

MATERIAL STANDARD
FOR
WATER SUPPLY
AND
SEWERAGE EQUIPMENT

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1. SCOPE

This Standard deals with the material specification of pipes and fittings that are used for water supply and sewerage systems in residential areas of industrial projects including such auxiliary items as manhole covers and frames, step irons, ladders and other components, with due consideration to the fact that commonly used pipes and fittings in water-supply and sewerage projects of municipalities and water distribution authorities or organizations are mostly produced by local manufacturing firms based on BSI or DIN standards and in compliance with the recommendations given in Publication No. 128, dated 1993 Plan and Budget Organization.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. and to the extent specified herein, form a part of this Standard.

BSI (BRITISH STANDARDS INSTITUTION)

BS 65: 1988	"Specifications for Vitrified Clay Pipes, Fittings, Joints and Ducts"
BS 416: 1973	"Specifications for Cast Iron Spigot and Socket Soil, Waste and Ventilating Pipes (Sand Cast and Spun and Fittings)"
BS 437: 1978	"Specifications for Cast Iron Spigot and Socket Drain Pipes and Fittings"
BS 460: 1964 (1981)	"Specifications for Cast Iron Rainwater Goods"
BS 486: 1981	"Specifications for Asbestos-Cement Pressure Pipes and Joints"
BS 534: 1981	"Specifications for Steel Pipes and Specials for Water and Sewage"
BS 729: 1971 (1986)	"Specifications for Hot Dip Galvanized Coatings on Iron and Steel Articles"
BS 1242: 1975	"Specifications for Manhole Step Irons"
BS 3506: 1969	"Specifications for Unplasticized PVC Pipe for Industrial Uses"
BS 3656: 1981	"Specifications for Asbestos-Cement Pipes, Joints and Fittings for Sewerage and Drainage"
BS 4211: 1987	"Specifications for Ladders for Permanent Access to Chimneys, Other High Structures, Silos and Bins"
BS 4622: 1970 (1983)	"Specifications for Gray Iron Pipes and Fittings"
BS 4660: 1973	"Specifications for Unplasticized PVC Underground Drain Pipe and Fittings"
BS 4772: 1988	"BS Specifications for Ductile Iron Pipes and Fittings"
BS 4942: 1981	"Short Link Chain for Lifting Purposes"
BS 5481: 1977	"Specifications for Unplasticized PVC Pipe and Fittings for Gravity Sewers"
BS 5911: Part 2:1982	"Specifications for Inspection Chambers and Street Gullies"
BS 6087: 1990	"Specifications for Flexible Joints for Gray or Ductile Cast Iron Drain Pipes and Fittings (BS 437) and for Discharge and Ventilating Pipes and Fittings (BS 416)"

DIN (DEUTSCHES INSTITUT FÜR NORMUNG E.V.)

DIN 1230: 1986	"Vitrified Clayware for Sewers"
DIN 1988: Pt. 2: 1988	"Drinking Water Supply Systems"
DIN 4032: 1981	"Concrete Pipes and Fittings"
DIN 19522: 1983	"Cast Iron Spigot (SML) Drain-Pipes and Fittings"
DIN 19534: Pt. 1: 1979	"Pipes and Fittings of Unplasticized Rigid PVC with Plug Socket for Sewerage Pipes and Lines"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 161-1: 1978	"Thermoplastics Pipes for Transport of Fluids"
ISO 881: 1980	"Asbestos-Cement Pipes, Joints and Fittings for Sewerage and Drainage"
ISO 4435: 1991	"Unplasticized PVC-U Pipes and Fittings for Burried Drainage and Sewerage Systems-Specifications"
ISO 6708: 1980	"Pipe Components-Definition of Nominal Size"
ISO 7186 : 1983	"Ductile Iron Pipes and Accessories for Non-Pressure Pipelines"
ISO 8283-1: 1991	"Plastics Pipes and Fittings"

ISIRI (INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH OF IRAN)

Publication No. 422: 1968	"Standard Steel Tubes, Thicknesses"
Publication No. 423: 1987	"Steel Tubes Suitable for Screwing in Accordance with ISO Recommendation R7"

PBO (PLAN AND BUDGET ORGANIZATION)

Publication No. 128: 1993	"Hot and Cold Water Service Lines in Buildings", Clauses 2.1-General and 2.2-Pipework
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Note:

This publication is only part of the engineering service lines that has been issued under Publication No. 128. The complementary publications when issued needs to be studied and as required the text of this IPS standard be updated to be in accord with PBO regulations.

BHRC (BUILDING AND HOUSING RESEARCH CENTER)

BHRC Report No. 122: 1987	"Plumbing Systems in Building"
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IPS (IRANIAN PETROLEUM STANDARDS)

E-CE-380	"Sewerage and Surface Water Drainage System"
M-PI-110	"Valves"
M-PI-190	"Line Pipes"

3. DEFINITIONS AND TERMINOLOGY

Nominal size (DN):

A numerical designation of size that is common to all components in a piping system other than components designated by outside diameters or by thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.

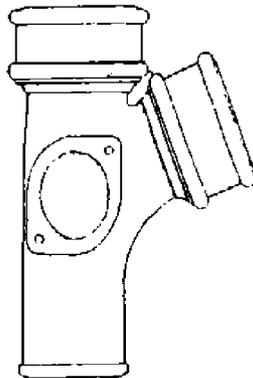
Notes:

- 1) Nominal size is designated by the letters DN followed by the appropriate number.
- 2) This definition is identical to ISO 6708.
- 3) The relationship between fitting size and nominal size is given hereunder for reference purposes.

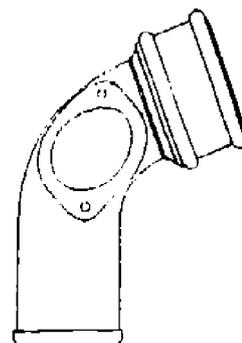
Designation of Thread Size	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
Nominal Size (DN)	6	8	10	15	20	25	32	40	50	65	80	100	125	150

Right hand fitting

A bend or branch which is so constructed that, when it is viewed with the spigot downwards and with the access door facing the observer, the socket of the bend or the arm of the branch projects to the right (see Fig. 1).



Right hand branch



Right hand bend

RIGHT HAND FITTINGS

Fig. 1

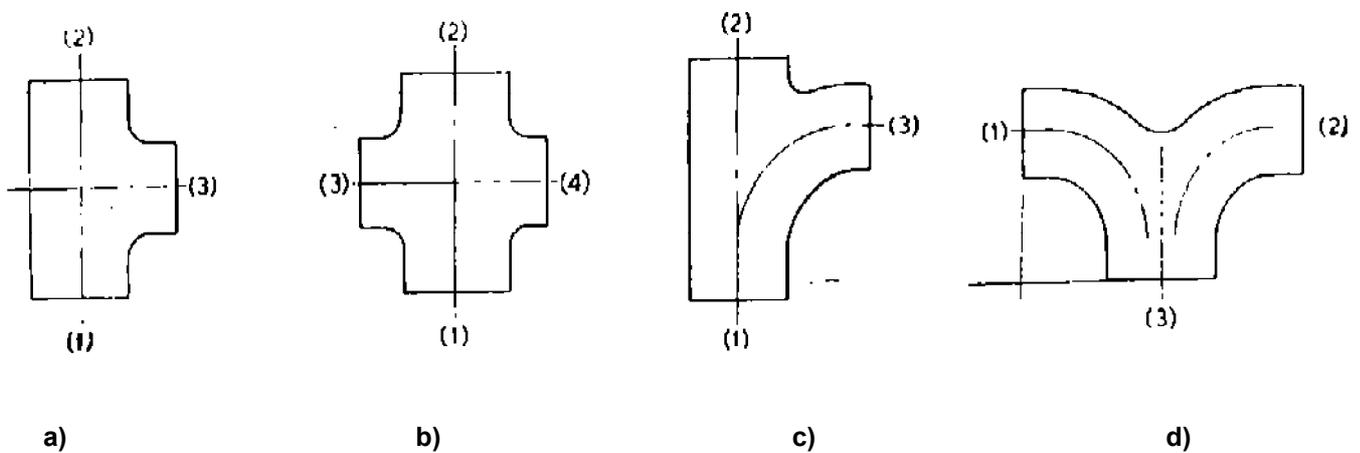
Terms relating to pressures and dimensions of pipes

For definition of technical words such as nominal pressure, nominal diameter or nominal size etc., used in DIN, BS and ISO Standards refer to Clauses 2.1.2 and 2.2.1.4 of Plan and Budget Organizations "Publication No. 128".

Designation of fitting size (see also Table 1 of Appendix A)

a) Equal fittings

Equal fittings where all outlets are the same size shall be specified by that one size, irrespective of the number of outlets (see Fig. 2).



Note:

The method of specifying outlets is in accordance with method (b) in ISO 49.

METHOD OF SPECIFYING OUTLETS OF FITTINGS HAVING MORE THAN TWO OUTLETS

Fig. 2

b) Unequal fittings

Unequal fittings shall be specified by the sizes of each outlet, the sequence being dependent upon the number of outlets, as follows:

a) for fittings having two outlets: the larger outlet shall be specified first;

b) for fittings having more than two outlets: these shall be specified in accordance with the sequence given in Fig. 2, e.g. a female reducing tee, Type B1 of Table A.1 of Appendix A, having thread sizes of 1½ for outlet (1), 1 for outlet (2) and 1½ for outlet (3) shall have the fitting size designation of 1½ × 1 × 1½;

c) tees Type B1 and pitcher tees Type E1 with equal outlets on the run and an increasing or reducing outlet on the branch shall be specified by stating the size of the run followed by the size of the branch, e.g. a female reducing tee Type B1 having thread sizes of 1½ for outlet (1), 1½ for outlet (2) and 1 for outlet (3) shall have the fitting size designation of 1½ × 1.

4. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

5. NON-PRESSURE PIPELINE COMPONENTS

5.1 General

General specification for non-pressure pipeline components including pipes, bends, "P" or "S" traps, branches and ancillaries such as manhole covers and frames, gullies, ladders, step irons, etc. that are used in sewerage or drainage systems should comply with the requirements of this Standard.

5.2 Rigid and Semi-Flexible Pipes

Whatever selection is made, pipes should have adequate strength to meet loading requirements, be sufficiently robust to withstand site handling and be sufficiently durable to remain watertight for the anticipated life of the system.

The various pipes and their application as recommended in BS standards are quoted hereunder as well as in Tables 1 and 2, moreover, the compatible standards in DIN, ISO and ISIRI are also given in Table 1.

5.2.1 Asbestos-Cement pipes

The asbestos-cement pipes and fittings with flexible joints for use in gravity sewers or drains should comply with BS 3656 which specifies the strength classification for pipe diameters from DN 100 to DN 2500, in pipe lengths of 3, 4 and 5 m.

The asbestos cement pipes and flexible joints used in force mains (rising mains) should comply with BS 486, which specifies the hydrostatic classification for pipe diameters from DN 50 to DN 2500 in pipe lengths of 3, 4 and 5 m. Asbestos-cement bends are available for diameters up to DN 225. Cast iron fittings are also available.

5.2.2 Spigot and socket clay pipes

Vitrified or salt glazed clay pipes and fittings for use with gravity flow under atmospheric pressure should comply with BS 65. They are available in nominal diameters from DN 75 to DN 1000, and in lengths up to 3.0 m. The following classifications of pipes are available:

- a) normal, i.e., suitable for all drains and sewers;
- b) surface water;
- c) perforated, suitable for soakaway land drains;
- d) extra chemically resistant.

Use of vitrified clay pipes for drainage of sanitary wastewater within curtilage of buildings and in sewers in the size range of DN 150 to 300 is highly recommended when the residential town is not within the earthquake zone and moreover when they be manufactured locally.

5.2.3 Concrete pipes

Precast concrete pipes and fittings of circular cross section for the conveyance of sewage or surface water under gravity, should comply with the appropriate Part of BS 5911.

BS 5911: Part 1 specifies requirements for flexibly jointed pipes in nominal diameters DN 150 to DN 3000 in standard lengths 0.45 m to 5 m (3 m for pipes DN 600), in three strength classes for sewage or surface water. For reinforced concrete pipes refer to Part 6 of Volume Three of IPS-M-PI-190/3

5.2.4 Spigot and socket gray cast-iron pipes and fittings

For non-pressure pipelines cast iron pipes and fittings should comply with BS 437 and BS 4622 respectively (see Table 1 for compatible acceptable standards). These pipes are manufactured in the size range DN 50 to DN 225; BS 437 makes provision for centrifugally cast pipes with flexible joints in lengths up to 5.5 m. Flexible joints for these pipes should comply with BS 6087.

Pressure pipes and fittings with flexible or flanged joints should comply with BS 4622. Pipes with flexible joints are normally available in 5.5 m lengths and those with flanged joints in 4 m lengths.

Fittings complying with BS 437 can be jointed directly to BS 4622 pipes with lead caulked joints in the smaller diameters (DN 100 and DN 150 only).

Note:

These pipes are suitable for below ground sewers and drains.

5.2.5 Cast iron spigot and socket soil, waste and ventilating pipes and fittings

Cast iron spigot and socket soil, waste and ventilating pipes (sand cast and spun) and fittings (for above ground use) should comply with BS 416: 1973 (inclusive of latest amendments) manufactured in the size range of DN 50 to 150 with type A sockets only.

Note:

These pipes may be used as rainwater pipes when a heavier grade of pipe than that specified in BS 460 is required.

5.2.6 Rainwater pipes and goods

Cast iron rainwater pipes and goods shall be manufactured by the sand cast or spun process with type A sockets only DN 50 to DN 150 complying with BS 460.

Note:

Locally made "Polika" plastic pipes are also suitable for drainage of rainwater providing the pipes are not exposed.

5.2.7 Corrugated metal pipes (semi-flexible)

For helically corrugated pipes, in sizes from DN 150 to DN 1500 made from galvanized steel sheet and in lengths from 6 m to 9 m having bituminous coating, refer to BS 2989.

5.2.8 Ductile iron pipes (semi-flexible)

Ductile iron pipes and fittings should comply with BS 4772 and are manufactured in a range from DN 80 to DN 1600. Ductile iron pipes with flexible joints are manufactured in nominal lengths of 5.5 m for DN 80 to DN 800 inclusive and nominal lengths of 8 m for DN 900 to DN 1600 inclusive. Ductile iron pipes are suitable for both pressure and non-pressure applications.

Commentary:

Pipework within pumping stations is usually of ductile gray iron and the pipe joints are mostly flanged. Pipe joints for use below ground should preferably be of the flexible type. If flanges are used on buried pipes the fastenings should be specially protected.

5.2.9 Ancillaries

5.2.9.1 Step irons or ladder rungs

Step irons fixed in deep brick and concrete manholes should be fabricated from ϕ 20 round bars in accordance with standard drawing Nos. IPS-D-CE-250 and IPS-D-CE-251 respectively and be galvanized before installation. For more information refer to BS 1247.

TABLE 1 - PIPES USED IN NON-PRESSURE PIPELINES

BS Standards are chosen as base.	RIGID PIPES						FLEXIBLE PIPES				REMARKS
	Asbestos	Clay	Concrete	Gray Cast Iron	Ductile Iron	Steel	Unplasticised PVC				
More or Less Compatible Standards	BS 3656	BS 486	BS 5911 Part + 100	BS 416 BS 437 BS 460	BS 4772	BS 534	BS 4660 (110 & 160 DN)	BS 5401 (200 to 630 DN)	BS 3506	BS 486 can be used in pressure mains also.	
	# 881	-	-	-	ISO 7186	-	ISO 8783 ISO 4435	ISO 1611	-		
Nominal Size	DIN (1980) Pts 1, 2 & 3		DIN 4032	DIN 19512	-	DIN 1530	DIN 19534 (100 to 600 DN)				
	Nominal bore	Nominal bore	Nominal bore	Nominal bore	Nominal bore	Outside diameter	Outside diameter	Outside diameter	Min. outside diameter	The diameter nominals (DN) of this Table refers to BS Std. only.	
75	mm	mm	mm	mm	mm	mm	mm	mm	mm	The smallest nominal size accepted in Oil Industries' pipes is DN 100	
100	100	100	-	100	100	114.3	110	-	114.1		
125	-	-	-	-	-	139.7	-	-	140.0		
150	150	150	150	150	150	168.3	160	-	168.0		
175	175	-	-	-	-	193.7	-	-	193.5		
200	200	200	-	200	200	219.1	-	200	218.8		
225	225	225	225	225	-	244.5	-	-	244.1		
250	250	250	-	-	250	273.0	-	250	272.6		
300	300	300	300	300	300	323.9	-	315	323.4		

Notes:

- 1) Pipes in diameters greater than 300 are available in many of these materials. Refer to respective subclauses of 5.2 .
- 2) Most of the pipes listed are manufactured locally.

TABLE 2 - CHEMICAL RESISTANCE OF MATERIALS (for general guidance)

GROUP	BS No.	MATERIAL AND APPLICATIONS	NORMAL DOMESTIC SEWAGE	TRADE EFFLUENT						
				At Normal Temperature		Organic Solvents	Containing Oils and Fats		Soil Environment Containing	
				Acids	Alkalis		Vegetable	Mineral	Sulphates	Acids
Ceramics	65, 1196 3921	Clayware pipes and fittings Bricks and blocks of fired brick-earth, clay or shale	A	S	S	S	S	S	S	S
			A	S	S	S	S	S	S	
Concrete	5911	Concrete: Ordinary Portland cement		E	A	A	E	A	E	E
		Sulphate-resisting Portland cement		E	A	A	E	A	A	E
Asbestos cement	3656	Asbestos cement pipes, joints and fittings (gravity) for sewerage and drainage	A	E	A	A	E	A	A	E
		Steel pipes and fittings	A	E	A	A	A	E	E	
Metals	534	Gray iron pipes and fittings (gravity)	A	E	A	A	A	A	E	E
		Ductile iron pipes and fittings	A	E	A	A	A	A	E	E
Plastics	4660 5481 3506	u PVC	A	S	S	E	A	A	S	S
		gravity drain and sewer pressure	A	S	S	E	A	A	S	S
Joining materials as specified by pipe supplier to meet the commentary requirements	Commentary: Pipes and joints should remain sufficiently watertight to prevent ingress of ground water and egress of effluent when subjected to ground movement and settlement.	Flexible joints are generally available for the range of materials used for drainage and they can accommodate angular deflection, axial displacement and draw within the joint. They are designed to resist shear loads without loss of watertightness. Where rigid joints are required they can be made by caulking metal or compound or by working a cement mortar into the joint, by bolted flanges or by welding the pipes together. Care should be taken on such jointing operations not to disturb the gradient of the line or the continuity of the bore.								
			Commentary: The coatings most commonly applied to metal pipes do not necessarily provide adequate protection against all types of corrosion. Specially designed coatings may be required for protection against concentrations of acids, alkalis, sulphates and other aggressive chemicals likely to be encountered in the ground and in liquids carried.							
Coatings (refer to IPS-E-TP-270)	A = normally suitable E = need expert advice, each case to be considered on its own merits. S = specially suitable.									

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Note:

It is important to take account of quantities and concentrations of all types of chemical likely to be encountered.

5.2.9.2 Manhole covers and frames

Gray cast iron manhole covers and frames should be cast in accordance with standard drawings No. IPS-D-CE-252 sheet 1 for heavy-weight and sheet 2 for light-weight cover and frame, applicable in both brick or concrete manholes, as chosen and required.

5.2.9.3 Safety chains (for sewage pumphouse)

Safety chains should be made of low carbon steel or of stainless steel, 10 mm nominal size, short-link, smooth welded chain to BS 4942: Part 2. When made of low carbon steel they should be protected by hot dip galvanizing in accordance with BS 729.

5.2.9.4 Ladders (for sewage pumphouse)

Fixed ladders should meet the dimensional requirements of BS 4211 except that stringers should be not less than 65 mm × 20 mm in section and rungs 25 mm in diameter. When made of low carbon steel they should be protected by hot dip galvanizing in accordance with BS 729.

For rise and tread dimensions, stringer and landing details refer to the specific engineering, drawing and IPS-D-CE-141 for guidance only.

5.2.9.5 Handrails and handholds (in sewage pumphouse)

Handrails and handholds should be at least 25 mm in diameter. Low carbon steel tubes can be used for fabrication at shop. They should be protected by hot dip galvanizing in accordance with BS 729, before assembly.

5.2.9.6 Gullies

Gullies should comply with BS 65, BS 437 or BS 5911: Part 2 as appropriate. A gully usually incorporates trap, or a sump, or both, to retain detritus. The top should be fitted with either a grating or sealed cover. Connections should be made below the grating or cover. Gullies may be specially designed to suit selected locations and the volume and nature of the flow.

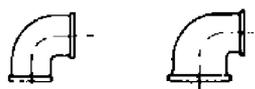
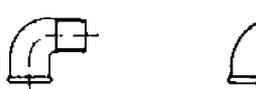
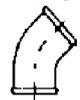
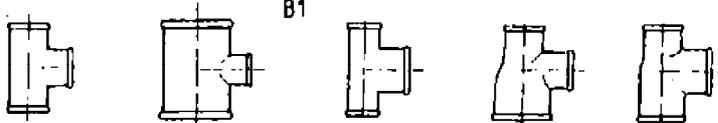
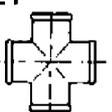
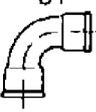
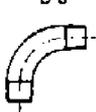
For engineering and constructional details refer to IPS-D-CE-232.

5.2.9.7 Valves (see also Clause 11.4 of IPS-E-CE-380)

For general information about valves refer to IPS-M-PI-110.

APPENDICES
APPENDIX A
INDEX OF PIPE FITTINGS

TABLE A.1 - INDEX OF FITTING TYPES, SYMBOLS AND INDEX TO TABLES

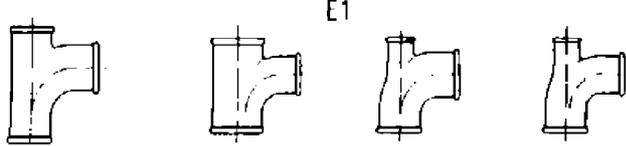
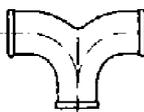
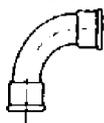
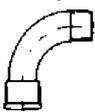
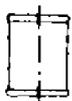
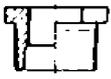
Type	Description	Symbol				
A	Elbows	A1 	A4 			
		Pipe ends	Female-equal	Female-reducing	Male and female-equal	Male and female-reducing
		Table no.	9	10	9	10
A	45° elbows	A1/45° 	A4/45° 			
		Pipe ends	Female-equal		Male and female-equal	
		Table no.	11		11	
B	Tees	B1 				
		Pipe ends	Female-equal	Female-reducing	Female-increasing	Female-reducing
		Table no.	9	12	12	13
C	Crosses	C1 				
		Pipe ends	Female-equal			
		Table no.	9			
D	Bends	D1 	D4 	D8 		
		Pipe ends	Female-equal	Male and female-equal		Male-equal
		Table no.	14	14		14
D	45° bends	D4/45° 				
		Pipe ends	Male and female-equal			
		Table no.	15			

* Pipe ends of fitting outlets.

** Table Nos. of BS 143 and 1256:1986.

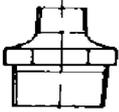
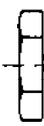
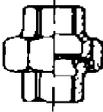
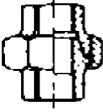
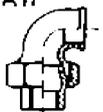
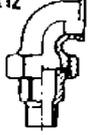
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APPENDIX A - TABLE A.1 (continued)

Type	Description	Symbol			
E	Picker tees				
	Pipe ends	Female-equal Female-reducing			
	Table no.	14 16			
E	Twin elbows				
	Pipe ends	Female-equal			
	Table no.	14			
G	Long sweep bends				
		Pipe ends	Female-equal Male and female equal		
	Table no.	17 17			
Kb	Return bends				
	Pipe ends	Female-equal			
	Table no.	18			
M	Sockets				
		Pipe ends	Female-equal Female-reducing Female-reducing Male and female-reducing		
	Table no.	19 19 19 19			
N	Bushes				
		Pattern	I II III		
	Table no.	20 20 20			

(to be continued)

APPENDIX A - TABLE A.1 (continued)

Type	Description	Symbol		
N	Hexagon nipples	N8		
				
		Pipe ends	Male-equal	Male-reducing
	Table no	21	21	
P	Backnuts	P4		
				
	Table no	22		
T	Caps	T1		T2
				
		Pattern	Hexagon	Round
	Table no	23	23	
T	Plugs	T8	T9	T11
				
		Pattern	Plain	Beaded
	Table no	23	23	23
U	Unions	U1	U11	U12
				
		Ends-pattern	Female-flat seat	Female-taper seat
	Table no	24	24	24
UA	Elbow unions	UA11	UA12	
				
		Ends-Pattern	Female-taper seat	Male and female-taper seat
	Table no	25	25	