{-1}	19.5^{+5}_{-1}	46^{+5}_{-1}	112^{+11}_{-3}	20^{+3}_{-1}	5^{+2}_{-1}
110	56^{+6}_{-1}	24^{+6}_{-1}	56^{+6}_{-1}	137^{+13}_{-4}	24^{+3}_{-1}	6^{+3}_{-1}
125	63.5^{+6}_{-1}	27^{+6}_{-1}	63.5^{+6}_{-1}	157^{+15}_{-4}	27^{+3}_{-1}	6^{+3}_{-1}
140	71^{+7}_{-1}	30^{+7}_{-1}	71^{+7}_{-1}	175^{+17}_{-5}	30^{+4}_{-1}	8^{+3}_{-1}
160	81^{+8}_{-1}	34^{+8}_{-1}	81^{+8}_{-1}	200^{+20}_{-6}	35^{+4}_{-1}	8^{+4}_{-1}
180	91^{+8}_{-1}	39^{+8}_{-1}	91^{+8}_{-1}	-	-	8^{+4}_{-1}
200	101^{+9}_{-1}	43^{+9}_{-1}	101^{+9}_{-1}	-	-	8^{+5}_{-1}
225	114^{+10}_{-1}	48^{+10}_{-1}	114^{+10}_{-1}			10^{+5}_{-1}
250	-	53^{+10}_{-1}	126^{+10}_{-1}	-	-	12^{+5}_{-2}
280	-	59^{+10}_{-1}	141^{+10}_{-1}	-	-	12^{+5}_{-2}
315	-	63^{+10}_{-1}	159^{+10}_{-1}	-	-	14^{+5}_{-2}

a) See Figure **1**

b) *For reducing tees, the z- length of the barrel shall be used for the branch as well.*

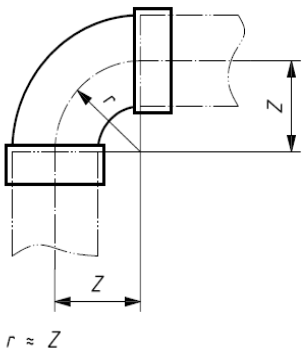


FIGURE 2 – Bends, injection -moulded

TABLE 2 – Calculated Z-lengths and recommended deviations for bends, injection-moulded

Dimensions in millimetres

Nominal diameter, d_n	Calculated Z-lengths and recommended deviations
20	40 ± 1
25	$50^{+1.2}_{-1}$
32	$64^{+1.6}_{-1}$
40	80^{+2}_{-1}
50	$100^{+1.6}_{-1}$
63	$126^{+3.2}_{-1}$
75	150^{+4}_{-1}
90	180^{+5}_{-1}
110	220^{+6}_{-1}
125	250^{+6}_{-1}
140	280^{+7}_{-1}
160	320^{+8}_{-1}
See Figure **2**	

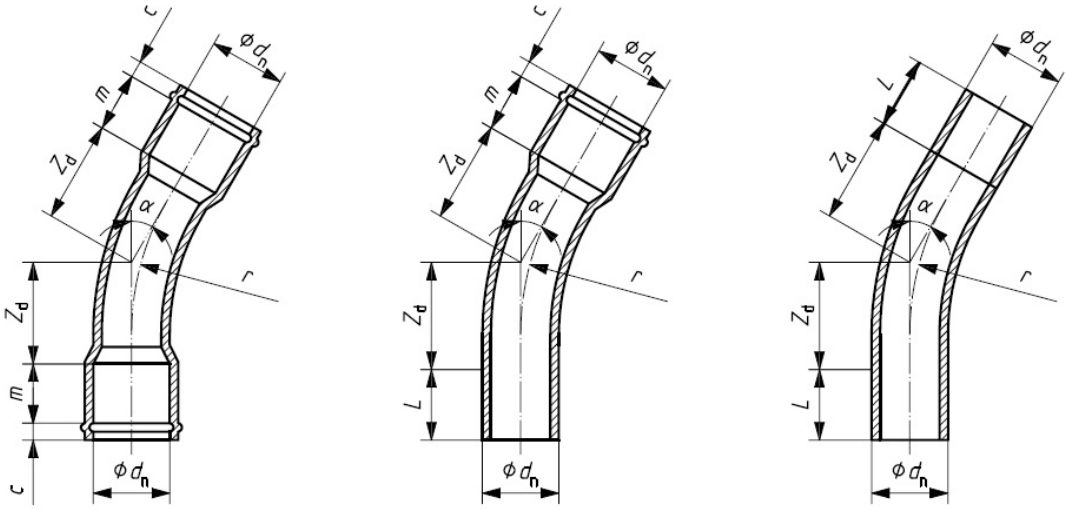


FIGURE 3 – Bends made from pipes

TABLE 3 – Calculated minimum bend radii and minimum design lengths for bends made from pipes

Dimensions in millimetres

Nominal diameter d_n	Minimum Bend radius r_{min} [b]	Minimum design length [a] Z_d, min					
		Angle, α					
		11^0	22^0	30^0	45^0	60^0	90^0
63	221	46	68	84	117	153	246
75	263	55	81	100	139	182	293
90	315	66	97	120	166	218	351
110	385	81	119	147	203	266	429
125	438	92	135	167	231	303	488
140	490	103	151	187	259	339	546
160	560	118	173	214	296	387	624
180	630	133	194	241	333	436	702
200	700	147	216	268	370	484	780
225	788	166	243	301	416	545	878
250	875	184	270	334	462	605	975
280	980	206	302	375	518	678	1092
315	1 103	232	340	421	583	763	1229
355	1 243	262	384	475	656	859	1385
400	1 400	295	432	535	740	968	1560
450	1 575	332	486	602	832	1089	1755
500	1 750	369	540	669	925	1210	1950

See Figure **3**

a) $Z_{d\,,\,min}$ is calculated using, $Z_{d\,min} = (3.5\ d_n \times \tan\frac{\alpha}{2}) + 0.4\ d_n$

b) r_{min} is calculated using, $r_{min} = 3.5\ d_n$

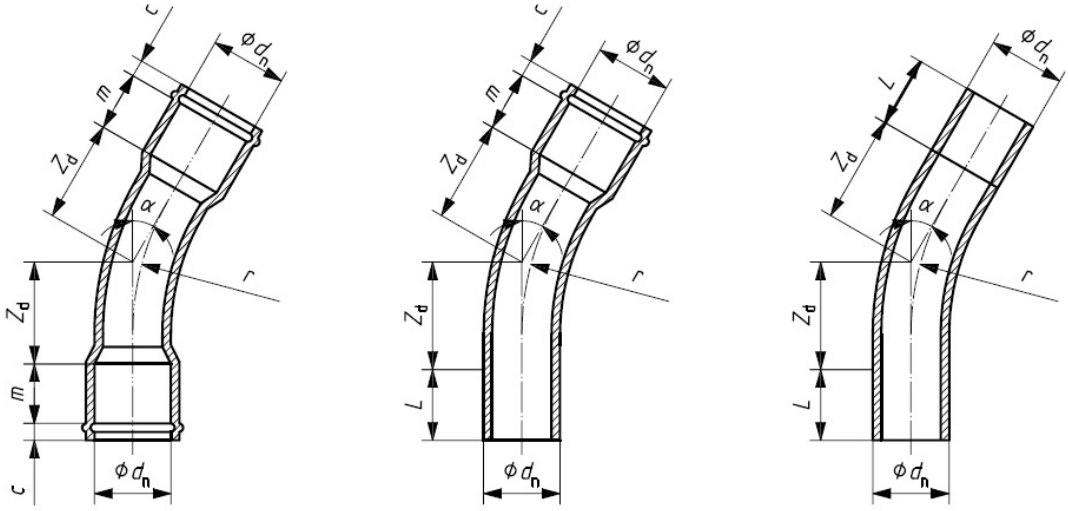


FIGURE 4 – Short bends made from pipes

TABLE 4 – Calculated minimum bend radii and minimum design lengths for short bends made from pipes

Dimensions in millimetres

Nominal diameter d_n	Minimum bend radius r_{min} [b]	Minimum design length [a] Z_d, min					
		Angle, α					
		11^0	22^0	30^0	45^0	60^0	90^0
63	157	31	46	58	81	107	173
75	187	37	55	69	96	127	206
90	225	44	66	83	116	152	248
110	275	54	81	101	141	186	303
125	312	61	92	115	161	212	344
140	350	69	103	129	180	237	385
160	400	79	118	147	206	271	440
180	450	88	133	166	231	305	495
200	500	98	147	184	257	339	550
225	562	110	166	207	289	381	619
250	625	123	184	230	321	423	688
280	700	137	206	258	360	474	770
315	787	155	232	290	405	533	866
355	887	174	261	327	456	601	976
400	1 000	196	294	368	514	677	1 100
450	1 125	221	331	414	578	762	1 238
500	1 250	245	368	460	643	847	1 375
See Figure **4**							
a) $Z_{d,\,min}$ is calculated using, $Z_{d,\,min} = (2.5\ d_n \times \tan\frac{\alpha}{2}) + 0.25\ d_n$ b) r_{min} is calculated using, $r_{min} = 2.5\ d_n$							

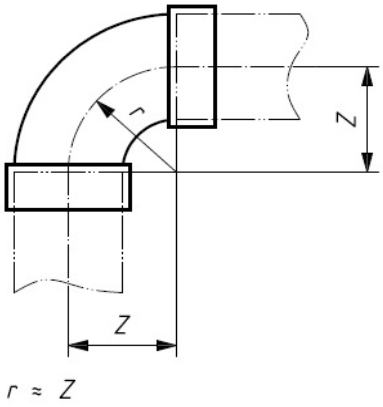


FIGURE 5 – Short bends, injection moulded

TABLE 5 – Calculated Z – lengths and recommended deviations for short bends, injection-moulded

Dimensions in millimetres

Nominal diameter, d_n	140	160	180	200	225	250	280	315
Calculated laying length, Z, and recommended deviations	105^{+8}_{-1}	120^{+8}_{-1}	135^{+8}_{-1}	150^{+9}_{-1}	168^{+9}_{-1}	187^{+9}_{-1}	210^{+10}_{-1}	236^{+10}_{-1}
See Figure **5**								

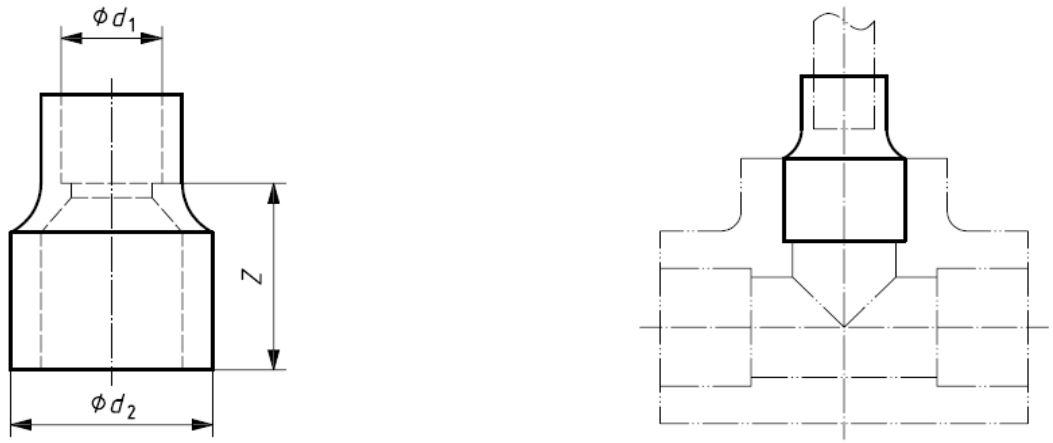
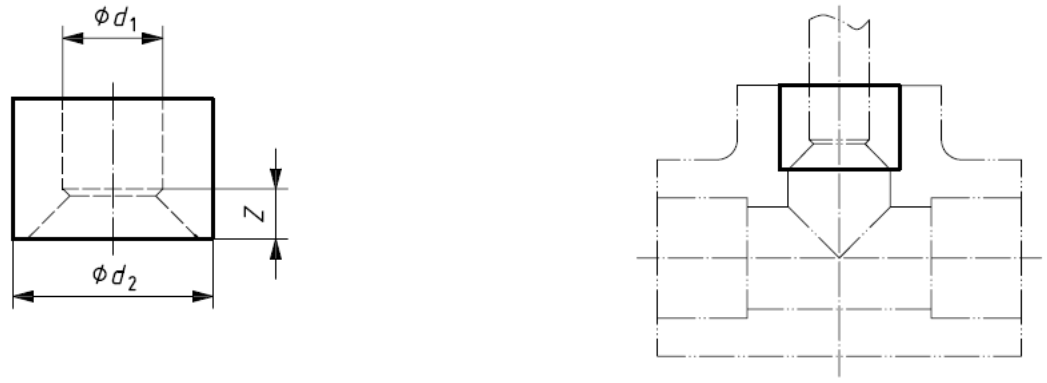


FIGURE 6 – Reducing bushes, long and example of application

TABLE 6 – Calculated Z – lengths and recommended deviations for reducing bushes, long

Dimensions in millimetres

Nominal socket diameter	**Nominal diameter of spigot d_2**											
	20	25	32	40	50	63	75	90	110	125	140	160
	Recommended deviations for z-length											
	± 1			± 1.5				± 2				
d_1	**Calculated Z – lengths**											
20	-	25	30	36	44	-	-	-	-	-	-	-
25	-	-	30	36	44	54	-	-	-	-	-	-
32	-	-	-	36	44	54	62	-	-	-	-	-
40	-	-	-	-	44	54	62	74	-	-	-	-
50	-	-	-	-	-	54	62	74	88	-	-	-
63	-	-	-	-	-	-	62	74	88	100	-	-
75	-	-	-	-	-	-	-	74	88	100	111	-
90	-	-	-	-	-	-	-	-	88	100	111	126
110	-	-	-	-	-	-	-	-	-	100	111	126
125	-	-	-	-	-	-	-	-	-	-	111	126
140	-	-	-	-	-	-	-	-	-	-	-	126
See Figure **6**												



a) Reducing bush, short

b) Practical application

FIGURE 7 – Reducing bushes, short and example of application

TABLE 7 – Calculated Z – lengths and recommended deviations for reducing bushes, short

Dimensions in millimetres

Nominal Socket diameter d_1	Calculated Z-lengths																	
	Nominal diameter of spigot, d_2																	
	20	25	32	40	50	63	75	90	110	125	140	160	180	200	225	250	280	315
20	-	2.5	6	10	15	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	3.5	7.5	12.5	19		-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	4	9	15.5	21.5		-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	5	11.5	17.5	25	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	6.5	12.5	20	30	-	-	-	-	-	-	-	-	-
63	-	-	-	-	-	-	6	13.5	23.5	31	-	-	-	-	-	-	-	-
75	-	-	-	-	-	-	-	7.5	17.5	25	32.5	-	-	-	-	-	-	-
90	-	-	-	-	-	-	-	-	10	17.5	25	35	-	-	-	-	-	-
110	-	-	-	-	-	-	-	-	-	7..5	15	25	35	-	-	-	-	-
125	-	-	-	-	-	-	-	-	-	-	7.5	17.5	27.5	37.5	-	-	-	-
140	-	-	-	-	-	-	-	-	-	-	-	10	20	30	42.5	-	-	-
160	-	-	-	-	-	-	-	-	-	-	-	-	10	20	32.5	45	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	-	10	22.5	35	50	-
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.5	25	40	57.5
225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.5	27.5	45
250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	32.5
280	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.5

a) See Figure **7**
b) The recommended deviations are ± 1 mm

5.3.3 *Adapter fittings*

5.3.3.1 Designation of adapter fittings

Adapter fittings are designated by

a) the nominal inside diameter of the fitting socket or the nominal outside diameter of the fitting spigot according to **SLS 147**.
b) the nominal size of the threaded part in accordance with **ISO 7-1**.

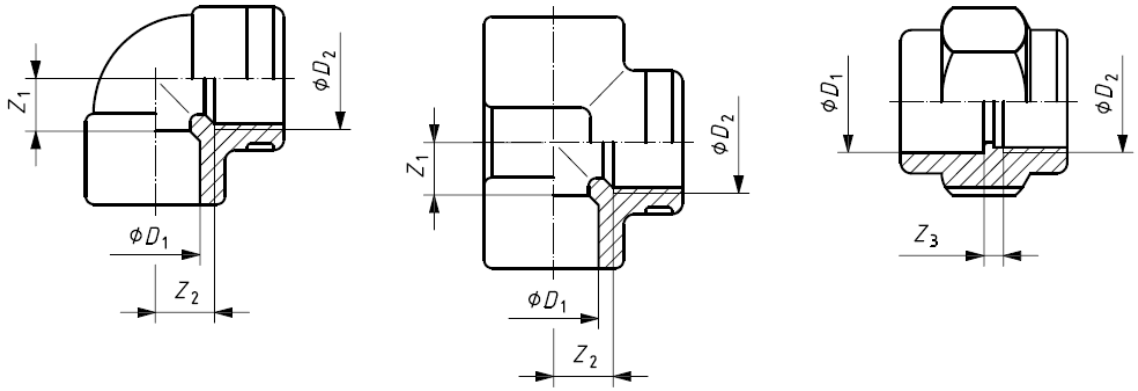
5.3.3.2 Reinforcement of adapter fittings

Adapter fittings with female threaded sockets for jointing to threaded metal pipes or fittings shall be strengthened/reinforced at the threaded outlets by any suitable method to prevent splitting of the threaded portion during assembly.

5.3.3.3 Dimensions of adapter fittings

The dimensions of plain sockets and/or spigots of the adapter fittings shall conform to **SLS 147**. The threaded parts of the fitting shall conform to **ISO 7-1**. The calculated values of the Z-length(s) are given in Table **8** and Table **9**.

The manufacturer shall state the exact value(s) of the Z-length(s) in their catalogues or any other technical documents.



a) 90° adapter elbow b) 90° adapter tee c) Adapter socket

FIGURE 8 – Typical adapter fittings – Equal

TABLE 8 – Calculated Z-lengths and recommended deviations for adapter fittings – Equal

Dimensions in millimetres

Diameter of socket D_1 [a]	**Size of thread D_2 [b]**	**Laying length Z**		
		Z_1 [c]	**Z_2 [d]**	**Z_3 [e]**
20	R ½”	11	14	5
25	R ¾”	13.5	17	5
32	R 1”	17	22	5
40	R 1¼”	21	28	5
50	R 1½”	26	38	7
63	R 2”	32.5	47	7
See Figure **8**				
a) Tolerances of diameters and length of sockets in accordance with **SLS 147**. b) Sizes and length of pipe thread in accordance with **ISO 7-1**. c) Laying length Z_1 and tolerances in accordance with Table **1** (90^0 elbow). d) Tolerances of laying Z_2 equal to Z_1. e) Tolerances of laying length Z_3 in accordance with Table **1** (socket).				

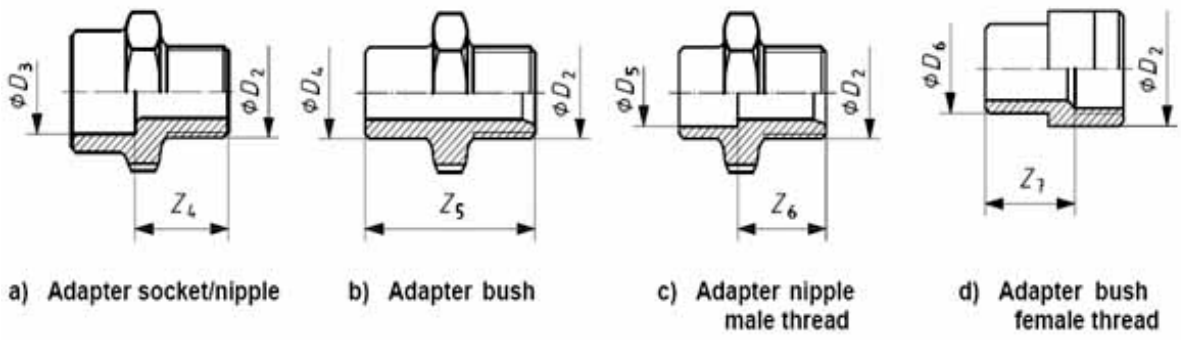


FIGURE 9 – Typical adapter fittings – Nipples and bushes

TABLE 9 – Calculated Z-lengths and recommended derivations for adapter fittings – Nipples and bushes

Dimensions in millimetres

Adapter socket/nipple		Adapter bush		Adapter nipple /male thread		Adapter bush /female thread		Size of thread
D_3 [a]	Z_4 [b]	D_4 [c]	Z_5 [b]	D_5 [a]	Z_6 [b]	D_6 [c]	Z_7 [b]	D_2 [d]
20	23	20	42	16	22	25	27	R ½”
25	25	25	47	20	22	32	32	R ¾”
32	28	32	54	25	27	40	38	R 1”
40	31	40	60	32	29	50	46	R 1¼”
50	32	50	66	40	29	63	57	R 1½”
63	38	63	78	50	34	-	-	R 2”

See Figure **9**

a) Tolerances of diameters and length of sockets in accordance with **SLS 147**.
b) Tolerances of laying length Z_4, Z_5, Z_6 and Z_7 in accordance with Table **1** (90^0 elbow).
c) Tolerances of diameters in accordance with Table **1** (reducing bush).
d) Sizes and length of pipe thread in accordance with **ISO 7-1**.

5.3.4 Tapping saddles

Tapping saddles, with or without a shut-off device, shall be fixed onto the water supply mains by solvent cementing or mechanical fixing with elastomeric sealing. Typical tapping saddles are shown in Figures **10**, **11**, **12** and **14**. Their dimensions shall conform to Table **10**.

NOTE: *Other designs are allowed subject to the agreement between the manufacturer and the purchaser.*

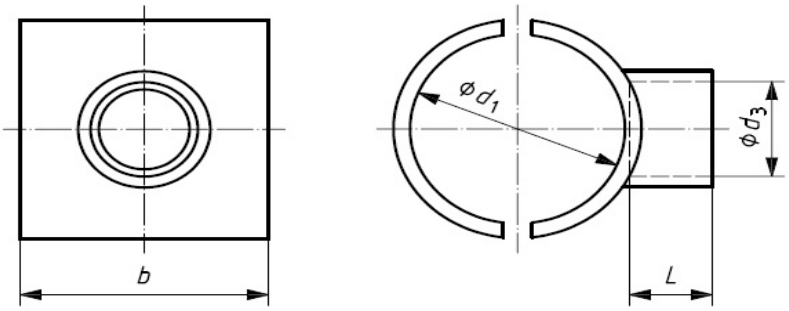


FIGURE10 - Typical socket saddle with solvent cement type socket

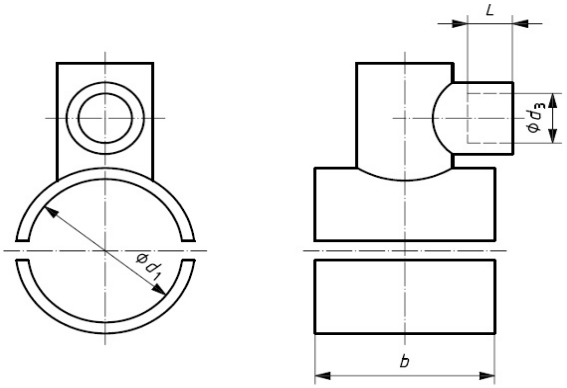


FIGURE 11 - Typical tee saddle with parallel, solvent cement type socket

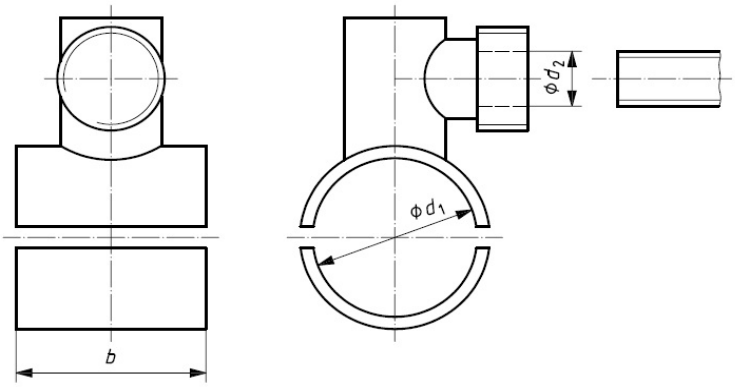


FIGURE 12 - Typical tee saddles with right-angled, mechanical joint

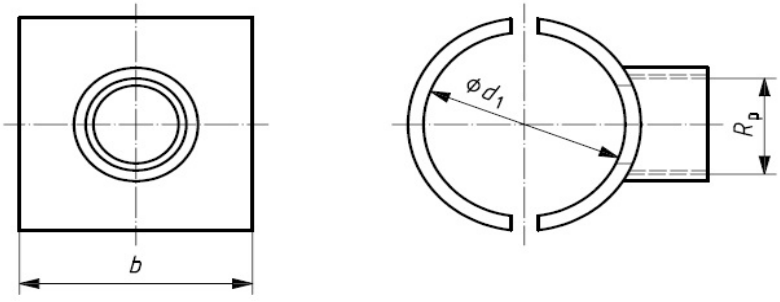


FIGURE 13 - Typical socket saddle with internally threaded socket

The length of the saddle, b, shall be specified by the manufacturer in their catalogues or any other technical documents.

TABLE 10 – Tapping saddle dimensions (continued)

Dimensions in millimetres

Water supply mains		Outlet connection			
Nominal outside diameter of pipe d_n	**Inside diameter of saddle** d_1	**Nominal outside diameter of connecting pipe** d_2	**Solvent cementing socket mean inside diameter**[a] d_3	**Solvent cementing length** L	**Internal pipe thread**[b] R_p
32	32	20	20	16	½
		25	25	19	¾
40	40	20	20	16	½
		25	25	19	¾
		32	32	22	1
50	50	20	20	16	½
		25	25	19	¾
		32	32	22	1
63	63	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½
75	75	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½
90	90	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½
110	110	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½
		63	63	38	2
125	125	32	32	22	1
		50	50	31	1½
		63	63	38	2

TABLE 10 – Tapping saddle dimensions (Concluded)

Water supply mains		Outlet connection			
Nominal outside diameter of pipe d_n	**Inside diameter of saddle d_1**	**Nominal outside diameter of connecting pipe d_2**	**Solvent cementing socket mean inside diameter[a] d_3**	**Solvent cementing length L**	**Internal pipe thread[b] R_p**
140	140	25	25	19	¾
		32	32	22	1
		50	50	31	1½
		63	63	38	2
160	160	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½
		63	63	38	2
200	200	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½
		63	63	38	2
		90	90	51	3
225	225	32	32	22	1
		40	40	26	1¼
		50	50	31	1½
		63	63	38	2
		90	90	51	3
250	250	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½
315	315	20	20	16	½
		25	25	19	¾
		32	32	22	1
		40	40	26	1¼
		50	50	31	1½

See Figures **10** to **13**

a) For diameters d_3 the tolerance is $^{+0.3}_{0}$ mm

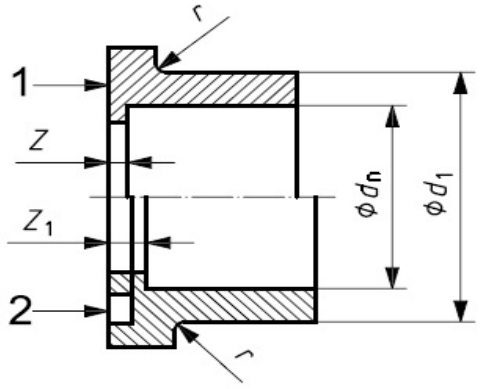
b) Jointing pipe thread, R_p shall conform to **ISO 7-1**

5.3.5 *Flange adapters and flanges*

5.3.5.1 Adapters for backing flange

Adapters for PN_T 9 (PN 10) and PN_T 14 (PN 16) flanges shall conform to the dimensions given in Table **11**, where the dimensions d_1, z, z_1 and r are as indicated in Figure **14**.

NOTE : *These dimensions have been chosen to ensure practical inter-changeability*.



Key
1 Joining face for flask gasket
2 Joining face with O-ring groove

FIGURE 14 – Dimensions of adapters for backing flanges

TABLE 11 – Dimensions of adapters for PN_T 9 and PN_T 14 flanges

Dimensions in millimetres

Adapters					Flanges
Nominal diameter of socket [a] d_n	External diameter d_1	Contour radius r_{max}	Joining face		Nominal size of flange DN
			flat z	with groove z_1	
20	27 ± 0.15	1	3	6	15
25	33 ± 0.15	1.5	3	6	20
32	41 ± 0.2	1.5	3	6	25
40	50 ± 0.2	2	3	8	32
50	61 ± 0.2	2	3	8	40
63	76 ± 0.3	2.5	3	8	50
75	90 ± 0.3	2.5	3	8	65
90	108 ± 0.3	3	5	10	80
110	131 ± 0.3	3	5	11	100
125	148 ± 0.4	3	5	11	125
140	165 ± 0.4	4	5	11	125
160	188 ± 0.4	4	5	11	150

See Figure **14**

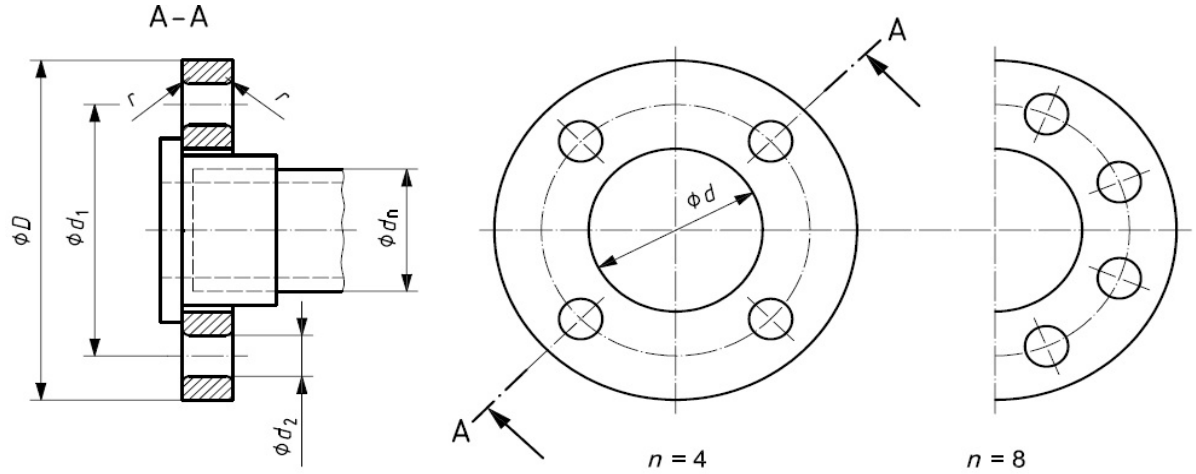
a) Socket dimensions and tolerances shall conform to **SLS 147.**

5.3.5.2 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 dimensions shown in Figure **15** shall conform to the requirements in Table **12** for PN_T 9 and PN_T 14.

NOTE: *The thickness of the flange depends on the PN_T and on the strength of the material used.*



Key

D	outside diameter of flange
d	inside diameter of flange
d_1	pitch circle diameter of bolt holes
d_2	diameter of a bolt hole
d_n	nominal outside diameter of pipe
n	number of bolt holes
r	radius

FIGURE 15 – Dimensions of flanges

TABLE 12 – Dimensions of PN_T 9 and PN_T 14 flanges

Dimensions in millimetres

Nominal outside diameter of corresponding pipe, d_n	Nominal size of flange DN	Outside diameter of flange[a] D	Inside diameter of flange[a] d	Pitch circle diameter of bolt holes, d_1	Radius r	Number of bolt holes n	Diameter of bolt holes d_2	Metric thread of bolt
20	15	95	28	65	1	4	14	M12
25	20	105	34	75	1.5	4	14	M12
32	25	115	42	85	1.5	4	14	M12
40	32	140	51	100	2	4	18	M16
50	40	150	62	110	2	4	18	M16
63	50	165	78	125	2.5	4	18	M16
75	65	185	92	145	2.5	4	18	M16
90	80	200	110	160	3	8	18	M16
110	100	220	133	180	3	8	18	M16
125	125	250	150	210	4	8	18	M16
140	125	250	167	210	4	8	18	M16
160	150	285	190	240	4	8	22	M20

See Figure **15**

a) Tolerance on d – 0.5 for d ≤ 62 and – 1 for d > 62, where *d* matches with the diameter of the flange adapter

5.3.6 *Elastomeric ring seal fittings*

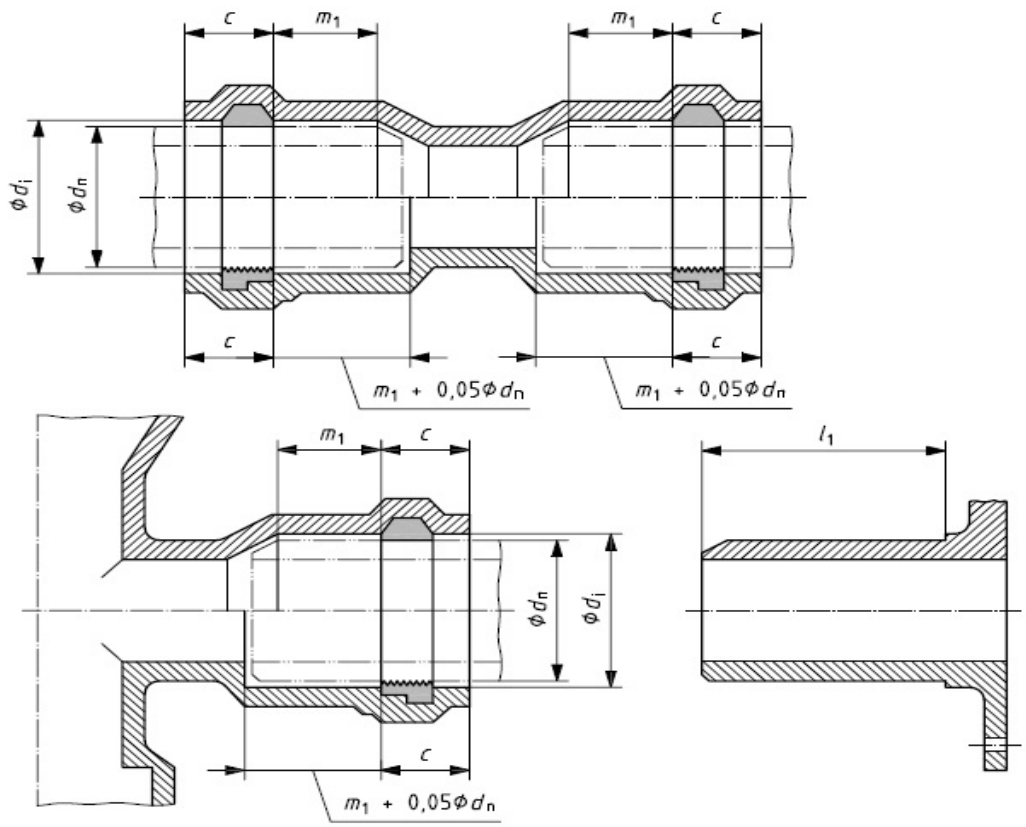
5.3.6.1 Socket and spigot dimensions

The socket inside diameter, d_i, the tolerance for out-of-roundness, the length of socket entrance and sealing area, c, and the chamfer of the fitting spigot shall conform to the same requirements as for sockets for elastomeric ring seal jointing of pipes given in **SLS 147**.

Elastomeric ring seal fittings made from materials other than PVC-U shall conform to the same geometric requirements.

5.3.6.2 Minimum depth of engagement for socketed fittings and length of fitting spigots.

Figure **16** shows the engagement when the male end is pushed to the socket bottom.



NOTE: *For assembly instructions see **ISO/TR 4191***

FIGURE 16 – Engagement of sockets and spigots

The minimum value for the depth of engagement, $m_{1,\,min}$ of double-sockets shall conform to Table **13**. The minimum value for the depth of engagement m_{min} of socketed fittings (other than double–sockets) shall be the same as for sockets for elastomeric ring seal joints of pipes and shall conform to **SLS 147**.

The manufacturer's information (e.g. catalogues) shall state the actual length of fitting spigots, $l_{1,}$ based on the following:

$$L_1 > m_1 + c + 0.05d_n$$

where the minimum values for m_1 are given in Table **13** and c conforms to **SLS 147**.

NOTE : *The minimum length of fitting spigots, l_{min} is given in Table **13** for guidance.*

TABLE 13 – Minimum depth of engagement for double-sockets and minimum length of fitting spigots

Dimensions in millimetres

Nominal inside diameter of socket d_n	Minimum depth of engagement[a] $m_{1,min}$	Minimum length of fitting spigot[b] $l_{1,min}$
32	32	84
40	33	85
50	33	89
63	34	93
75	35	98
90	35	102
110	36	110
125	37	114
140	38	119
160	39	127
180	40	133
200	41	139
225	42	147
250	44	156
280	45	166
315	48	176
355	50	187
400	52	198
450	55	212
500	57	224
See Figure **16**		
a) $m_{1,min}$ is calculated using $m_{1\ min} = 30\ mm + 0.15\ d_n - 2e_n$, where e_n is the nominal wall thickness of the corresponding pipes of series S 10. b) l_{min} is calculated using $l_{min} = m_{min} + c + 0.05 d_{n,}$ where m_{min} and c are given in **SLS 147**.		

5.3.6.3 Diameters, laying lengths, design lengths, bend radii and angles

The relevant dimensions are shown in Figures **3**, **4**, **17**, **18**, **19**, **20**, **21** and **22** as applicable.

The laying lengths (Z-lengths) shall be equal to or greater than the applicable minimum values given in Tables **14**, **15**, **16** and **17**, and Table **19** for injection moulded fittings and for fittings made from pipe.

The manufacturer's information (eg. catalogue) shall state the actual z-lengths. For bends made from pipe and for spigot fittings, the z_d (Z-design lengths) and the bend radii shall be equal to or greater than the applicable values given in Table **3** and Table **4**.

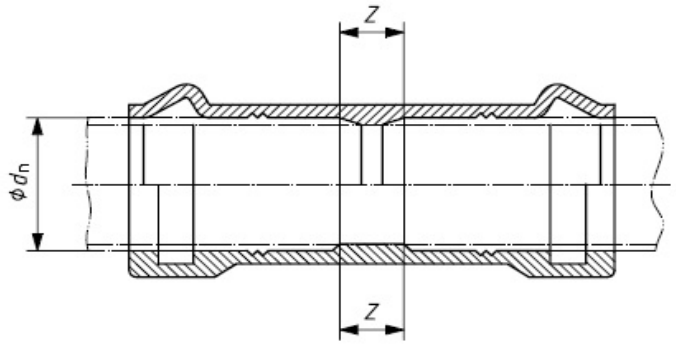


FIGURE 17 – Double-sockets

TABLE 14 – Z- lengths for double–sockets

Dimensions in millimetres

Nominal diameter of socket, d_n	Minimum Z-length	Nominal diameter of socket, d_n	Minimum Z-length
32	2	200	6
40	2	225	7
50	2	250	8
63	2	280	8
75	3	315	8
90	3	355	8
110	4	400	8
125	4	450	8
140	5	500	8
160	5	560	8
180	5	630	8
See Figure **17**			

NOTE: *Double-sockets without central register are intended to be used for repair purposes.*

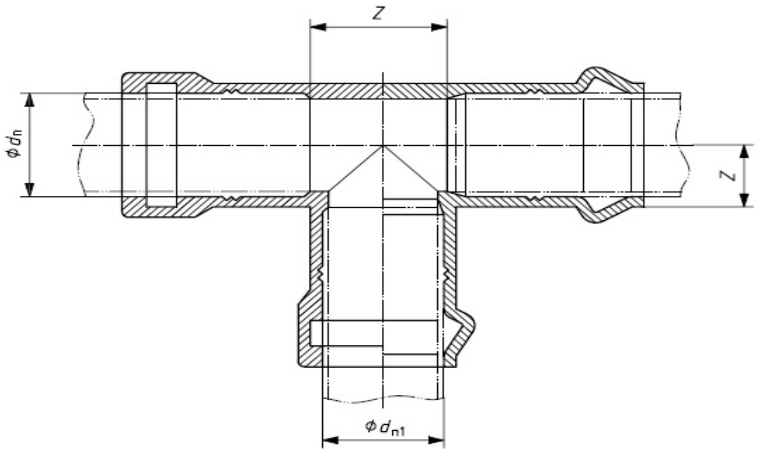


FIGURE 18 – Typical tee with sockets, injection-moulded

TABLE 15 – Calculated minimum laying lengths for injection-moulded tees with sockets (equal and with branch reduced)

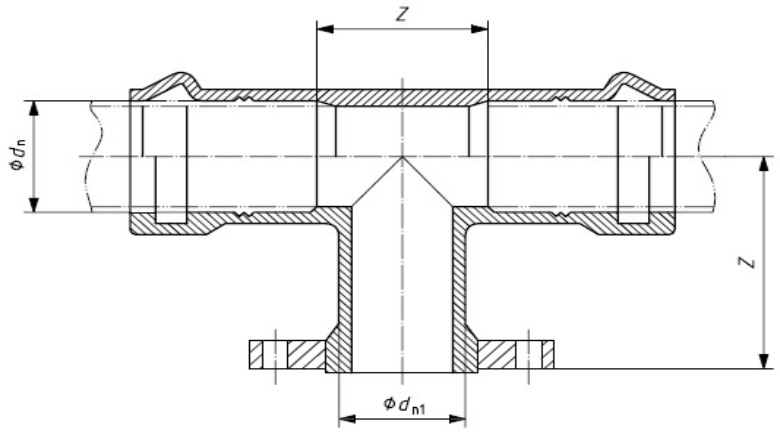
Dimensions in millimetres

Nominal diameters		Minimum laying lengths		Nominal diameters		Minimum laying lengths	
d_n	d_{n1}	Z_{min}	$Z_{1\cdot min}$ [b]	d_n	d_{n1}	$Z_{\cdot min}$ [a]	$Z_{1\cdot min}$ [b]
63	63	63	32	160	63	63	80
75	63	63	38		75	75	80
	75	75	38		90	90	80
90	63	63	45		110	110	80
	75	75	45		125	125	80
	90	90	45		140	140	80
110	63	63	55		160	160	80
	75	75	55	200	90	90	100
	90	90	55		110	110	100
	110	110	55		125	125	100
125	63	63	63		140	140	100
	75	75	63		160	160	100
	90	90	63		200	200	100
	110	110	63	225	63	63	113
	125	125	63		75	75	113
140	63	63	70		90	90	113
	75	75	70		110	110	113
	90	90	70		125	125	113
	110	110	70		140	140	113
	125	125	70		160	160	113
	140	140	70		200	200	113
					225	225	113

See Figure **18**

a) $Z_{min} = d_{n1}$

b) $Z_{min} = 0.5d_n$ rounded to the next greater millimetre.



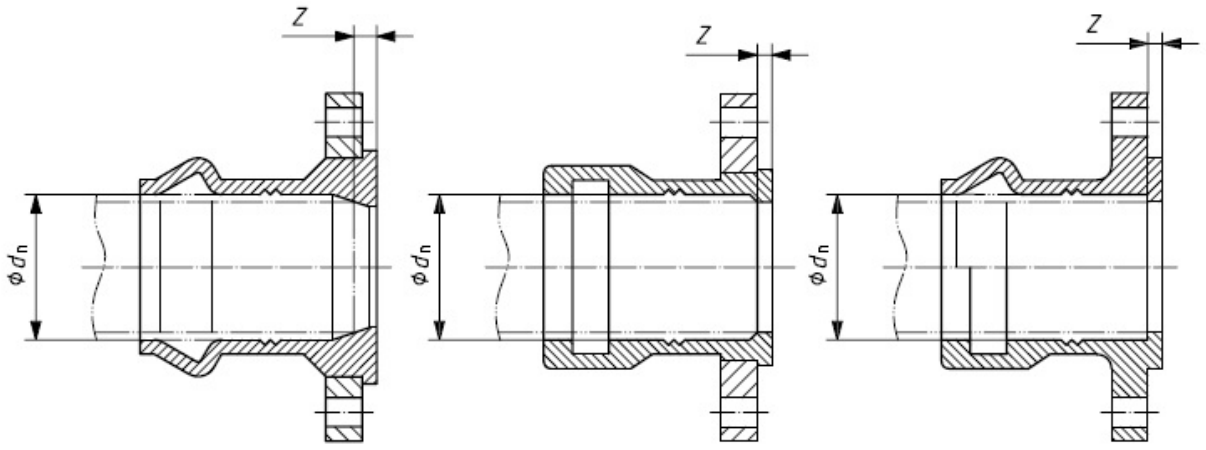
NOTE : *For flange dimensions, see Table **12**, for collar dimensions, see Table **11**.*

FIGURE 19 - Typical tee with sockets and flanged branch, injection-moulded

TABLE 16 - Calculated minimum laying lengths for injection-moulded tees with sockets and flanged branch (equal and with branch reduced)

Dimensions in millimetres

Nominal diameters		Minimum laying lengths		Nominal diameters		Minimum laying lengths	
d_n	d_{n1}	Z_{min}	$Z_{1\cdot min}$ [b]	d_n	d_{n1}	$Z_{\cdot min}$ [a]	$Z_{1\cdot min}$ [b]
63	63	63	130	160	63	63	190
75	63	63	140		75	75	190
	75	75	140		90	90	200
90	63	63	150		110	110	210
	75	75	150		125	125	210
	90	90	150		140	140	210
110	63	63	160		160	160	230
	75	75	160	200	90	90	225
	90	90	170		110	110	235
	110	110	180		125	125	235
125	63	63	170		140	140	235
	75	75	170		160	160	255
	90	90	180		200	200	265
	110	110	190	225	63	63	230
	125	125	190		75	75	230
140	63	63	180		90	90	240
	75	75	180		110	110	250
	90	90	190		125	125	250
	110	110	200		140	140	250
	125	125	200		160	160	270
	140	140	200		(200)	200	280
					225	225	280
See Figure **19**							



a) $Z_{min} = d_{n1}$

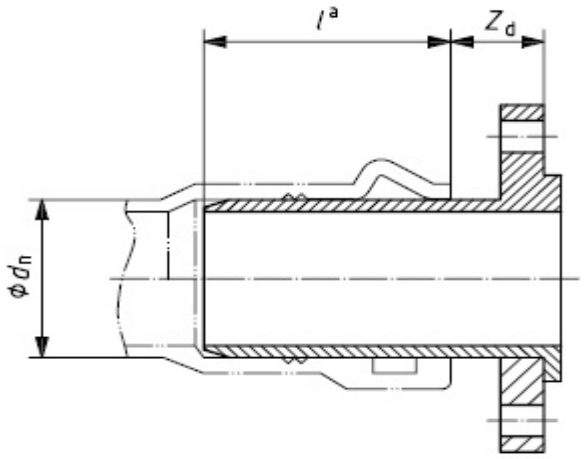
NOTE : *For flange dimensions, see Table **12**, for collar dimensions, see Table **11**.*

FIGURE 20 – Typical flanged sockets, injection-moulded

TABLE 17 – Calculated minimum laying lengths for injection-moulded flanged sockets

Dimensions in millimetres

Nominal diameter of the socket, d_n	63	75	90	110	125	140	160	200	225
Minimum laying length Z_{min}	3	3	5	5	5	5	5	6	6
See Figure **20**									



a - l_{min} conforms to Table **13**.

NOTE: *For flange dimensions, see Table **12**, for collar dimensions, see Table **11.***

FIGURE 21 - Typical flanged spigot, injection – moulded

TABLE 18 - Calculated minimum Z_d lengths for injection-moulded flanged spigots

Dimensions in millimetres

Nominal diameter of the socket d_n	63	75	90	110	125	140	160	200	225
Minimum design length $Z_{d\,min}$ [a]	33	34	35	37	39	40	42	46	49
See Figure **21**									
a) $Z_{d\,min} = 0.1\ d_n + 26$ mm									

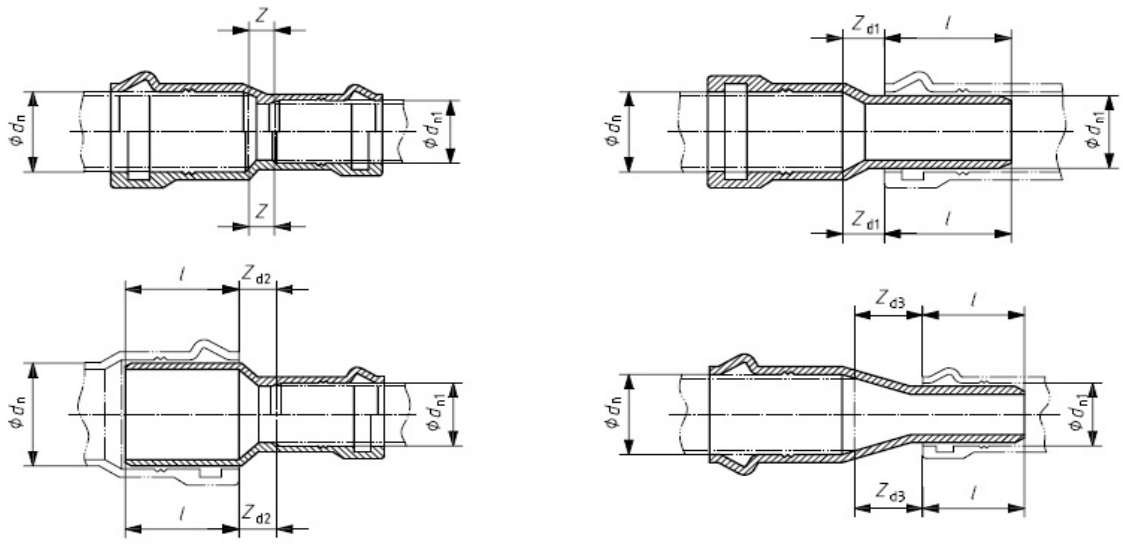


FIGURE 22 - Typical reducers

TABLE 19 – Minimum laying and design lengths for reducers

Dimensions in millimetres

Nominal diameters		**Minimum laying and design lengths**			
d_n	**d_{n1}**	**Z_{min}**	**$Z_{d1,min}$**	**$Z_{d2,min}$**	**$Z_{d3,min}$**
75	63	3	6	6	34
90	63	4	14	14	62
	75	4	8	8	41
110	75	5	18	18	79
	90	5	10	10	53
125	90	5	18	18	81
	110	5	8	8	47
140	90	7	25	25	109
	110	7	15	15	76
	125	7	8	8	50
160	110	7	25	25	113
	125	7	18	18	88
	140	7	10	10	62
200	140	10	30	30	137
	160	10	20	20	103
225	160	10	33	33	150
	200	10	13	13	81
See Figure **22**					
a) For 1_{min} see Table **13.**					

5.3.6.4 Wall thickness

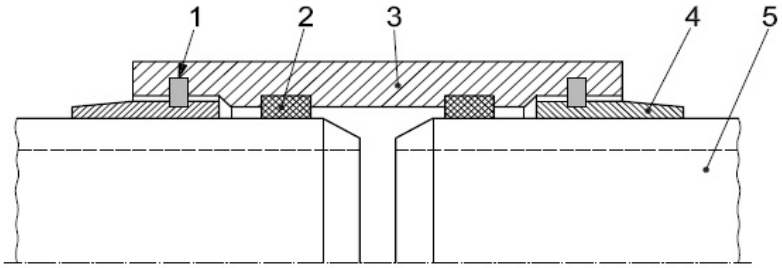
The minimum wall thickness of the sockets and spigots at any point, except the sealing ring groove, shall be not less than the minimum wall thickness specified for the connecting pipe in **SLS 147**.

A bend made from pipe shall have a wall thickness at the bent area not less than the minimum wall thickness specified for the corresponding pipe in **SLS 147**.

NOTE: *If needed, the next pipe series with the smaller S-number can be used see also **4.1***

5.3.7 End-load bearing double-sockets with elastomeric seals

End-load bearing double sockets is designed to join PVC-U pipes with outside diameters conforming to **SLS 147** when longitudinal forces on the double sockets shall be expected. The end bearing double sockets are provided with elastomeric seals and a locking device (see Figure **23**).



Key
1 locking device
2 sealing ring
3 PVC-U coupling
4 solvent cemented PVC-U sleeve
5 PVC-U pipe

FIGURE 23 – Example of an end-load-bearing double-socket

5.4 Physical properties

5.4.1 *Vicat softening temperature*

When tested in accordance with **7.4**, the minimum vicat softening temperature of fitting shall be 74 ^{0}C.

5.4.2 *Effects of heating*

When tested in accordance with **7.5**, the fitting shall not show any blisters or signs of weld line splitting[1].

No surface damage in the area of any injection point shall penetrate deeper than 50 per cent of the wall thickness at that point. Outside the area of any injection point no surface damage shall occur[2].

NOTES:

1)The weld-line is likely to become more pronounced, but this should not be taken as a sign of weld-line opening.

*2) For sprue-gating, the area of injection point shall be calculated using a radius $R= 0.3d_n$ with a maximum value of 50 mm. For fittings moulded by end–gating techniques, eg: ring or diapharagm methods, the gating area shall be a cylindrical portion with a length of $L= 0.3d_n$ with a maximum value of 50 mm(see Figure **24**). Any cracks or delamination in the wall of the fitting within to the injection area, parallel to the axis of the fitting, shall not penetrate in the axial direction more than 20 per cent of the length L defined in this note.*

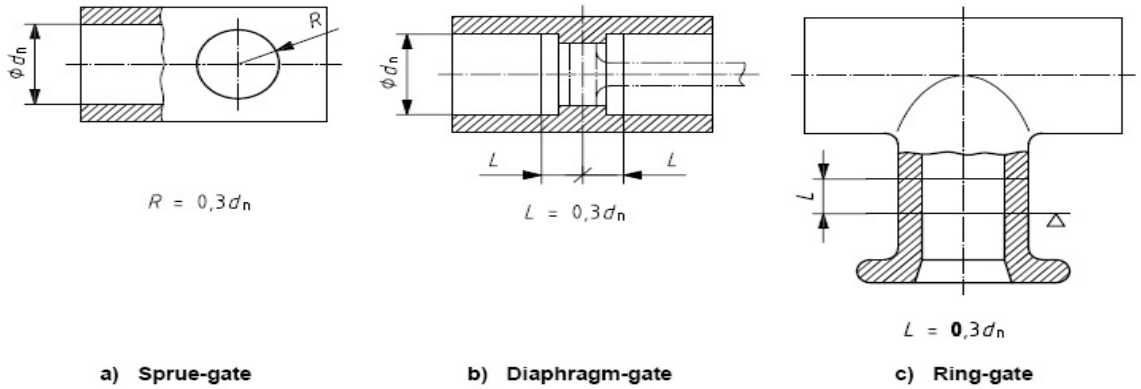


FIGURE 24 - Injection gating areas

5.5 Mechanical properties

5.5.1 *Resistance to internal pressure of fittings or parts of fittings*

When tested in accordance with **7.6**, there shall be no break on the fitting or parts of the fitting, during the specified test period therein.

5.5.2 *Crushing test*

Injection-moulded parts of fittings, on which hydrostatic pressure cannot be applied, shall be tested in accordance with **7.7**. The tested fitting parts shall not shatter when they undergo a deformation of 20 per cent.

6 MARKING

6.1 Marking on fittings

The following shall be marked legibly and indelibly on the fittings :

a) Manufacturer's name or registered trade-mark;
b) Material;
c) Nominal diameter(s), d_n ; and
d) Maximum allowable pressure at 30 ^{0}C, PN_T (eg: PN_T 14).

NOTE: *The fittings of nominal diameter, $d_n \leq 50$ mm, nominal diameter and batch number may either be marked directly on the fitting or on a label attached to the fitting or on the packaging.*

6.2 Marking on flanges

The following shall be marked legibly and indelibly on flanges :

a) Manufacturer's name or registered trade-mark;
b) Material;
c) Nominal size, DN ; and
d) Maximum allowable pressure at 30 ^{0}C of flange, PN_T (eg: PN_T 14).

NOTE: *The flanges of nominal size, DN ≤ 25 mm, nominal diameter and batch number may either be marked directly on the flange or on a plate/label attached to the fitting or on the packaging.*

7 METHODS OF TEST

7.1 Determination of material density

The density of the pipe material shall be determined in accordance with **SLS ISO 1183 - 1**. The test results shall be reported for each test specimen to the nearest 1 kgm^{-3}.

7.2 Determination of opacity

The opacity of the fitting shall be determined in accordance with **SLS ISO 7686**.

7.3 Determination of dimensions

Dimensions shall be measured in accordance with **SLS ISO 3126**.

All the dimensions shall be measured at 23± *2 ^0C*

7.4 Determination of vicat softening temperature

The vicat softening temperature shall be determined in accordance with **SLS ISO 2507-1** and **SLS ISO 2507-2**.

7.5 Determination of effects heating

The effects of heating shall be determined in accordance with Method A (air oven) of **SLS ISO 580.**

7.6 Hydrostatic pressure test

The hydrostatic pressure of the fitting shall be determined for water in water test condition, in accordance with **SLS ISO 1167-1** and **SLS ISO 1167-3**.

TABLE 20 – Resistance of fittings or parts of fittings to internal pressure at 20 ^{0}C

Type **(1)**	**Nominal diameter, mm** **(2)**	**Test pressure, bar** **(3)**	**Test period h** **(4)**
Injection moulded fittings	$d_n < 160$	4.2 X PN	1
		3.2 X PN	1000
	$d_n \geq 160$	3.36 X PN	1
		2.56 X PN	1000
Fittings made from pipes	$d_n \leq 90$	4.2 X PN	1
	$d_n > 90$	3.36 X PN	1

NOTES:

1) The test pressure p, shall be determined by using the following equation;

$$\text{Test pressure, } p = \frac{\text{(Test stress)}}{\text{(Design stress)}} \times PN$$

where, the test stress shall be 42 MPa for 1 h and 32 MPa for 1000 h at 20 ^{0}C.

2) For factory production control and process control, test pressure at 30 ^{0}C for 1 h period could be as follows;

for injection moulded fittings $d_n < 160$, 3.6 x PN

$d_n \geq 160$, 2.88 x PN

for fittings made from pipes $d_n \leq 90$, 3.6 x PN

$d_n > 90$, 2.88 x PN

7.7 Crushing test

Crushing test shall be carried in accordance with **EN 802**.

The period between manufacture and testing, t_1, and the conditioning period, t_2, shall be not less than 30 min. The closure speed of the press plates shall be (50 ± 5) mm/min.

APPENDIX A
COMPLIANCE OF A LOT

The sampling scheme given in this Appendix should be applied where compliance of a lot to the requirements of this standard is to be assessed based on statistical sampling and inspection.

Where compliance with this standard is to be assured based on manufacturer's control systems coupled with type testing and check tests or any other procedure, appropriate schemes of sampling and inspection should be adopted.

A.1 SAMPLING

A.1.1 *Lot*

All fittings in a single consignment of the same type and size manufactured under essentially similar conditions shall constitute a lot.

A.1.2 *Scale of sampling*

A.1.2.1 Samples shall be tested from each lot separately for ascertaining conformity of the lot to the requirements of this standard.

A.1.2.2 The number of fittings to be taken from the lot shall depend on the size of the lot and shall be in accordance with Table **21**.

TABLE 21 – Scale of sampling

Number of fittings in the lot	Number of fittings to be selected
Up to 500	14
501 to 1200	20
1201 and above	32

A.1.2.3 The fittings shall be selected at random. In order to ensure randomness of selection, random number tables as given in **SLS 428** shall be used.

A.1.3 *Number of tests*

A.1.3.1 Each fitting selected as in **A.1.2.2** shall be examined for the requirements given in **5.2.2** and **6**.

A.1.3.2 Each fitting selected as in **A.1.3.1** shall be examined for requirements given in **5.2.1** and **5.3** of this specification.

A.1.3.3 If the lot has been found satisfactory in respect of visual and dimensional requirements, a sub-sample of twelve fittings shall be tested for the requirements given in Table **22**.

TABLE 22 - Number of samples to be tested for each requirement

Requirement	Number of fittings
5.1.1	1
5.1.3	1
5.2.3	1
5.4.1	1
5.4.2	3
5.5.1	3
5.5.2	4

A.1.4 *Conformity to standard*

A.1.4.1 The lot shall be declared as conforming to the requirements of this standard if the following conditions are satisfied:

A.1.4.2 Each fitting satisfies the relevant requirements when inspected as given in **A.1.3.1** and **A.1.3.2**.

A.1.4.3 Each fitting in the sub sample tested as in **A.1.3.3** satisfies the relevant requirements.

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Amendment No. 1 to SLS 659: 2015 approved on 2019-04-03.

Sri Lanka Standard Specification for unplasticized poly (vinyl chloride) fittings for water supply and for buried and above ground drainage and sewerage under pressure

Page 07

5.3.1 Nominal Diameters

Delete existing sub clause **5.3.1** and substitute with the following;

" 5.3.1 Nominal diameters

The nominal inside diameter(s), dn, of a fitting shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe(s) for which the fitting is designed.

The Minimum wall thickness of injection moulded fittings shall be 3.0 mm"

5.3.2.2 Diameters, laying lengths, bend radii and angles

Add following under note;

"For laying length of reducing sockets, reducing sockets (shorts bush type), reducing tees, reducing elbows refers Appendix B"

Page 08

Table 1

Delete existing foot note (a) and (b)

Add the following "See figure 1"

Page 17

Delete the existing Figure 10

Add the following

"d_1 - Diameter of the complete circle.

Curvature of the tapping saddles shall be same as that of the pipe on which saddle is mounted. Measurement of the internal diameter of the tapping saddle shall be made accordingly.

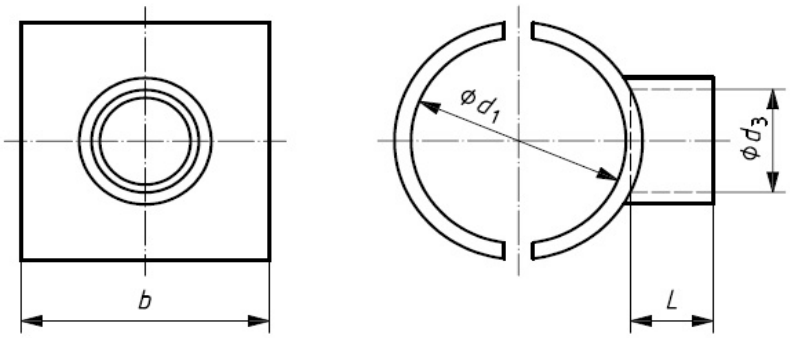

FIGURE10 - Typical socket saddle with solvent cement type socket"

Page 31

6.1 Marking on fittings

Add following to the sub **clause 6.1**

e) Intended use as "W/P"

Note:

W-Drinking water supply, Pressure

P- Drainage and Sewerage, Pressure

Page 36

Incorporate the following as **Appendix B**.

APPENDIX B

LAYING LENGTHS OF REDUCING SOCKETS, REDUCING TEES AND REDUCING ELBOWS

B.1 The laying lengths of reducing socket, reducing tees and reducing elbows shall be as given in Table 23 (a), 23 (b), 24 and 25 respectively.

TABLE 23 (a) – Laying length of reducing sockets (see Figure 25 a)

MINOR DIAMETERS JOINTING (d_1)	MAJOR DIAMETERS OF JOINTING (d_2)										
	2	3	4	5	6	7	8	9	10	11	12
	25	32	40	50	63	75	90	110	125	140	160
	Laying Lengths (Z)										
	±1		± 1.5				± 2				
20	6	8	10	15							
25		8	10	13	20						
32			10	13	17	21					
40				13	17	19	25				
50					17	19	23	30			
63						19	23	27	32		
75							23	27	32	35	
90								27	32	35	40
110									32	35	40
125										35	40
140											40

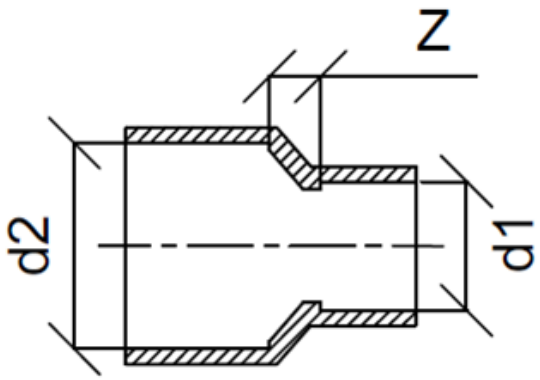

FIGURE 25 (a)

TABLE 23 (b) – Laying length of reducing sockets (shorts bush type) (see Figure 25 b)

Size (mm) (1)	Laying length (mm) (Z) (2)
25 x 20	3 +1 -1
32 x 20	3 +1.6 -1
32 x 25	3 +1.6 -1
40 x 20	3 +2 -1
40 x 25	3 +2 -1
40 x 32	3 +2 -1
50 x 32	3 +2 -1
50 x 40	3 +2 -1
63 x 32	3 +2 -1
63 x 40	3 +2 -1
63 x 50	3 +2 -1
75 x 63	4 +2 -1
90 x 75	5 +2 -1

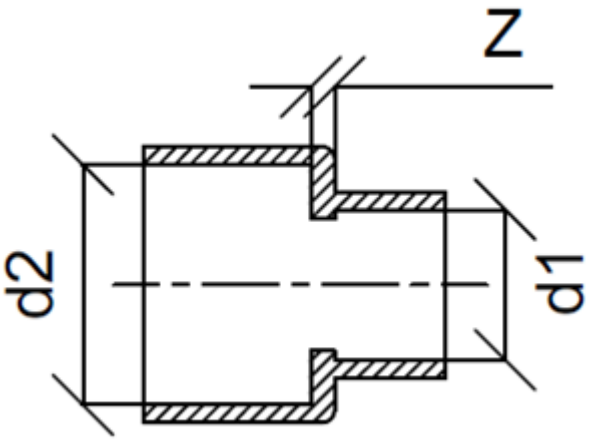

FIGURE 25 b

TABLE 24 – Laying length of reducing tees (see Figure 26)

Size (mm)	Laying length (Z)
25 x 20	13.5 +1.2 -1
32 x 20	17 +1.6 -1
32 x 25	17 +1.6 -1
40 x 20	21 +2 -1
40 x 25	21 +2 -1
40 x 32	21 +2 -1
50 x 20	26 +2.5 -1
50 x 25	26 +2.5 -1
50 x 32	26 +2.5 -1
50 x 40	26 +2.5 -1
63 x 25	32.5 +3.2 -1
63 x 32	32.5 +3.2 -1
63 x 40	32.5 +3.2 -1
63 x 50	32.5 +3.2 -1
75 x 32	38.5 +4 -1
75 x 40	38.5 +4 -1
75 x 50	38.5 +4 -1
75 x 63	38.5 +4 -1
90 x 40	46 +5 -1
90 x 50	46 +5 -1
90 x 63	46 +5 -1
90 x 75	46 +5 -1

110 x 50	56 +6 -1
110 x 63	56 +6 -1
110 x 75	56 +6 -1
110 x 90	56 +6 -1
160 x 110	81 +7 -1

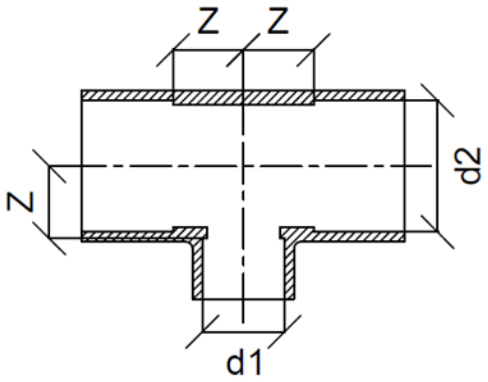

FIGURE 26

TABLE 25 – Laying length of reducing elbows (see Figure 27)

Size mm	Laying length (Z) mm
25 x 20	13.5 +1.2 -1
32 x 20 32 x 25	17 +1.6 -1
40 x 20 40 x 25 40 x 32	21 +2 -1
50 x 32 50 x 40	26 +2.5 -1
63 x 32 63 x 40 63 x 50	32.5 +3.2 -1
75 x 40 75 x 50	38.5 +4 -1
75 x 63	38.5 +4 -1
90 x 50 90 x 63	46 +5 -1
90 x 75	46 +5 -1

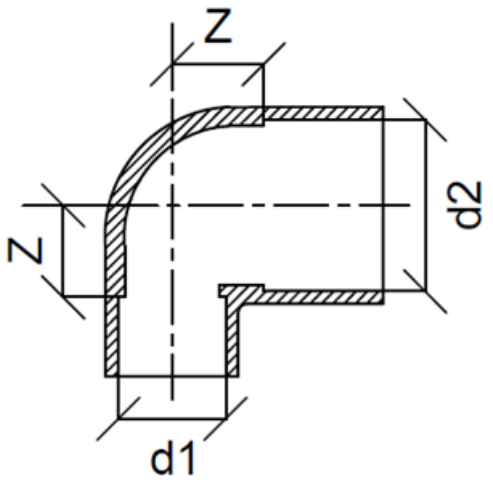

FIGURE 27-Reducing Elbow

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