INTERNATIONAL STANDARD

ISO 49

Second edition
1994-12-15

Malleable cast iron fittings threaded to ISO 7-1

Raccords en fonte malléable filetés conformément à l'ISO 7-1

Reference number
ISO 49:1994(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 49 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 5, *Threaded or plain end butt-welding fittings, threads, gauging of threads*.

This second edition cancels and replaces the first edition (ISO 49:1983), which has been technicallly revised.

Annex A of this International Standard is for information only.

International Organization for Standardization
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Malleable cast iron fittings threaded to ISO 7-1

1 Scope

This International Standard specifies requirements for the design and performance of malleable cast iron threaded pipe fittings.

These fittings are for general purposes for the transmission of fluids and gases up to the limits of pressure and temperature specified in this International Standard. They are intended for the connection of elements threaded in accordance with ISO 7-1, sizes 1/8 to 6.

For use in conditions outside the pressure and temperature limits specified, consult the fitting manufacturer.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part1: Dimensions, tolerances and designation.*

ISO 228-1:1994, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 2859-0:—[1], *Sampling procedures for inspection by attributes — Part 0: Introduction to the ISO 2859 attribute sampling system.*

ISO 2859-1:1989, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 2859-2:1985, *Sampling procedures for inspection by attributes — Part 2: Sampling plans indexed by limiting quality (LQ) for isolated lot inspection.*

ISO 2859-3:1991, *Sampling procedures for inspection by attributes — Part 3: Skip-lot sampling procedures.*

ISO 5922:1981, *Malleable cast iron.*

ISO 6708:—[2], *Pipe components — Definition of nominal size (DN).*

1) To be published. (Revision of ISO 2859:1974)

2) To be published. (Revision of ISO 6708:1980)

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 fitting: Connecting piece, of one or more parts.

3.2 jointing thread: Thread complying with ISO 7-1.

3.3 fastening thread: Thread complying with ISO 228-1.

3.4 fitting size; designation of thread size: Size designation of the threads of the threaded outlets as derived from ISO 7-1 (see also clause 13).

3.5 nominal size; DN: For definition see ISO 6708.

NOTES

1 Nominal size is designated by the letters DN followed by the appropriate number.

2 The relationship between fitting size and nominal size (DN) is given in clause 15 for guidance only.

3 Nominal size (DN) should not be used for the designation of fitting size.

3.6 reinforcement: Additional material on the outside diameter of an internally threaded fitting in the form of a band or bead (see figure 1).

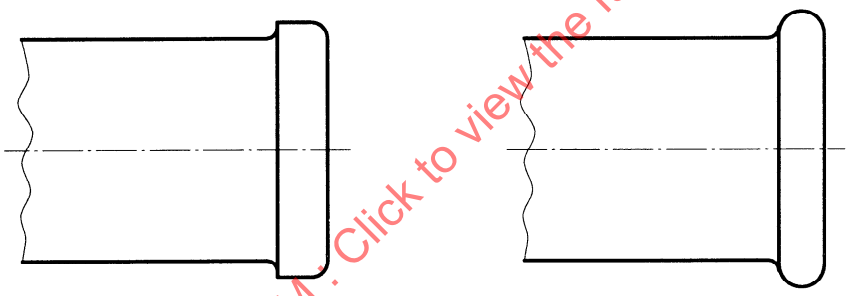


Figure 1 — Forms of reinforcements

3.7 rib: Local and axially aligned additional material on the outside or inside of a fitting for assistance in assembly or manufacturing.

3.8 outlet: Internally or externally threaded end of a fitting, which connects with a tube, fitting or other component threaded in accordance with ISO 7-1.

3.9 run: Two principal axially aligned outlets of a tee or cross.

3.10 branch(es): Side outlet(s) of a tee or cross.

3.11 chamfer: Conical portion at the entrance of a thread removed to assist assembly and prevent damage to the start of the thread.

3.12 face-to-face dimension: Distance between the two parallel faces of axially aligned outlets of a fitting.

3.13 face-to-centre dimension: Distance between the face of an outlet and the central axis of an angularly disposed outlet.

3.14 laying length: Average distance from the assembled pipe end to the axis of the fitting, or between the ends of two assembled pipes (see also 7.2).

4 Types of fitting

Table 1 provides an index to fitting types, patterns and symbols. The symbols relate to the identification of fittings and may be used for designation (see 13.1).

Table 1 — Index of fitting types and symbols, with corresponding clauses and patterns

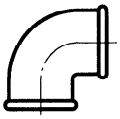
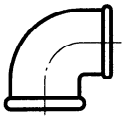
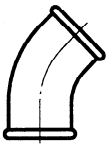
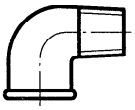
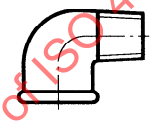
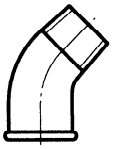
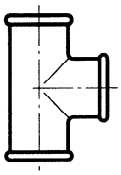
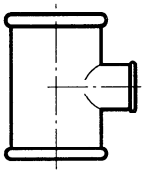
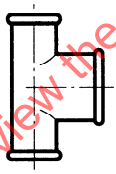
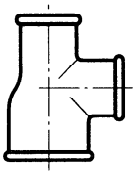
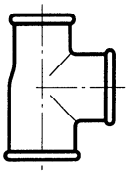
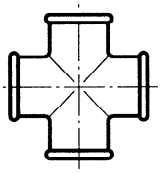
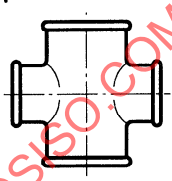
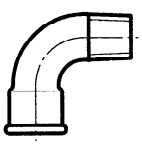
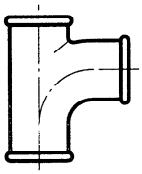
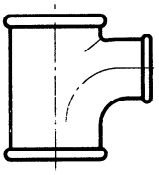
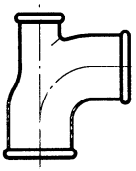
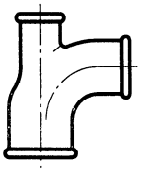
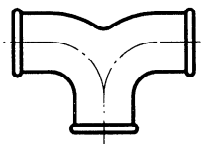
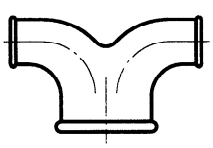
Type	Symbol									
A Elbows	A1		A1/45°	A4		A4/45°				
	 Clause 17	 Clause 18	 Clause 19	 Clause 17	 Clause 18	 Clause 19				
B Tees	B1									
	 Clause 17	 Clause 20	 Clause 20	 Clause 21	 Clause 21					
C Crosses	C1									
	 Clause 17	 Clause 22								
D Short bends	D1		D4							
	 Clause 23		 Clause 23							
E Pitcher tees Twin elbows	E1					E2				
	 Clause 23	 Clause 24	 Clause 24	 Clause 24		 Clause 23	 Clause 25			

Table 1 — Index of fitting types and symbols, with corresponding clauses and patterns *(continued)*

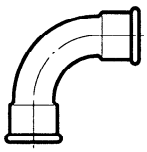
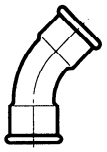
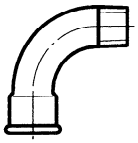
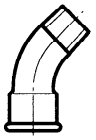
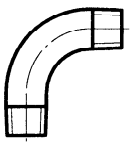
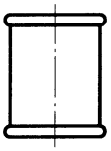
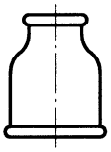
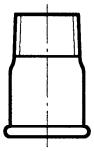
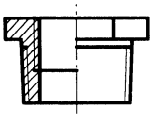
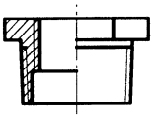
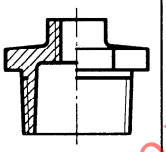
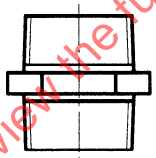
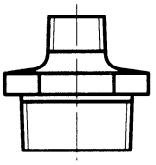
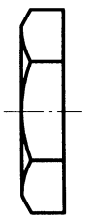
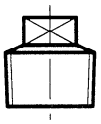
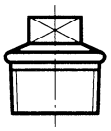
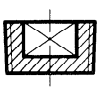
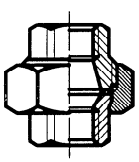
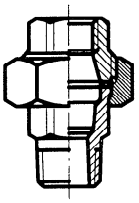
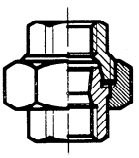
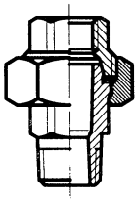
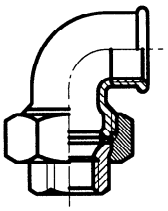
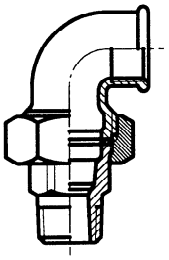
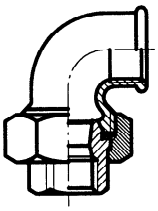
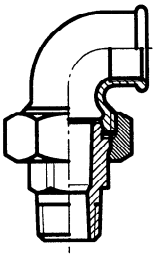
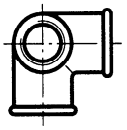
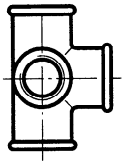
Type	Symbol					
G Long sweep bends	G1  Clause 26	G1/45°  Clause 27	G4  Clause 26	G4/45°  Clause 27	G8  Clause 26	
M Sockets	M2 M2 R-L  Clause 28	M2  Clause 28	M4  Clause 29	 Clause 29		
N Bushings Hexagon nipples	N4  Clause 30	 Clause 30	 Clause 30	N8 N8 R-L  Clause 31	N8  Clause 31	
P Backnuts	P4  Clause 32					
T Caps Plugs	T1  Clause 33		T8  Clause 33	T9  Clause 33	T11  Clause 33	
U Unions	U1  Clause 34	U2  Clause 34	U11  Clause 34	U12  Clause 34		

Table 1 — Index of fitting types and symbols, with corresponding clauses and patterns (*concluded*)

Type	Symbol				
UA Union elbows	UA1  Clause 35	UA2  Clause 35	UA11  Clause 35	UA12  Clause 35	
Za Side outlet elbows and tees	Za1  Clause 17	Za2  Clause 17			

5 Materials

5.1 Fitting material

5.1.1 Malleable cast iron

The material used shall be malleable cast iron (except see 5.1.2) meeting the requirements of ISO 5922. The grade of material used shall be selected from the following grades depending on the design chosen (see 6.1):

Grade W400-05 or W350-04 for whiteheart fittings;
Grade W350-10 or B300-06 for blackheart fittings.

5.1.2 Other ferrous materials

Any other ferrous materials which give mechanical properties at least equivalent to those grades of malleable cast iron specified in 5.1.1 are allowed for fittings not larger than size 3/8 of the straight type, but excluding unions.

5.2 Hot-dip zinc coating

Where a protection by zinc coating is required, the zinc coating shall be applied by the hot-dip process and shall meet the following requirements.

NOTE 4 For fittings supplied in other ferrous materials (see 5.1.2), an alternative to zinc coating may be provided by agreement with the purchaser.

5.2.1 Chemical composition of the zinc coating

The percentage by mass of the trace elements in the finished zinc coating shall not exceed the following maximum values:

aluminium	(Al)	0,1 %	
antimony	(Sb)	0,01 %	
arsenic	(As)	0,02 %	
bismuth	(Bi)	0,01 %	
cadmium	(Cd)	0,01 %	
copper	(Cu)	0,1 %	
lead	(Pb)	1,6 %;	in certain cases 1,8 %
tin	(Sn)	0,1 %	

5.2.2 Coating mass per unit surface area

The areic mass of the zinc coating shall be not less than 500 g/m^2, as an average of five fittings. This corresponds to an average layer thickness of 70 µm. The areic mass shall be not less than 450 g/m^2 (63 µm) on each individual sample.

The average layer thickness $\bar{s}$, in micrometres, of the zinc coating may be calculated by using the approximation:

$$\bar{s} = \frac{m_A}{7,2}$$

where m_A is the areic mass of the zinc coating, in grams per square metre.

5.2.3 Surface condition of the zinc coating

The zinc coating on the internal surface of the fitting shall be continuous, with the exception of machined black surfaces. In the special case of larger material cross-sections, the iron–zinc alloy phases may grow through. The internal zinc coating shall be free from zinc blisters, zinc burrs and nonmetallic remainders.

5.3 Despatch conditions of finished fittings

The surfaces of the finished fittings shall be free of aromatic hydrocarbons.

6 Design

6.1 Fittings shall be identified by design symbols according to the material selected (see 5.1.1) and the choice of thread (see 8.1.1) as given in table 2.

Table 2 — Design symbols

Design symbol	Thread type		Material grade
	external	internal	
A	R	Rp	W400-05 or B350-10
B	R	Rp	W350-04 or B300-06
C	R	Rc	W400-05 or B350-10
D	R	Rc	W350-04 or B300-06

NOTE — For fittings having only external threads, the design symbol shall be the same as that specified for fittings manufactured with internal thread and in the same material grade.

6.2 The types and sizes dimensionally standardized are given in clauses 17 to 35. The drawings are diagrammatic, without prejudice to the manufactured form.

6.3 Fittings shall be reinforced at the internally-threaded ends by a band or bead, except where they are polygonal in shape to allow for spanner flats, or where fittings have side outlets (types Za1 and Za2).

6.4 Ribs may be incorporated at the manufacturer's discretion. Ribs should not project higher than the reinforcing bead or band.

6.5 Backnuts may be plain or recessed and one face may be machined.

6.6 Clauses 34 and 35 show two typical types of seats of unions and their designations. Other types of seat design and seat material shall be considered as complying with this International Standard provided the dimensions in clauses 34 and 35 and other requirements of this International Standard are observed. Such unions do not have a formal designation.

7 Dimensions and tolerances

7.1 Fittings shall have the appropriate dimensions (see clauses 17 to 35). Where maximum or minimum dimensions are not specified, the tolerances for face-to-face and face-to-centre dimensions shall be as given in table 3.

NOTE 5 The face-to-face and face-to-centre dimensions of unions may not always comply with the tolerances given, due to the compound effect of piece tolerances and design upon the final assembly.

Table 3 — Tolerance on length

Values in millimetres

Dimension	Tolerance
⩽ 30	± 1,5
> 30 ⩽ 50	± 2
> 50 ⩽ 75	± 2,5
> 75 ⩽ 100	± 3
> 100 ⩽ 150	± 3,5
> 150 ⩽ 200	± 4
> 200	± 5

7.2 Laying lengths are given in clauses 17 to 35 for assistance and guidance during installation. Their accuracy is dependent upon the tolerances given in 7.1 and on the tolerance of the threads specified in ISO 7-1. The dimensions (z_1, z_2 and z_3) given in clauses 17 to 35 are the average distance from the pipe end to the axis of the fitting (see figure 2) or the distance from pipe end to pipe end (see figure 3).

These assembly dimensions are calculated by deducting average lengths of engagement from the face-to-face or face-to-centre dimensions given in the appropriate table. The average lengths of engagement are rounded from the dimensions given in ISO 7-1 and are given in table 4.

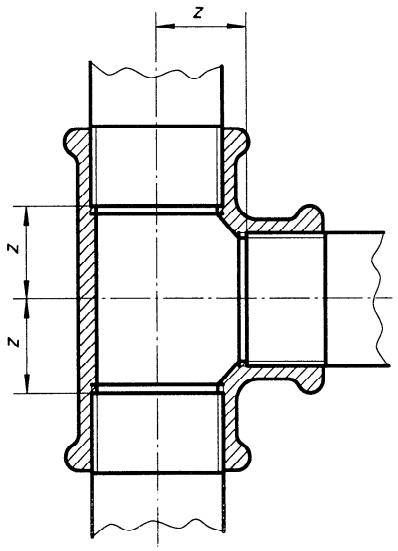


Figure 2 — Laying lengths z in the case of an angularly disposed fitting

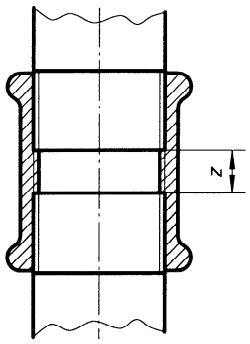


Figure 3 — Laying length z in the case of an axially aligned fitting

Table 4 — Lengths of engagement

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
Length of engagement, mm	7	10	10	13	15	17	19	19	24	27	30	36	40	40

7.3 The dimensions of widths across flats, s, depend on the design of the fittings and are left to the discretion of the manufacturer.

7.3.1 Flats on plugs shall be square. Flats on other fittings up to and including size 3/4 should be hexagonal. Flats on other fittings above size 3/4 may be hexagonal or octagonal. Flats on union parts, excluding the union nut, may be hexagonal, octagonal or decagonal.

7.3.2 The minimum depth of the spanner flats measured at the corners shall be as given in table 5. For backnuts, any chamfering shall not reduce the depth of spanner flats below the minimum dimensions given in table 5.

Table 5 — Minimum depth of spanner flats

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
Minimum depth of spanner flats, mm	4	4	5	5	5,5	6	6,5	6,5	7	7	7,5	8

8 Threads

8.1 Choice of thread

8.1.1 Jointing thread

Fittings shall be threaded in accordance with ISO 7-1. External threads are taper (R); internal threads may be parallel (Rp) or taper (Rc).

8.1.2 Fastening threads

The threads of union nuts and their mating threads shall be in accordance with ISO 228-1. Backnuts shall be in accordance with ISO 228-1.

8.2 Alignment of threads

The axes of the screw threads shall be accurate to within ± 0,5° of the specified angle.

8.3 Chamfering

The outlets of the fittings shall have a chamfer.

On internal threads, the chamfer should have a minimum included angle of 90°, and the diameter at the face should exceed the major diameter of the thread.

On external threads, the chamfer should have a minimum included angle of 60° and the diameter at the face should not exceed the minor diameter of the thread at that face.

9 Manufactured aspect

Fittings shall not contain material detrimental to their application. They should be smooth, free from sand, blow holes, cracks and other injurious defects. They shall not be impregnated to cover such defects.

10 Required characteristics

10.1 Permissible working pressure and temperature

The fittings of all sizes shall be suitable for the maximum permissible working pressures within the temperature ranges given in table 6 (see also figure 4). Intermediate pressure ratings at temperatures between 120 °C and 300 °C shall be obtained by linear interpolation. For normal applications the lowest service temperature appropriate for fittings is – 20 °C. For special applications at temperatures below – 20 °C, the manufacturer shall be consulted.

Table 6 — Pressure/temperature ratings

Service temperature °C	Maximum permissible working pressure bar[1)]
– 20 to 120	25
between 120 and 300	interpolated values
300	20
1) 1 bar = 10^5 N/m^2 = 100 kPa	

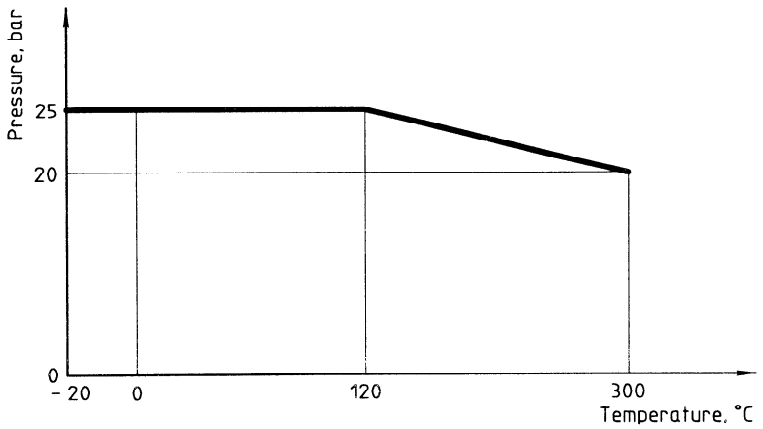


Figure 4 — Pressure/temperature ratings

10.2 Design strength

Pressure-containing fittings, including the component parts of unions, shall be designed to withstand the design test pressures given in table 7. Each size of fitting shall be type-tested in accordance with table 7.

Table 7 — Design test pressures

Hydrostatic design test pressure (gauge)	
Fitting sizes: 1/8 to 4	Fitting sizes: 5 and 6
100 bar	64 bar

Leakage from a union joint is permissible at a pressure below the pressure given in table 7, provided that the pressure is not less than 1,5 × maximum permissible working pressure at ambient temperature (see 10.1).

10.3 Assembly

The fittings shall be capable of withstanding the forces normally involved during assembly when correctly assembled with threads in accordance with 8.1.

11 Testing and inspection

11.1 Malleable cast iron

The manufacturer shall ensure by adequate tests that the malleable cast iron meets the requirements of the material grade specified in 5.1.1.

In addition to the test requirements of ISO 5922, the manufacturer shall carry out sufficient tests, after annealing and before machining, to ensure that all fittings are satisfactorily malleabilized.

11.2 Hot-dip zinc coating

Where protection by hot-dip zinc coating is specified, the manufacturer shall ensure that the hot-dip zinc coating meets the requirements of 5.2. The elements specified in 5.2.1 shall be determined using a recognized test method, e.g. atomic absorption spectroscopy. The method of determination of the coating mass per surface unit should be taken from ISO 1460. The thickness of the coating may be checked by using calibrated electronic or magnetic instruments (see e.g. ISO 2178) or by microscopic examination. The result for a fitting is then calculated as the arithmetic mean of at least 10 individual measurements at points distributed statistically across the fitting.

Hot-dip zinc-coated fittings shall be visually inspected for compactness and continuity of the zinc coating in accordance with sampling plans (see ISO 2859).

11.3 Threads

11.3.1 Jointing threads

The manufacturer shall ensure by adequate control that the jointing threads meet the requirements of ISO 7-1.

NOTE 6 ISO 7-2 recommends a system of gauging but other systems of gauging can be used providing they ensure that equivalent results are obtained and that threads conform to ISO 7-1.

11.3.2 Fastening threads

Fastening threads shall meet the requirements of ISO 228-1.

NOTE 7 ISO 228-2 recommends a system of gauging but other systems of gauging can be used providing they ensure that equivalent results are obtained and that threads conform to ISO 228-1.

11.3.3 Alignment

The alignment of the threads shall meet the requirements specified in 8.2.

11.4 Leaktightness test

All pressure-containing fittings shall be tested, after machining but before protective coating other than zinc coating, by one of the following methods. Each fitting, when so tested, shall show no sign of leakage.

a) by the application of an internal hydrostatic pressure of not less than 20 bar; or

b by the application of an internal pneumatic pressure of not less than 5 bar, while the fitting is completely immersed in water or light oil; or

c) by other tests which ensure an equivalent quality.

Fittings which do not satisfy the chosen test shall be rejected.

11.5 Final visual inspection

The fittings shall be free from visible casting or threading defects. The verification regarding this shall be done by adequate visual inspection.

11.6 Acceptance tests for higher performance criteria

11.6.1 If the purchaser requires acceptance tests, these shall be stipulated but agreed with the manufacturer at the enquiry or order stage. The purchaser shall bear the cost of acceptance tests. Acceptance tests should be carried out with suitable equipment and manpower of the manufacturer.

11.6.2 Acceptance hydraulic pressure tests for working pressures above 25 bar shall be carried out by agreement between purchaser and manufacturer at the order stage. The test pressure shall not exceed the limit beyond which permanent deformation and changes to the thread dimensions would occur.

11.7 Analysis for aromatic hydrocarbons

Verification of the absence of aromatic hydrocarbons (see 5.3) shall be performed by means of gas or thin-layer chromatography or other equivalent methods.

11.8 Certificates

If specifically requested by the purchaser, the manufacturer shall issue a test certificate which contains a statement that the fittings have been tested in accordance with this International Standard and stating the actual pressures and medium used for the test. If the testing conditions have been agreed at the order stage, then this certificate corresponds to a certificate of compliance with the order.

12 Quality assurance

Manufacturers of fittings to this International Standard are recommended to establish and maintain a documented quality system conforming to ISO 9001 or ISO 9002 as a means of ensuring that the fittings conform to the specified requirements. This would include:

a) the preparation of documented quality system procedures and instructions in accordance with ISO 9001 or ISO 9002, and

b) the effective implementation of the documented quality system procedures and instructions.

Users of this International Standard are advised to consider the desirability of third-party assessment of the manufacturer's quality systems in accordance with ISO 9001 or ISO 9002.

13 Designation

13.1 Elements of the designation

Fittings complying with this International Standard shall be designated as follows:

a) the type of fitting (see table 1);

b) reference to this International Standard (ISO 49);

c) the pattern symbol (see table 1);

d) fitting size (see 13.2 and clauses 17 to 35);

e) the symbol for surface condition [whether black (symbol Fe) or hot-dip zinc-coated (symbol Zn)];

f) design symbol (see 6.1).

13.2 Complementary designation of size

13.2.1 Equal fittings, where all outlets are of the same size, are referred to by that one size, irrespective of the number of outlets.

13.2.2 Unequal fittings having two outlets are specified by their outlets in decreasing order (larger outlet – smaller outlet).

13.2.3 Unequal fittings having more than two outlets and reducing on the run or having three different outlets may be specified by either method a) or method b), according to national practice, as shown in figure 5.

NOTE 8 It is recommended that method b) be phased out by the year 2000. All such fittings should thereafter be designated using method a).

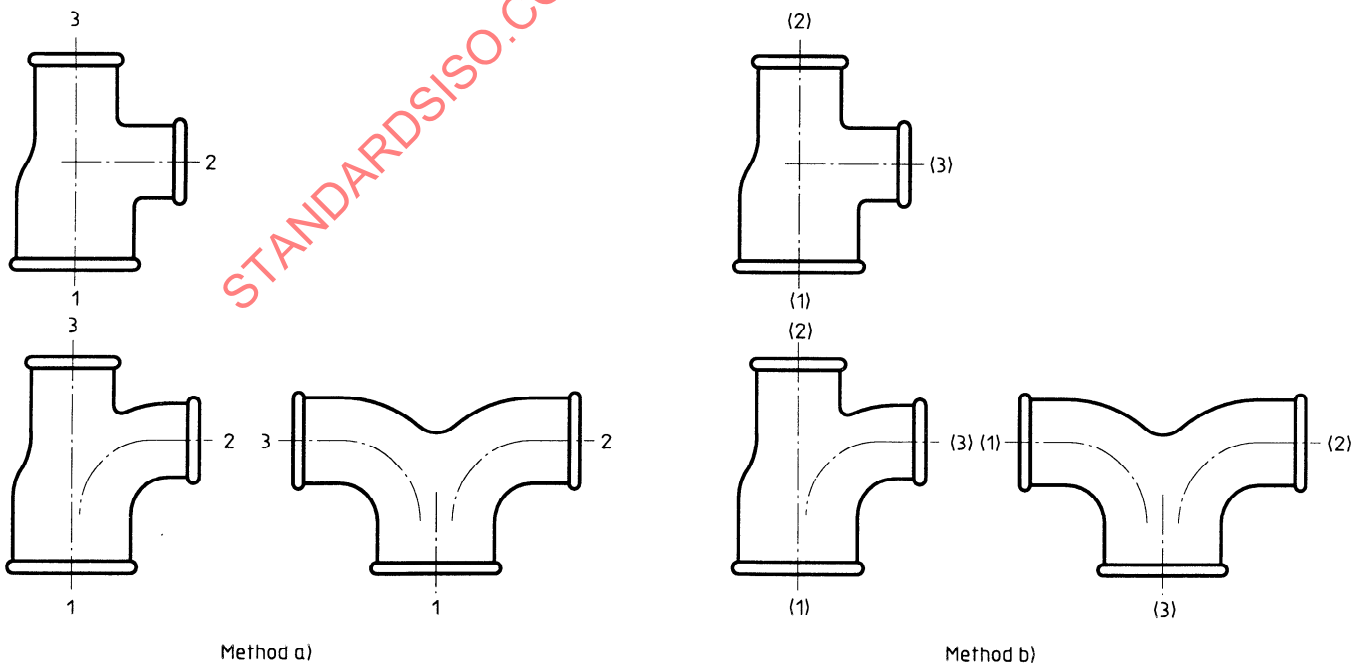


Figure 5 — Sequence of specifying multiple outlets when the simplified method given in 13.2.4 does not apply

13.2.4 Unequal fittings having more than two outlets but not reducing on the run are specified according to the simplified method as follows:

a) tees B1 and E1 with equal outlets on the run and an increasing or decreasing outlet on the branch: specified by the size of the run followed by the size of the branch, for example 1 × 3/4 (see clauses 20 and 24);

b) twin elbows reducing E2: the size of the large outlet is specified followed by the size of the two smaller outlets, for example, 1 1/2 × 1 1/4 (see clause 25);

c) reducing crosses C1: the size of the largest run is specified followed by the size of the two smaller (but equal) branches, for example 1 1/2 × 1 (see clause 22).

13.3 Examples

a) Equal female elbow size 2, black finish, design symbol A:

Elbow ISO 49 - A1 - 2 - Fe - A

b) Reducing tee with run 2 and branch 1, hot-dip zinc-coated, design symbol C:

Tee ISO 49 - B1 - 2×1 - Zn - C

c) Reducing tee with runs 1 and 3/4 and branch 1/2, black finish, design symbols B and D respectively:

using method a): **Tee ISO 49 - B1 - 1x1/2x3/4 - Fe - B**

using method b): **Tee ISO 49 - B1 - 1×3/4×1/2 - Fe - D**

14 Marking of fittings

Unless it is not practicable because of casting method space limitations, fittings shall be marked by casting at least with:

a) the manufacturer's name or trademark;

b) the fitting size (as defined in 3.4).

Other markings shall not conflict with the markings detailed in a) and b).

When it is not practicable to mark fittings because of casting method space limitations, it is permissible to omit either or both of the markings detailed in a) and b) providing the omitted markings are given on the packaging material, but in this case the fitting shall not be marked with any other marking.

15 Relationship between designation of thread size and nominal size

The relationship between designation of thread size, which is also the fitting size, and nominal size is given in table 8.

Table 8 — Thread designation and nominal size

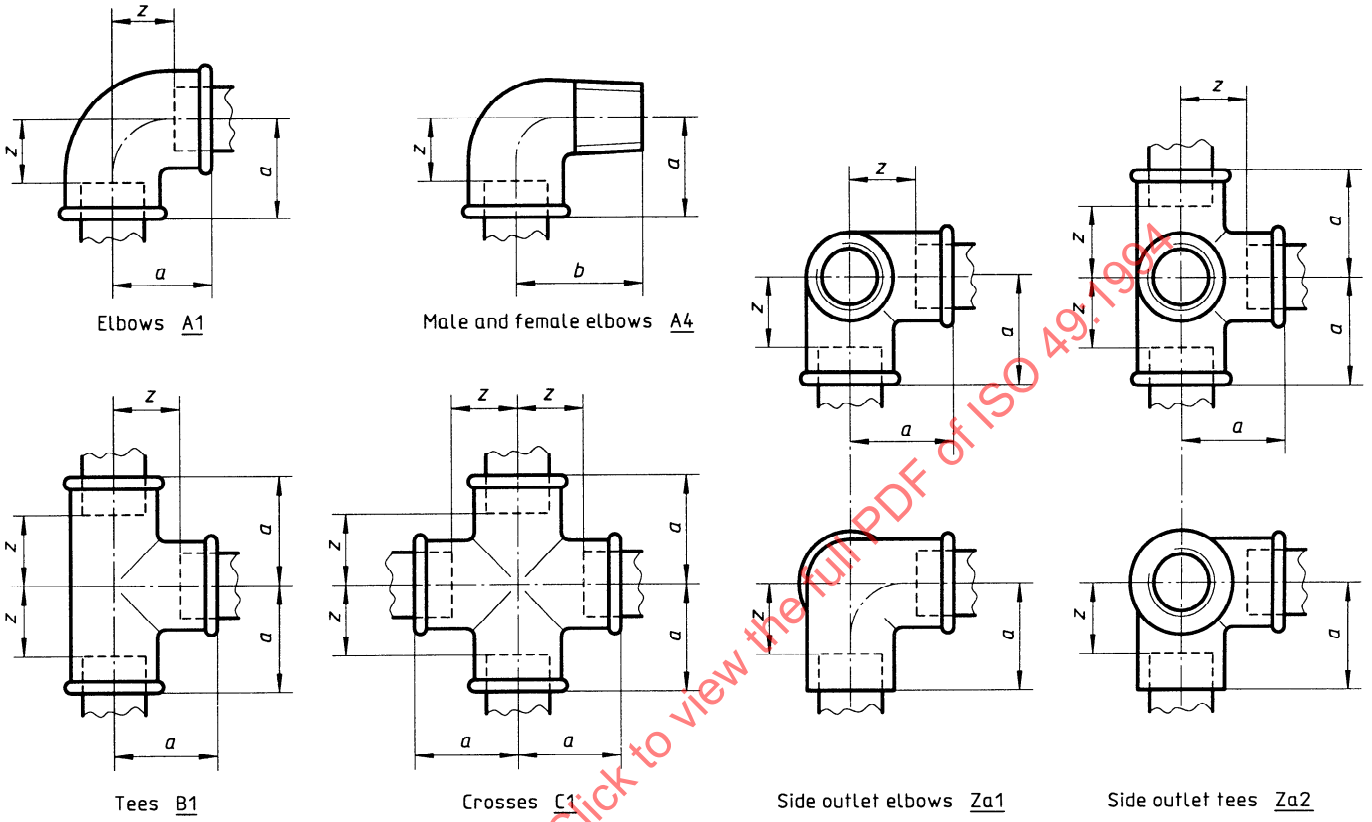
Designation of thread size/fitting size	**1/8**	**1/4**	**3/8**	**1/2**	**3/4**	**1**	**1 1/4**	**1 1/2**	**2**	**2 1/2**	**3**	**4**	**5**	**6**
Nominal size, DN	6	8	10	15	20	25	32	40	50	65	80	100	125	150

16 Fitting dimensions and laying lengths — General

Fittings shall have the appropriate dimensions and laying lengths given in clauses 17 to 35. For information on tolerances, see 7.1; for determination of laying length, see 7.2.

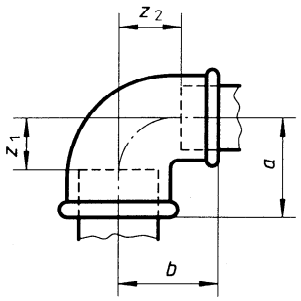
Fitting sizes shown in parentheses are optional sizes. Dimensions which are not specified are left to the discretion of the manufacturer. Unless otherwise specified, threads are in accordance with ISO 7-1.

17 Elbows, tees and crosses

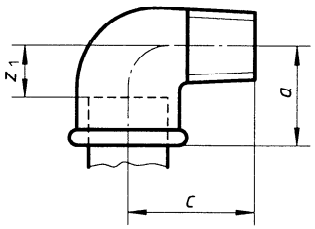


Fitting sizes						Dimensions mm		Laying lengths mm
A1	A4	B1	C1	Za1	Za2	*a*	*b*	*z*
1/8	1/8	1/8	—	—	—	19	25	12
1/4	1/4	1/4	(1/4)	—	—	21	28	11
3/8	3/8	3/8	3/8	(3/8)	(3/8)	25	32	15
1/2	1/2	1/2	1/2	1/2	(1/2)	28	37	15
3/4	3/4	3/4	3/4	3/4	(3/4)	33	43	18
1	1	1	1	(1)	(1)	38	52	21
1 1/4	1 1/4	1 1/4	1 1/4	—	—	45	60	26
1 1/2	1 1/2	1 1/2	1 1/2	—	—	50	65	31
2	2	2	2	—	—	58	74	34
2 1/2	2 1/2	2 1/2	(2 1/2)	—	—	69	88	42
3	3	3	(3)	—	—	78	98	48
4	4	4	(4)	—	—	96	118	60
(5)	—	(5)	—	—	—	115	—	75
(6)	—	(6)	—	—	—	131	—	91

18 Reducing elbows



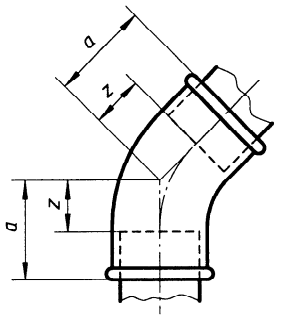
Elbows, reducing A1



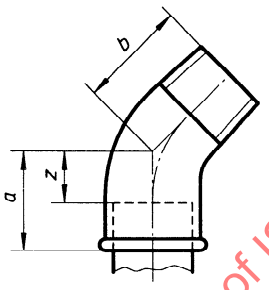
Male and female elbows, reducing A4

Fitting sizes		Dimensions mm			Laying lengths mm	
A1	A4	a	b	c	z_1	z_2
(3/8 × 1/4)	—	23	23	—	13	13
1/2 × 3/8	1/2 × 3/8	26	26	33	13	16
(3/4 × 3/8)	—	28	28	—	13	18
3/4 × 1/2	3/4 × 1/2	30	31	40	15	18
1 × 1/2	—	32	34	—	15	21
1 × 3/4	1 × 3/4	35	36	46	18	21
1 1/4 × 3/4	—	36	41	—	17	26
1 1/4 × 1	1 1/4 × 1	40	42	56	21	25
(1 1/2 × 1)	—	42	46	—	23	29
1 1/2 × 1 1/4	—	46	48	—	27	29
2 × 1 1/2	—	52	56	—	28	36
(2 1/2 × 2)	—	61	66	—	34	42

19 45° elbows



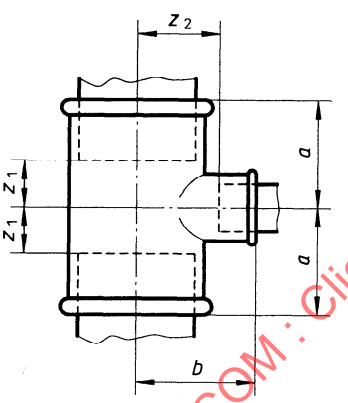
45° elbows A1/45°



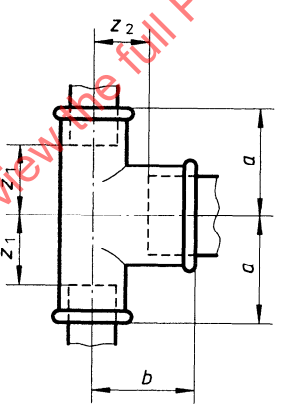
45° male and female elbows A4/45°

Fitting sizes		Dimensions mm		Laying lengths mm
A1 45°	A4 45°	*a*	*b*	*z*
3/8	3/8	20	25	10
1/2	1/2	22	28	9
3/4	3/4	25	32	10
1	1	28	37	11
1 1/4	1 1/4	33	43	14
1 1/2	1 1/2	36	46	17
2	2	43	55	19

20 Tees reducing or increasing on the branch



Tees reducing on the branch B1



Tees increasing on the branch B1

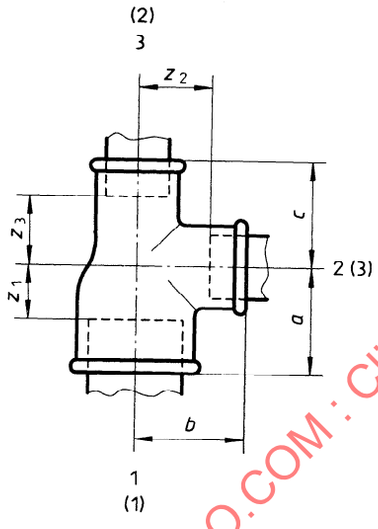
Tees reducing on the branch				
Fitting sizes	Dimensions mm		Laying lengths mm	
	a	b	z_1	z_2
3/8 × 1/4	23	23	13	13
1/2 × 1/4	24	24	11	14
1/2 × 3/8	26	26	13	16
(3/4 × 1/4)	26	27	11	17
3/4 × 3/8	28	28	13	18
3/4 × 1/2	30	31	15	18
(1 × 1/4)	28	31	11	21
1 × 3/8	30	32	13	22
1 × 1/2	32	34	15	21
1 × 3/4	35	36	18	21
(1 1/4 × 3/8)	32	36	13	26
1 1/4 × 1/2	34	38	15	25
1 1/4 × 3/4	36	41	17	26
1 1/4 × 1	40	42	21	25
1 1/2 × 1/2	36	42	17	29
1 1/2 × 3/4	38	44	19	29
1 1/2 × 1	42	46	23	29
1 1/2 × 1 1/4	46	48	27	29
2 × 1/2	38	48	14	35
2 × 3/4	40	50	16	35
2 × 1	44	52	20	35
2 × 1 1/4	48	54	24	35
2 × 1 1/2	52	55	28	36
2 1/2 × 1	47	60	20	43
2 1/2 × 1 1/4	52	62	25	43
2 1/2 × 1 1/2	55	63	28	44
2 1/2 × 2	61	66	34	42
3 × 1	51	67	21	50
(3 × 1 1/4)	55	70	25	51
3 × 1 1/2	58	71	28	52
3 × 2	64	73	34	49
3 × 2 1/2	72	76	42	49
4 × 2	70	86	34	62
4 × 3	84	92	48	62

NOTE — Method of designation of fitting sizes: see 13.2.4 a).

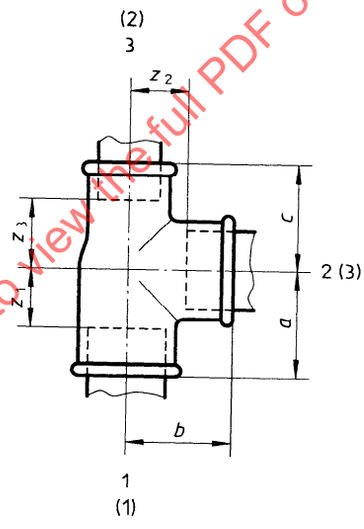
Tees increasing on the branch				
Fitting sizes	Dimensions mm		Laying lengths mm	
	a	b	z_1	z_2
3/8 × 1/2	26	26	16	13
1/2 × 3/4	31	30	18	15
(1/2 × 1)	34	32	21	15
3/4 × 1	36	35	21	18
(3/4 × 1 1/4)	41	36	26	17
1 × 1 1/4	42	40	25	21
(1 × 1 1/2)	46	42	29	23
1 1/4 × 1 1/2	48	46	29	27
(1 1/4 × 2)	54	48	35	24
1 1/2 × 2	55	52	36	28

NOTE — Method of designation of fitting sizes: see 13.2.4 a).

21 Tees reducing on the run



Tees reducing on the run and the branch B1



Tees reducing on the run and equal on the branch B1

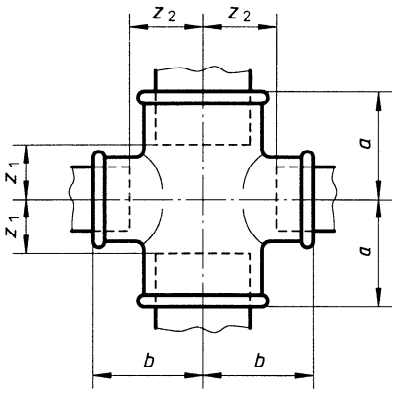
Tees reducing on the run and the branch																
Fitting sizes									Dimensions mm			Laying lengths mm		
Method a)				Method b)												
1	2		3	(1)	(2)		(3)		a	b	c	z_1	z_2	z_3
1/2	× 3/8	×	3/8	1/2	× 3/8	×	3/8		26	26	25	13	16	15
3/4	× 3/8	×	1/2	3/4	× 1/2	×	3/8		28	28	26	13	18	13
3/4	× 1/2	×	3/8	3/4	× 3/8	×	1/2		30	31	26	15	18	16
3/4	× 1/2	×	1/2	3/4	× 1/2	×	1/2		30	31	28	15	18	15
1	× 1/2	×	1/2	1	× 1/2	×	1/2		32	34	28	15	21	15
1	× 1/2	×	3/4	1	× 3/4	×	1/2		32	34	30	15	21	15
1	× 3/4	×	1/2	1	× 1/2	×	3/4		35	36	31	18	21	18
1	× 3/4	×	3/4	1	× 3/4	×	3/4		35	36	33	18	21	18
1 1/4	× 1/2	×	1	1 1/4	× 1	×	1/2		34	38	32	15	25	15
1 1/4	× 3/4	×	3/4	1 1/4	× 3/4	×	3/4		36	41	33	17	26	18
1 1/4	× 3/4	×	1	1 1/4	× 1	×	3/4		36	41	35	17	26	18
1 1/4	× 1	×	3/4	1 1/4	× 3/4	×	1		40	42	36	21	25	21
1 1/4	× 1	×	1	1 1/4	× 1	×	1		40	42	38	21	25	21
1 1/2	× 1/2	×	1 1/4	1 1/2	× 1 1/4	×	1/2		36	42	34	17	29	15
1 1/2	× 3/4	×	1 1/4	1 1/2	× 1 1/4	×	3/4		38	44	36	19	29	17
1 1/2	× 1	×	1	1 1/2	1		1		42	46	38	23	29	21
1 1/2	× 1	×	1 1/4	1 1/2	× 1 1/4	×	1		42	46	40	23	29	21
(1 1/2	× 1 1/4	×	1)	(1 1/2	× 1	×	1 1/4)		46	48	42	27	29	25
1 1/2	× 1 1/4	×	1 1/4	1 1/2	× 1 1/4	×	1 1/4		46	48	45	27	29	26
2	× 3/4	×	1 1/2	2	× 1 1/2	×	3/4		40	50	38	16	35	19
2	× 1	×	1 1/2	2	× 1 1/2	×	1		44	52	42	20	35	23
2	× 1 1/4	×	1 1/4	2	× 1 1/4	×	1 1/4		48	54	45	24	35	26
2	× 1 1/4	×	1 1/2	2	× 1 1/2	×	1 1/4		48	54	46	24	35	27
(2	× 1 1/2	×	1 1/4)	(2	× 1 1/4	×	1 1/2)		52	55	48	28	36	29
2	× 1 1/2	×	1 1/2	2	× 1 1/2	×	1 1/2		52	55	50	28	36	31

NOTE — Method of designation of fitting size: see 13.2.3.

Tees reducing on the run and equal on the branch																
Fitting sizes									Dimensions mm			Laying lengths mm		
Method a)				Method b)												
1	2		3	(1)	(2)		(3)		a	b	c	z_1	z_2	z_3
1/2	× 1/2	×	3/8	1/2	× 3/8	×	1/2		28	28	26	15	15	16
3/4	× 3/4	×	3/8	3/4	× 3/8	×	3/4		33	33	28	18	18	18
3/4	× 3/4	×	1/2	3/4	× 1/2	×	3/4		33	33	31	18	18	18
(1	× 1	×	3/8)	(1	× 3/8	×	1)		38	38	32	21	21	22
1	× 1	×	1/2	1	× 1/2	×	1		38	38	34	21	21	21
1	× 1	×	3/4	1	× 3/4	×	1		38	38	36	21	21	21
1 1/4	× 1 1/4	×	1/2	1 1/4	× 1/2	×	1 1/4		45	45	38	26	26	25
1 1/4	× 1 1/4	×	3/4	1 1/4	× 3/4	×	1 1/4		45	45	41	26	26	26
1 1/4	× 1 1/4		1	1 1/4	× 1	×	1 1/4		45	45	42	26	26	25
1 1/2	× 1 1/2	×	1/2	1 1/2	× 1/2	×	1 1/2		50	50	42	31	31	29
1 1/2	× 1 1/2	×	3/4	1 1/2	× 3/4	×	1 1/2		50	50	44	31	31	29
1 1/2	× 1 1/2	×	1	1 1/2	× 1	×	1 1/2		50	50	46	31	31	29
1 1/2	× 1 1/2	×	1 1/4	1 1/2	× 1 1/4	×	1 1/2		50	50	48	31	31	29
2	× 2	×	3/4	2	× 3/4	×	2		58	58	50	34	34	35
2	× 2	×	1	2	× 1	×	2		58	58	52	34	34	35
2	× 2	×	1 1/4	2	× 1 1/4	×	2		58	58	54	34	34	35
2	× 2	×	1 1/2	2	× 1 1/2	×	2		58	58	55	34	34	36

NOTE — Method of designation of fitting size: see 13.2.3.

22 Reducing crosses

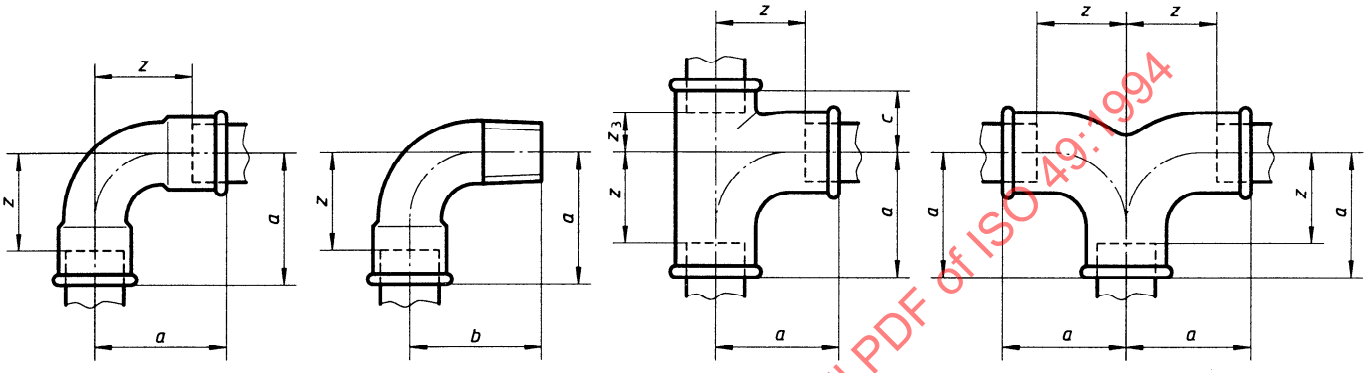


Crosses, reducing C1

Fitting sizes	Dimensions mm		Laying lengths mm	
	a	b	z_1	z_2
(1/2 × 3/8)	26	26	13	16
3/4 × 1/2	30	31	15	18
1 × 1/2	32	34	15	21
1 × 3/4	35	36	18	21
(1 1/4 × 3/4)	36	41	17	26
1 1/4 × 1	40	42	21	25
(1 1/2 × 1)	42	46	23	29

NOTE — Method of designation of fitting sizes: see 13.2.4 c).

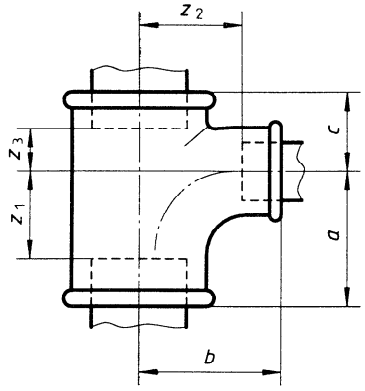
23 Short bends, pitcher tees and twin elbows



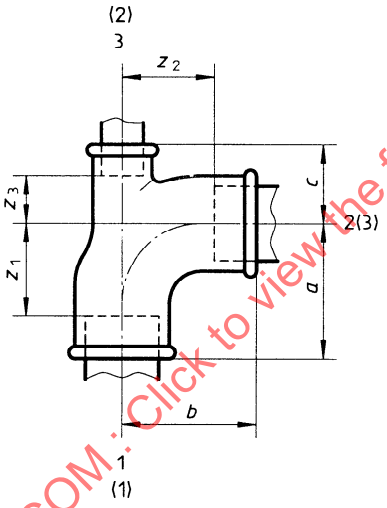
Short bends D1 — Male and female short bends D4 — Pitcher tees E1 — Twin elbows E2

Fitting sizes				Dimensions mm		Laying lengths mm	
D1	D4	E1	E2	$a = b$	c	z	z_3
1/4	1/4	—	—	30	—	20	—
3/8	3/8	3/8	3/8	36	19	26	9
1/2	1/2	1/2	1/2	45	24	32	11
3/4	3/4	3/4	3/4	50	28	35	13
1	1	1	1	63	33	46	16
1 1/4	1 1/4	1 1/4	1 1/4	76	40	57	21
1 1/2	1 1/2	1 1/2	1 1/2	85	43	66	24
2	2	2	2	102	53	78	29

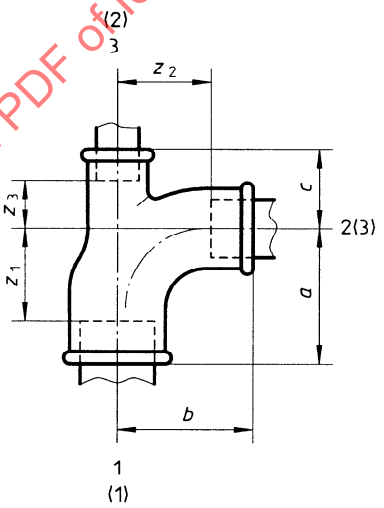
24 Reducing pitcher tees



Pitcher tees reducing on the branch E1



Pitcher tees reducing on the run E1



Pitcher tees reducing on the branch and run E1

Pitcher tees reducing to the branch							
Fitting sizes	Dimensions mm			Laying lengths mm			
	a	b	c	z_1	z_2	z_3
3/4 × 1/2	47	48	25	32	35	10
1 × 1/2	49	51	28	32	38	11
1 × 3/4	53	54	30	36	39	13
1 1/4 × 1/2	51	56	30	32	43	11
1 1/4 × 3/4	55	58	33	36	43	14
1 1/4 × 1	66	68	36	47	51	17
(1 1/2 × 3/4)	55	61	33	36	46	14
(1 1/2 × 1)	66	71	36	47	54	17
(1 1/2 × 1 1/4)	77	79	41	58	60	22
(2 × 1)	70	77	40	46	60	16
(2 × 1 1/4)	80	85	45	56	66	21
(2 × 1 1/2)	91	94	48	67	75	24

NOTE — Method of designation of fitting sizes: see 13.2.4 a).

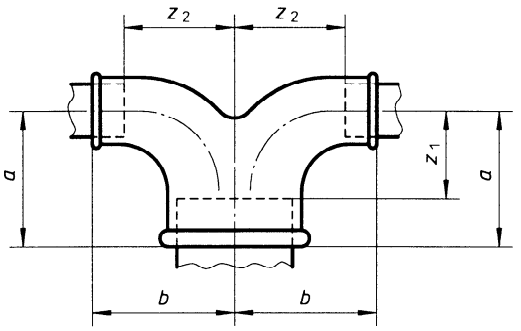
Pitcher tees reducing on the run									
Fitting sizes						Dimensions mm			Laying lengths mm		
Method a)			Method b)			a	b	c	z_1	z_2	z_3
1	2	3	(1)	(2)	(3)						
3/4	**× 3/4**	**× 1/2**	**3/4**	**× 1/2**	**× 3/4**	50	50	27	35	35	14

NOTE — Method of designation of fitting sizes: see 13.2.3.

Pitcher tees reducing on the branch and run											
Fitting sizes						Dimensions mm			Laying lengths mm		
Method a)			Method b)			a	b	c	z_1	z_2	z_3
1	2	3	(1)	(2)	(3)						
3/4	**× 1/2**	**× 1/2**	**3/4**	**× 1/2**	**× 1/2**	47	48	24	32	35	11
1	**× 1/2**	**× 3/4**	**1**	**× 3/4**	**× 1/2**	49	51	25	32	38	10
1	**× 3/4**	**× 3/4**	**1**	**× 3/4**	**× 3/4**	53	54	28	36	39	13

NOTE — Method of designation of fitting sizes: see 13.2.3.

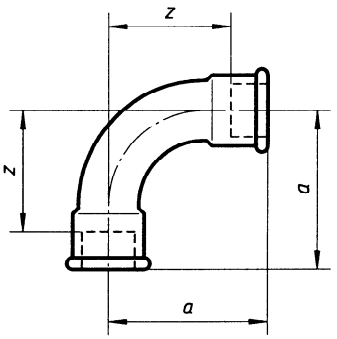
25 Reducing twin elbows



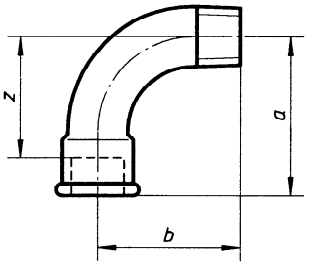
Twin elbows, reducing E2

Fitting sizes	Dimensions mm		Laying lengths mm	
	a	b	z_1	z_2
(3/4 × 1/2)	47	48	32	35
(1 × 3/4)	53	54	36	39
(1 1/4 × 1)	66	68	47	51
(1 1/2 × 1 1/4)	77	79	58	60
(2 × 1 1/2)	91	94	67	75
NOTE — Method of designation of fitting sizes: see 13.2.4 b).				

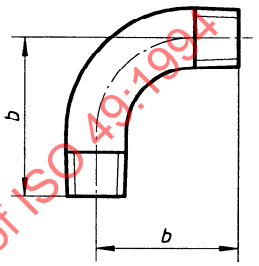
26 Long sweep bends



Long sweep bends G1



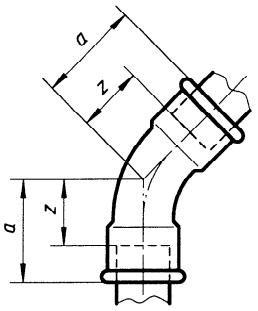
Male and female long sweep bends G4



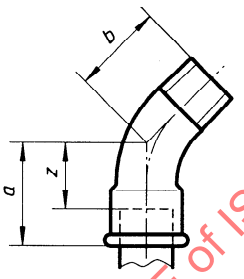
Male long sweep bends G8

Fitting sizes			Dimensions mm		Laying lengths mm
G1	G4	G8	*a*	*b*	*z*
—	(1/8)	—	35	32	28
1/4	1/4	—	40	36	30
3/8	3/8	(3/8)	48	42	38
1/2	1/2	1/2	55	48	42
3/4	3/4	3/4	69	60	54
1	1	1	85	75	68
1 1/4	1 1/4	(1 1/4)	105	95	86
1 1/2	1 1/2	(1 1/2)	116	105	97
2	2	(2)	140	130	116
2 1/2	(2 1/2)	—	176	165	149
3	(3)	—	205	190	175
4	(4)	—	260	245	224

27 45° long sweep bends



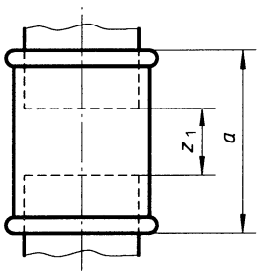
45° long sweep bends G1/45°



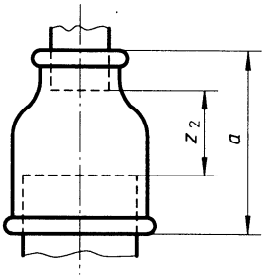
45° male and female long sweep bends G4/45°

Fitting sizes		Dimensions mm		Laying lengths mm
G1/45°	G4/45°	*a*	*b*	*z*
—	(1/4)	26	21	16
(3/8)	3/8	30	24	20
1/2	1/2	36	30	23
3/4	3/4	43	36	28
1	1	51	42	34
1 1/4	1 1/4	64	54	45
1 1/2	1 1/2	68	58	49
2	2	81	70	57
(2 1/2)	(2 1/2)	99	86	72
(3)	(3)	113	100	83

28 Sockets



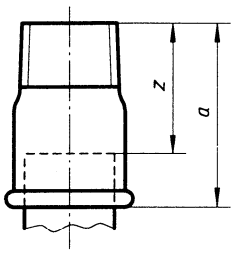
Sockets M2
Sockets, right- and left-hand thread M2 R-L



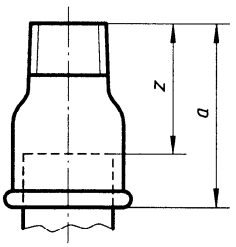
Sockets, reducing M2

Fitting sizes			Dimensions mm	Laying lengths mm	
M2	M2 R-L	M2 reducing	a	z_1	z_2
1/8	—	—	25	11	—
1/4	—	1/4 × 1/8	27	7	10
3/8	3/8	(3/8 × 1/8) 3/8 × 1/4	30	10	13 10
1/2	1/2	1/2 × 1/4 1/2 × 3/8	36	10	13 13
3/4	3/4	(3/4 × 1/4) 3/4 × 3/8 3/4 × 1/2	39	9	14 14 11
1	1	1 × 3/8 1 × 1/2 1 × 3/4	45	11	18 15 13
1 1/4	1 1/4	1 1/4 × 1/2 1 1/4 × 3/4 1 1/4 × 1	50	12	18 16 14
1 1/2	1 1/2	(1 1/2 × 1/2) 1 1/2 × 3/4 1 1/2 × 1 1 1/2 × 1 1/4	55	17	23 21 19 17
2	2	(2 × 1/2) (2 × 3/4) 2 × 1 2 × 1 1/4 2 × 1 1/2	65	17	28 26 24 22 22
2 1/2	—	(2 1/2 × 1 1/4) (21/2 × 1 1/2) (2 1/2 × 2)	74	20	28 28 23
3	—	(3 × 1 1/2) (3 × 2) (3 × 2 1/2)	80	20	31 26 23
4	—	(4 × 2) (4 × 2 1/2) (4 × 3)	94	22	34 31 28
(5)	—	—	109	29	—
(6)	—	—	120	40	—

29 Male and female sockets



Male and female sockets M4

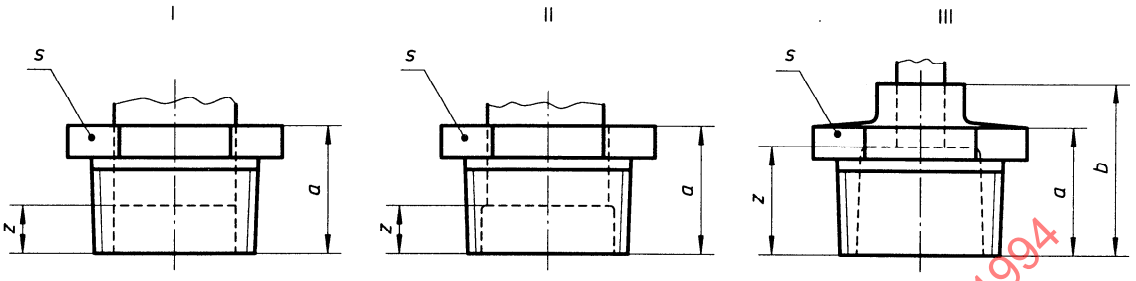


Male and female sockets, reducing M4

Fitting sizes		Dimensions mm	Laying lengths mm
M4	M4 reducing	*a*	*z*
3/8	3/8 × 1/4	35	25
1/2	1/2 × 1/4 1/2 × 3/8	43	30
3/4	(3/4 × 3/8) 3/4 × 1/2	48	33
1	1 × 1/2 1 × 3/4	55	38
1 1/4	1 1/4 × 3/4 1 1/4 × 1	60	41
—	1 1/2 × 1 1 1/2 × 1 1/4	63	44
—	(2 × 1 1/4) (2 × 1 1/2)	70	46

30 Bushings

Widths across flats, s, are left to the discretion of the manufacturer.



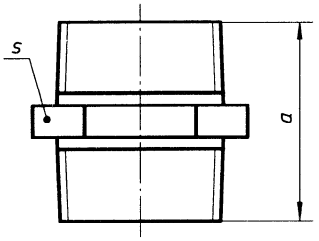
Bushings N4

Fitting sizes	Patterns	Dimensions mm		Laying lengths mm
		a	*b*	*z*
1/4 × 1/8	I	20	—	13
3/8 × 1/8	II	20	—	13
3/8 × 1/4	I	20	—	10
1/2 × 1/8	II	24	—	17
1/2 × 1/4	II	24	—	14
1/2 × 3/8	I	24	—	14
3/4 × 1/4	II	26	—	16
3/4 × 3/8	II	26	—	16
3/4 × 1/2	I	26	—	13
1 × 1/4	II	29	—	19
1 × 3/8	II	29	—	19
1 × 1/2	II	29	—	16
1 × 3/4	I	29	—	14
1 1/4 × 3/8	II	31	—	21
1 1/4 × 1/2	II	31	—	18
1 1/4 × 3/4	II	31	—	16
1 1/4 × 1	I	31	—	14
(1 1/2 × 3/8)	II	31	—	21
1 1/2 × 1/2	II	31	—	18
1 1/2 × 3/4	II	31	—	16
1 1/2 × 1	II	31	—	14
1 1/2 × 1 1/4	I	31	—	12

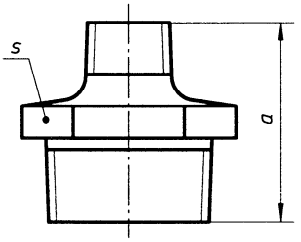
Fitting sizes	Patterns	Dimensions mm		Laying lengths mm
		a	*b*	*z*
2 × 1/2	III	35	48	35
2 × 3/4	III	35	48	33
2 × 1	II	35	—	18
2 × 1 1/4	II	35	—	16
2 × 1 1/2	II	35	—	16
2 1/2 × 1	III	40	54	37
2 1/2 × 1 1/4	III	40	54	35
2 1/2 × 1 1/2	II	40	—	21
2 1/2 × 2	II	40	—	16
3 × 1	III	44	59	42
3 × 1 1/4	III	44	59	40
3 × 1 1/2	III	44	59	40
3 × 2	II	44	—	20
3 × 2 1/2	II	44	—	17
4 × 2	III	51	69	45
4 × 2 1/2	III	51	69	42
4 × 3	II	51	—	21

31 Hexagon nipples

Widths across flats, s, are left to the discretion of the manufacturer.



Hexagon nipples N8
Hexagon nipples, right- and left-hand thread N8 R-L



Hexagon nipples, reducing N8

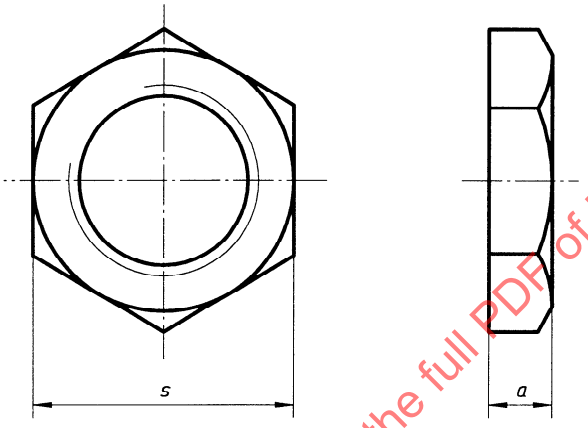
Fitting sizes			Dimensions mm
N8	N8 R-L	N8 reducing	a
1/8	—	—	29
1/4	—	—	36
3/8	—	3/8 × 1/4	38
1/2	1/2	1/2 × 1/4 1/2 × 3/8	44
3/4	3/4	3/4 × 3/8 3/4 × 1/2	47
1	(1)	1 × 1/2 1 × 3/4	53
1 1/4	—	(1 1/4 × 1/2) 1 1/4 × 3/4 1 1/4 × 1	57
1 1/2	—	(1 1/2 × 3/4) 1 1/2 × 1 1 1/2 × 1 1/4	59
2	—	(2 × 1) 2 × 1 1/4 2 ×1 1/2	68
2 1/2	—	(2 1/2 × 2)	75
3	—	(3 × 2) (3 × 2 1/2)	83
4	—	—	95

32 Backnuts

Backnuts may be plain or recessed, and one face may be machined.

Widths across flats, s, are left to the discretion of the manufacturer.

Threads: in accordance with ISO 228-1.



Backnuts P4

Fitting sizes	Dimensions mm
	a min.
1/4	6
3/8	7
1/2	8
3/4	9
1	10
1 1/4	11
1 1/2	12
2	13
2 1/2	16
3	19