

INTERNATIONAL
STANDARD

ISO
8434-2

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**Metallic tube connections for fluid power
and general use —**

Part 2:
37° flared fittings

*Raccords de tubes métalliques pour transmissions hydrauliques et
pneumatiques et applications générales —*

Partie 2: Raccords évasés à 37°



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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 8434-2 was prepared jointly by Technical Committees ISO/TC 5, *Ferrous metal pipes and metallic fittings* and ISO/TC 131, *Fluid power systems*, Subcommittee SC 4, *Connectors and similar products and components*.

This first edition, together with ISO 8434-1, cancels and replaces ISO 8434:1986, which has been technically revised.

ISO 8434 consists of the following parts, under the general title *Metallic tube connections for fluid power and general use*:

- Part 1: *24 degree compression fittings*
- Part 2: *37 degree flared fittings*
- Part 3: *O-ring face seal fittings*
- Part 4: *24 degree cone connectors with O-ring weld-on nipples*
- Part 5: *Test methods for threaded hydraulic fluid power connectors*

Annex A of this part of ISO 8434 is for information only.

Introduction

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. In general applications, a fluid may be conveyed under pressure. Components may be connected through their ports by connections (fittings), tubes and hoses. Tubes are rigid conductors; hoses are flexible conductors.

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Metallic tube connections for fluid power and general use —

Part 2: 37° flared fittings

1 Scope

This part of ISO 8434 specifies general and dimensional requirements for the design and performance of 37° flared fittings which are suitable for use with ferrous and non-ferrous tubes with outside diameters from 6 mm to 50 mm, inclusive. These fittings are for use in fluid power and general applications within the limits of pressure and temperature specified in this part of ISO 8434.

They are intended for the connection of tubes and hose fittings to ports in accordance with ISO 6149-1, ISO 1179-1 and ISO 11926-1.

NOTES

- 1 For new designs in hydraulic fluid power applications, see the requirements given in 9.6.
- 2 For use under conditions outside the pressure and/or temperature limits specified, see 5.4.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8434. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this

part of ISO 8434 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 228-1:1994, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 261:—¹⁾, *ISO general-purpose metric screw threads — General plan.*

ISO 263:1973, *ISO inch screw threads — General plan and selection for screws, bolts and nuts — Diameter range 0.06 to 6 in.*

ISO 274:1975, *Copper tubes of circular section — Dimensions.*

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts.*

ISO 725:1978, *ISO inch screw threads — Basic dimensions.*

ISO 1127:1992, *Stainless steel tubes — Dimensions, tolerances and conventional masses per unit length.*

1) To be published. (Revision of ISO 261:1973)

ISO 1179-1:—²⁾, *Connections for general use and fluid power — Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing — Part 1: Threaded ports.*

ISO 1179-3:—²⁾, *Connections for general use and fluid power — Ports and stud ends with ISO 228-1 threads with elastomeric or metal-to-metal sealing — Part 3: Light-duty (L series) stud ends with sealing by O-ring with retaining ring (types G and H).*

ISO 3304:1985, *Plain end seamless precision steel tubes — Technical conditions for delivery.*

ISO 4759-1:1978, *Tolerances for fasteners — Part 1: Bolts, screws and nuts with thread diameters between 1,6 (inclusive) and 150 mm (inclusive) and product grades A, B and C.*

ISO 5598:1985, *Fluid power systems and components — Vocabulary.*

ISO 5864:1993, *ISO inch screw threads — Allowances and tolerances.*

ISO 6149-1:1993, *Connections for fluid power and general use — Ports and stud ends with ISO 261 threads and O-ring sealing — Part 1: Ports with O-ring seal in truncated housing.*

ISO 6149-3:1993, *Connections for fluid power and general use — Ports and stud ends with ISO 261 threads and O-ring sealing — Part 3: Light-duty (L series) stud ends — Dimensions, design, test methods and requirements.*

ISO 6508:1986, *Metallic materials — Hardness test — Rockwell test (scales A - B - C - D - E - F - G - H - K).*

ISO 8434-1:1994, *Metallic tube connections for fluid power and general use — Part 1: 24 degree compression fittings.*

ISO 9227:1990, *Corrosion tests in artificial atmospheres — Salt spray tests.*

ISO 11926-1:—²⁾, *Connections for general use and fluid power — Ports and stud ends with ISO 725 threads and O-ring sealing — Part 1: Threaded ports.*

ISO 11926-3:—²⁾, *Connections for general use and fluid power — Ports and stud ends with ISO 725 threads and O-ring sealing — Part 3: Light-duty (L series) stud ends.*

2) To be published.

3 Definitions

For the purposes of this part of ISO 8434, the definitions given in ISO 8434-1 and ISO 5598 and the following definitions apply.

3.1 adjustable stud end: Stud end connector that allows for fitting orientation through final tightening of the locknut to complete the connection. This type of stud end is typically used on shaped fittings (e.g. tees, crosses and elbows).

3.2 non-adjustable stud end: Stud end connector that does not require specific orientation before final tightening of the connection because it is only used on straight fittings.

4 Requirements for materials

Figure 1 shows the cross-section and component parts of a typical fitting.

4.1 Fitting bodies

Bodies shall be manufactured from carbon steel, stainless steels or copper alloys which will provide the minimum requirements for the pressure/temperature ratings specified in clause 5. They shall have characteristics which make them suitable for use with the fluid to be conveyed and to provide an effective joint.

4.2 Nuts

Nuts to be used with carbon steel bodies shall be made of carbon steel and those for use with stainless steel bodies shall be made of stainless steel, unless otherwise specified. Nuts to be used with copper alloy bodies shall be made of a material similar to the bodies.

4.3 Sleeves

Sleeves shall be manufactured from a material similar to the bodies.

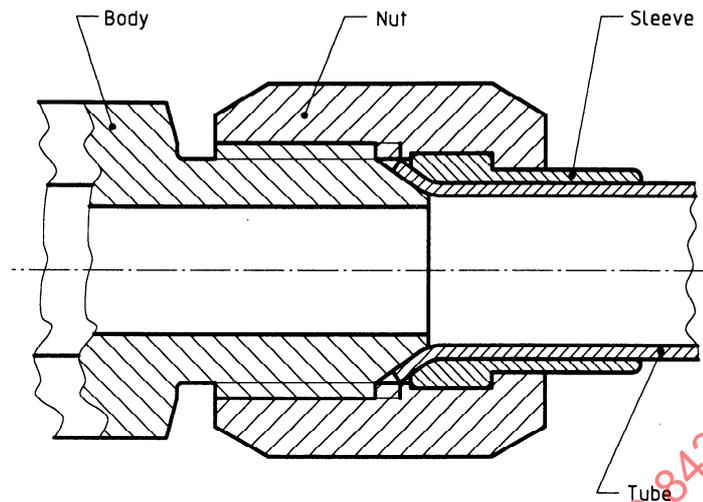


Figure 1 — Cross-section of a typical 37° flared fitting

5 Pressure/temperature requirements

5.1 Flared fittings made of carbon steel complying with this part of ISO 8434 shall be suitable for use at the working pressures given in table 1 when used at fluid temperatures between -20 °C and $+120\text{ °C}$. Such fittings shall be suitable for use in hydraulic systems at temperatures from -40 °C to $+150\text{ °C}$.

5.2 Fittings made of stainless steel complying with this part of 8434 shall be suitable for use at the working pressures given in table 1 when used at temperatures between -60 °C and $+50\text{ °C}$. Pressure deratings of fittings made from stainless steel and used at elevated temperatures shall be

4 % at $+50\text{ °C}$,

11 % at $+100\text{ °C}$, and

20 % at $+200\text{ °C}$.

5.3 Copper alloy fittings shall be suitable for use at the working pressures given in table 1 when used at temperatures between -40 °C and $+175\text{ °C}$.

5.4 For applications under conditions outside the pressure and/or temperature limits given in table 1 and in 5.1 to 5.3, the manufacturer shall be consulted.

5.5 The fitting assembly shall not leak or fail when hydrostatically tested at four times the applicable recommended working pressure specified in table 1. Testing shall be conducted at room temperature.

5.6 The pressure/temperature requirements given in table 1 and in 5.1 to 5.5 are for tube and hose connections and fitting bodies only. For port and stud end pressure/temperature requirements, the values specified in the respective port and stud end standards shall apply.

5.7 To achieve these maximum working pressures with a 4:1 design factor, the maximum tubing wall thickness shown in table 1 shall be used.

Table 1 — Working pressures for 37° flared fittings and tubes

Tube outside diameter (OD)			Wall thickness of tube for flaring ¹⁾		Working pressure			
Metric ²⁾	Inch		Metric tube	Inch tube	Carbon steel and stainless steel		Copper alloy ³⁾	
mm	in	mm ⁴⁾	mm	mm	MPa	(bar) ⁵⁾	MPa	(bar)
6	1/4	6,35	1,5	1,65	35	(350)	20	(200)
8	5/16	7,94	1,5	1,65	35	(350)	20	(200)
10	3/8	9,52	1,5	1,65	25	(250)	16	(160)
12	1/2	12,7	2	2,1	25	(250)	16	(160)
16	5/8	15,88	2,5	2,41	20	(200)	12,5	(125)
20	3/4	19,05	3	2,76	20	(200)	12,5	(125)
25	1	25,4	3	3,05	16	(160)	10	(100)
32	1 1/4	31,75	3	3,05	12,5	(125)	8	(80)
38	1 1/2	38,1	3	3,05	10	(100)	6,3	(63)
50	2	50,8	3,5	3,4	8	(80)	5	(50)

NOTE — For dynamic conditions or working pressure applications higher than those given in table 1, the manufacturer shall be consulted.

1) Maximum wall thickness which can be flared, due to fitting design.

2) Metric tubing shall be used for new and future designs.

3) The pressure values for copper alloy fittings and tubes were produced using brass fittings with phosphorized soft annealed copper tubing.

4) Equivalent dimensions in millimetres.

5) 1 bar = 10^5 N/m² = 10^5 Pa = 0,1 MPa

6 Designation of fittings

6.1 Fittings shall be designated by an alphanumeric code to facilitate ordering. They shall be designated by ISO 8434-2, followed by a spaced hyphen, then the fitting style letter symbols (see 6.2), followed by a spaced hyphen, and, for the ends, the outside diameter of the tube with which they are to be connected, each separated by a multiplication sign (×). For stud ends (connector ends), the thread designation of the stud end shall be added.

EXAMPLE

A straight stud fitting with an M16 thread, in accordance with ISO 6149-3, to be connected to a 12 mm OD tube is designated as follows:

ISO 8434-2 - SDS - 12 × M16

6.2 The letter symbol designation of the fitting style shall have two parts: the connection end type, immediately followed by the shape of the fitting.

6.3 Tube ends are assumed to be male and thus do not need to be included in the code. However, if another type of end is involved, it shall be designated.

6.4 Reducing fittings (figure 2) and reducing elbows (figure 3) shall be designated by specifying the larger tube end first.

6.5 Stud fittings (figure 4) shall be designated by specifying the tube end first, then the thread size for the stud end.

6.6 For tee fittings (figures 5 and 6), the order of designation of the connection ends shall be from larger to smaller on the run, followed by the branch end.

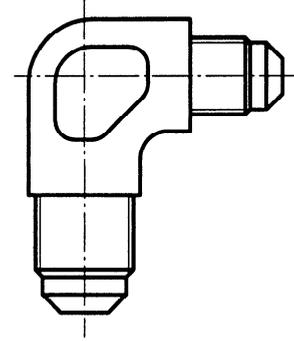
6.7 For cross fittings, the order of designation of the connection ends shall be from left to right, followed by top to bottom, with the larger ends on the left and at the top.

6.8 The following letter symbols shall be used:

Connection end type	Letter
Bulkhead	BH
Swivel	SW
Port	P
Stud	SD
Reducing	RE

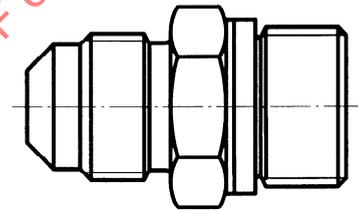
Shape	Letter
Straight	S
Elbow	E
45° elbow	E45
Tee	T
Run tee	RT
Branch tee	BT
Cross	K

Component type	Letter
Nut	N
Sleeve	SL
Locknut	LN
Plug	PL
Cap	CP
Nipple	NP
Metric	M
Inch	I



ISO 8434-2 - REE - 20 × 12

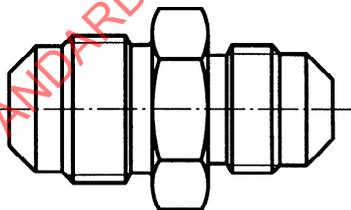
Figure 3 — Reducing elbow



ISO 8434-2 - SDS - 20 × G 3/4 A

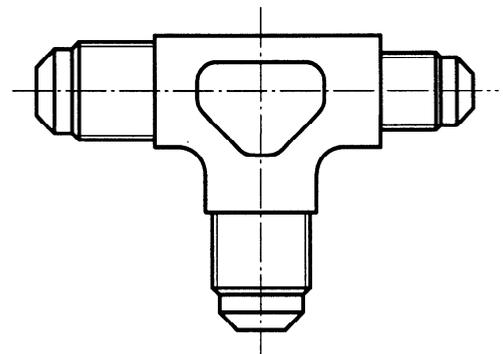
Figure 4 — Stud fitting

Examples of flared fittings and designations are given in figures 2 to 6.



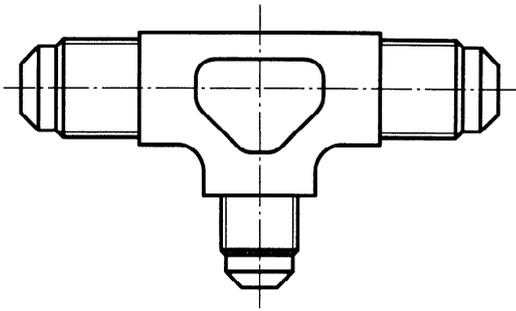
ISO 8434-2 - RES - 20 × 12

Figure 2 — Reducing fitting



ISO 8434-2 - RERT - 20 × 12 × 20

Figure 5 — Reducing run tee



ISO 8434-2 - REBT - 20 × 20 × 12

Figure 6 — Reducing branch tee

7 Requirements for tubes

The fittings shall be suitable for use with tubes with limits of outside diameter as given in tables 2 and 3. These limits include ovality.

Metric tubing shall be preferred. Metric and inch tubing shall comply with the relevant dimensions given in tables 1 and 3. All steel tubing to be flared shall comply with delivery condition R37 NBK as specified in ISO 3304 and shall have a minimum elongation of 35 % in 50 mm and a maximum hardness of 65 HRB (see ISO 6508).

Carbon steel tubes shall (except for dimensions of inch tubes) comply with ISO 3304 (cold-drawn, and annealed or normalized). Stainless steel tubes shall (except for dimensions of inch tubes) comply with ISO 1127 (cold-drawn and annealed or normalized). Copper alloy tubes shall (except for dimensions of inch tubes) comply with ISO 274 (as-drawn or half-hard).

Table 2 — Metric tube sizes

Tube OD mm	Limits of OD mm	
	min.	max.
6	5,9	6,1
8	7,9	8,1
10	9,9	10,1
12	11,9	12,1
16	15,9	16,1
20	19,9	20,1
25	24,9	25,1
32	31,85	32,15
38	37,85	38,15
50	49,8	50,2

NOTE — Metric tubing shall be preferred.

Table 3 — Inch tube sizes

Tube OD		Limits of OD	
in	mm ¹⁾	mm	
		min.	max.
1/4	6,35	6,25	6,45
5/16	7,94	7,84	8,04
3/8	9,52	9,42	9,62
1/2	12,7	12,60	12,80
5/8	15,88	15,78	15,98
3/4	19,05	18,95	19,15
1	25,4	25,30	25,50
1 1/4	31,75	31,60	31,90
1 1/2	38,1	37,95	38,25
2	50,8	50,60	51,00

1) Equivalent dimensions in millimetres.

8 Across-flats dimensions

8.1 The dimensions across flats for nuts and on the bodies of the fittings shall be those given in tables 7 to 17. For sizes up to and including 24 mm, tolerances for across-flats dimensions shall be $^0_{-0,8}$ mm, and for sizes larger than 24 mm they shall be $^0_{-1}$ mm.

8.2 Hex tolerances across flats shall be in accordance with ISO 4759-1:1978, product grade C. Minimum across-corner hex dimensions are 1,092 times the width across flats. The minimum side flat is 0,43 times the nominal width across flats. Unless otherwise specified or shown, hex corners shall be chamfered 15° to 30° to a diameter equal to the width across flats, with a tolerance of $^0_{-0,4}$ mm.

9 Design

9.1 Fittings

The fittings shall conform to the requirements given in figures 7 to 20 and tables 4 to 17.

9.2 Dimensions

Dimensions specified apply to finished parts, including any plating or other treatments. The tolerance value for all dimensions not otherwise limited shall be $\pm 0,4$ mm. The sealing seats of fittings shall be concentric with straight thread pitch diameters within 0,25 mm full indicator movement (FIM).

9.3 Passage tolerances

Where passages in straight fittings are machined from opposite ends, the offset at the meeting point shall

not exceed 0,4 mm. No cross-sectional area at a junction of passages shall be less than that of the smallest passage.

9.4 Angular tolerances

Angular tolerances on axis of ends of elbows, tees and crosses shall be $\pm 2,5^\circ$ for fittings for tube sizes 10 mm and less, and $\pm 1,5^\circ$ for all larger sizes.

9.5 Contour details

Details of contour shall be chosen by the manufacturer provided the dimensions given in tables 3 to 16 are maintained. Wrench flats on elbows and tees shall conform to the dimensions given in the relevant tables. Abrupt reduction of a section shall be avoided. Junctions of small external sections and adjoining sections that are relatively heavy shall be blended by means of ample fillets.

9.6 Ports and stud ends

These fittings are intended for the connection of plain end tubes and hose fittings to ports in accordance with ISO 6149-1, ISO 1179-1 or ISO 11926-1. For new designs in hydraulic fluid power applications, only ports and stud ends in accordance with the relevant parts of ISO 6149 shall be used. Ports and stud ends in accordance with the relevant parts of ISO 1179 and ISO 11926 shall not be used for new designs in hydraulic fluid power applications.

10 Screw threads

10.1 Tube flare ends

The screw threads on the flare ends of the fittings shall be ISO inch screw thread in accordance with ISO 725.

Threads shall be chamfered at the face of the fitting to an included angle of 45° . The diameter of the chamfer shall be equal to the minor diameter of the thread, with a tolerance of ${}^0_{-0,4}$ mm.

10.2 Stud ends (connection ends)

The thread for stud ends (connection ends) of fittings shall be chosen from ISO 261 for ISO 6149-3 stud ends, ISO 228-1 (class A) for ISO 1179-3 stud ends or from ISO 725 for ISO 11926-3 stud ends. The dimensions of the stud ends shall comply with the requirements given in tables 10 to 14 and the relevant stud end standards.

NOTE 3 Parallel threads require an undercut with a sealing washer, O-ring or similar device to ensure a leakproof joint, unless the stud end undercut is designed for metal-to-metal sealing.

11 Manufacture

11.1 Construction

Carbon steel fittings made from multiple components shall be bonded together with materials having a melting point of not less than 1 000 °C.

11.2 Workmanship

Workmanship shall conform to the best commercial practice to produce high-quality fittings. Fittings shall be free from visual contaminants, all hanging burrs, loose scale and slivers which might be dislodged in use and any other defects that might affect the function of the parts. All machined surfaces shall have a surface roughness value of $R_a \leq 6,3 \mu\text{m}$, except where otherwise noted.

11.3 Finish

The external surfaces and threads on all fittings shall be protected with an appropriate coating to pass a minimum 72-h neutral salt spray test in accordance with ISO 9227, unless otherwise agreed upon by the manufacturer and user. Any appearance of red rust during the salt spray test shall be considered failure. Fluid passages shall be excluded from the plating or coating requirements but shall be protected from rust.

11.4 Fitting protection

By a method agreed between the manufacturer and user, the face of the fittings and threads (both internal and external) shall be protected by the manufacturer from nicks and scratches that would be detrimental to the fitting's function. Passages shall be securely covered to prevent the entrance of dirt or other contaminants. Nuts and sleeves that are furnished separately from the fitting shall be protected from rust but do not require capping.

11.5 Corners

Unless otherwise noted, all sharp corners shall be broken to 0,15 mm max.

12 Assembly instruction

The assembly of the fittings with the connecting tubes shall be carried out without external loads.

The manufacturer shall draw up assembly instructions for the use of the fittings. These instructions shall include at least the following:

- details relating to the material and quality of suitable tubes;
- details concerning the preparation of the selected tube;
- instructions regarding the assembly of the fitting, such as the number of wrenching turns or assembly torque;
- recommendations regarding the tools to be used for assembly.

13 Procurement information

The following information should be supplied by the purchaser when making an inquiry or placing an order:

- description of fitting;
- material of fitting;
- material and size of tube;

- fluid to be conveyed;
- working pressure;
- working temperature.

14 Marking of components

Fitting bodies and nuts shall be permanently marked with the manufacturer's name, trademark or code identifier, unless otherwise agreed by the user and manufacturer. Nuts shall also be marked with the tube outside diameter.

15 Identification statement (Reference to this part of ISO 8434)

Use the following statement in test reports, catalogues and sales literature when electing to comply with this part of ISO 8434;

"Dimensions and design for 37° flared metallic fittings in accordance with ISO 8434-2:1994, *Metallic tube connections for fluid power and general use — Part 2: 37 degree flared fittings.*"

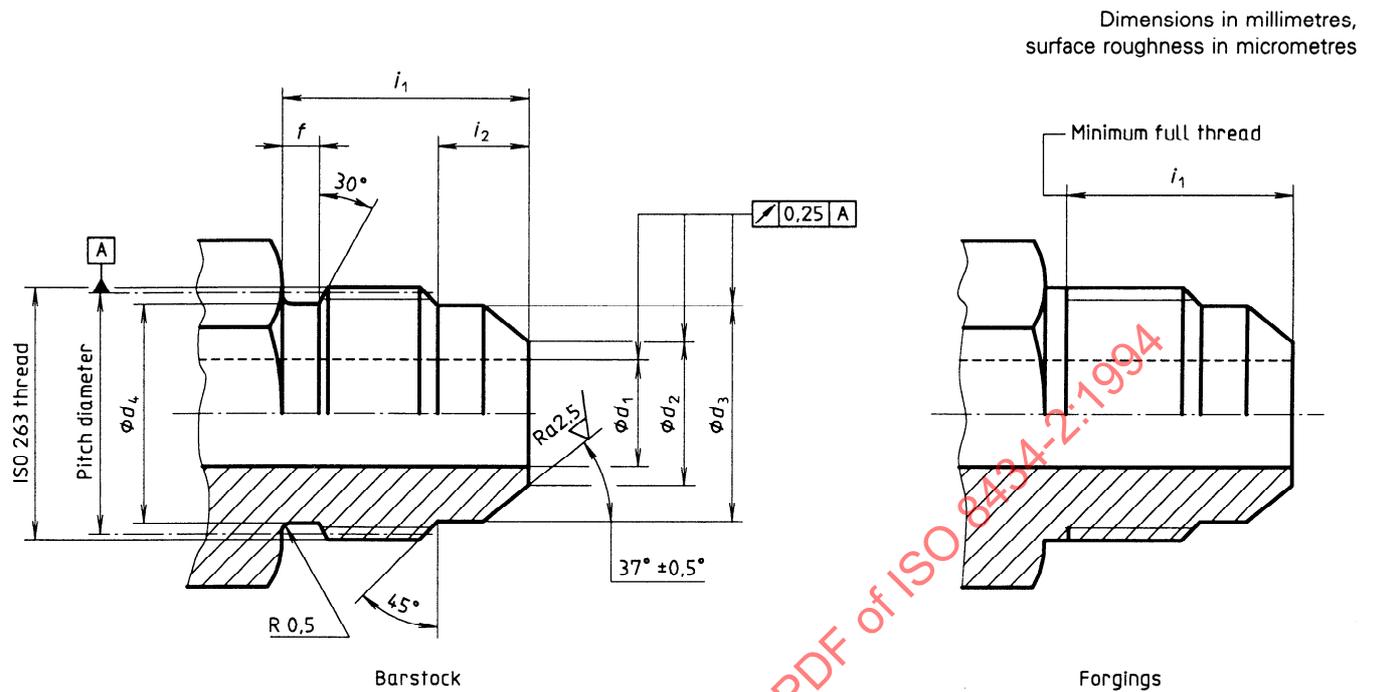


Figure 7 — 37° flared fitting connection

Table 4 — Dimensions of 37° flared fitting connections

Dimensions in millimetres

Tube OD	ISO 263 thread ¹⁾	d_1 H13 ²⁾	d_2 $\pm 0,08$	d_3 $\begin{matrix} 0 \\ -0,13 \end{matrix}$	d_4 $\begin{matrix} +0,05 \\ -0,25 \end{matrix}$	f $\pm 0,2$	i_1 $\pm 0,4$	i_2 $\pm 0,2$
6	7/16 - 20 UNF	4,4	4,9	9,12	9,25	2,1	14	5,1
8	1/2 - 20 UNF	6	6,48	10,69	10,85	2,1	14	5,1
10	9/16 - 18 UNF	7,5	8,08	12,09	12,24	2,3	14,1	5,2
12	3/4 - 16 UNF	9,9	10,82	16,61	16,76	2,6	16,7	6,6
16	7/8 - 14 UNF	12,3	13,69	19,48	19,63	2,9	19,3	7
20	1 1/16 - 12 UN	15,5	16,87	23,82	24	3,4	21,9	8,2
25	1 5/16 - 12 UN	21,5	23,19	30,18	30,35	3,4	23,1	8,2
32	1 7/8 - 12 UN	27,5	29,13	38,12	38,28	3,4	24,3	9,5
38	2 - 12 UN	33	35,08	44,45	44,6	3,4	27,5	9,8
50	2 1/2 - 12 UN	45	47,75	60,32	60,48	3,4	33,9	11,9

1) For basic dimensions of threads, see ISO 725; also see provisions for screw threads in ISO 5864, class 2A.

2) See ISO 286-2.

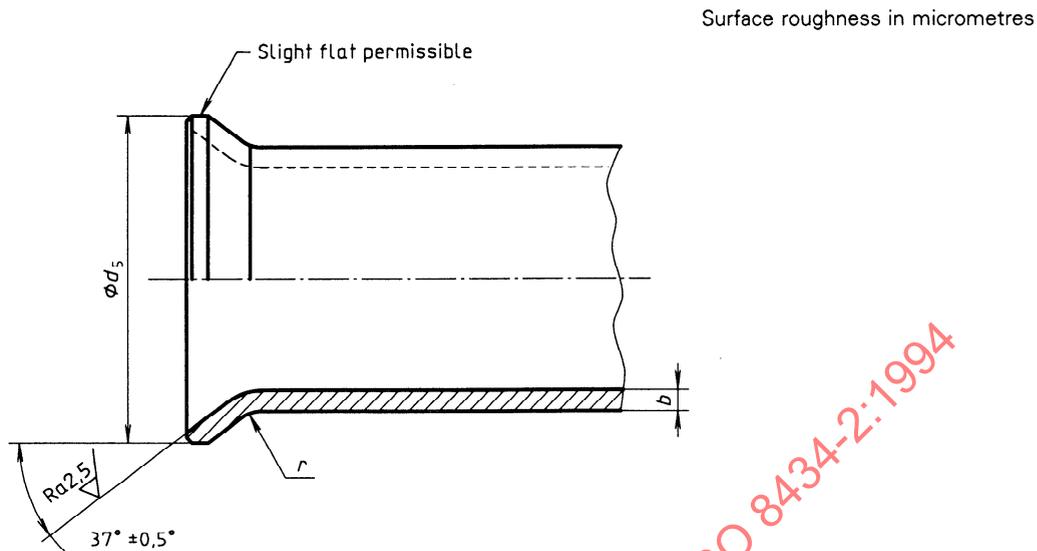


Figure 8 — 37° flare for tubes

Table 5 — Dimensions of 37° flare for metric and inch tubes

Dimensions in millimetres

Metric ¹⁾	Tube OD		b_{max}		d_5		r ± 0,5
	Inch in	mm ²⁾	Metric tube	Inch tube	min.	max.	
6	1/4	6,35	1,5	1,65	8,6	9,1	0,8
8	5/16	7,94	1,5	1,65	10,2	10,9	0,8
10	3/8	9,52	1,5	1,65	11,7	12,4	1
12	1/2	12,7	2	2,1	16,0	16,8	1,5
16	5/8	15,88	2,5	2,41	19,3	20,1	1,5
20	3/4	19,05	3	2,76	23,4	24,1	2
25	1	25,4	3	3,05	29,7	30,5	2,3
32	1 1/4	31,75	3	3,05	37,6	38,4	2,3
38	1 1/2	38,1	3	3,05	43,2	43,9	2,8
50	2	50,8	3,5	3,4	59,2	59,9	2,8

1) Metric tubing shall be preferred for new and future designs.

2) Equivalent dimensions in millimetres.

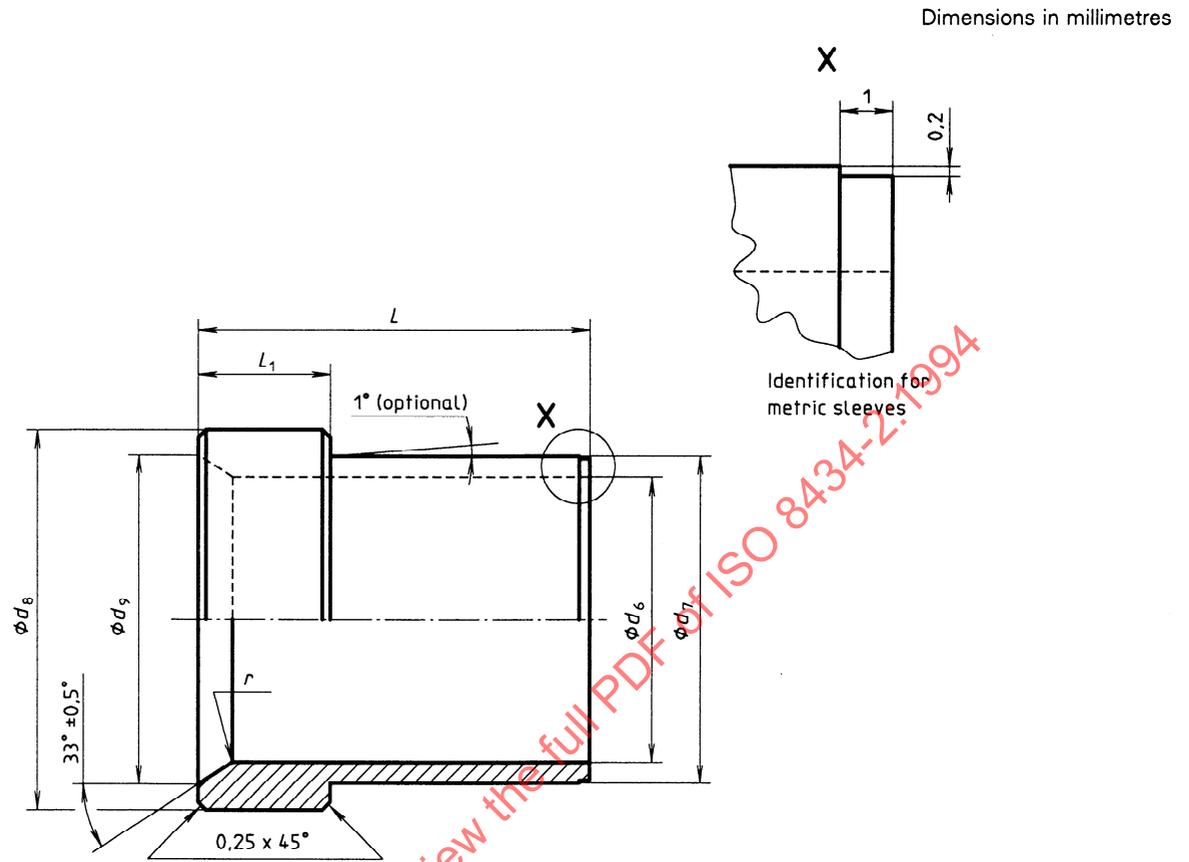


Figure 9 — Sleeves — MSL (for metric tubing) and ISL (for inch tubing)

Table 6 — Dimensions of sleeves for metric and inch tubing

Dimensions in millimetres

Metric tubing ¹⁾ Tube OD	Inch tubing		d_6 ± 0,05	d_7 ± 0,05	d_8 ± 0,05	d_9 ± 0,1	L ± 1	L_1 ± 0,5	r ± 0,3	
	d_6 ± 0,05	Tube OD mm ²⁾								
6	6,18	1/4	6,35	6,53	7,5	9,65	8	10,4	3,6	0,8
8	8,18	5/16	7,94	8,13	9,25	11,25	9,5	11,2	4,1	
10	10,18	3/8	9,52	9,73	10,95	12,7	11,2	12,7	4,3	1,2
12	12,18	1/2	12,7	12,88	14,25	17,25	15	14,2	5,6	1,6
16	16,2	5/8	15,88	16,08	17,45	20,2	17,9	16,8	6,1	
20	20,2	3/4	19,05	19,28	20,95	24,6	22,4	17,3	6,6	2
25	25,2	1	25,4	25,6	27,45	30,95	28,7	19,8	7,1	2,4
32	32,3	1 1/4	31,75	32,05	33,95	38,9	35,9	23,1	7,9	
38	38,4	1 1/2	38,1	38,4	40,85	42,25	41,4	28,4	8,6	2,8
50	50,4	2	50,8	51,21	54,75	61,1	55,8	30,2	10,4	

1) Metric tubing shall be preferred for new and future designs.

2) Equivalent dimensions in millimetres.

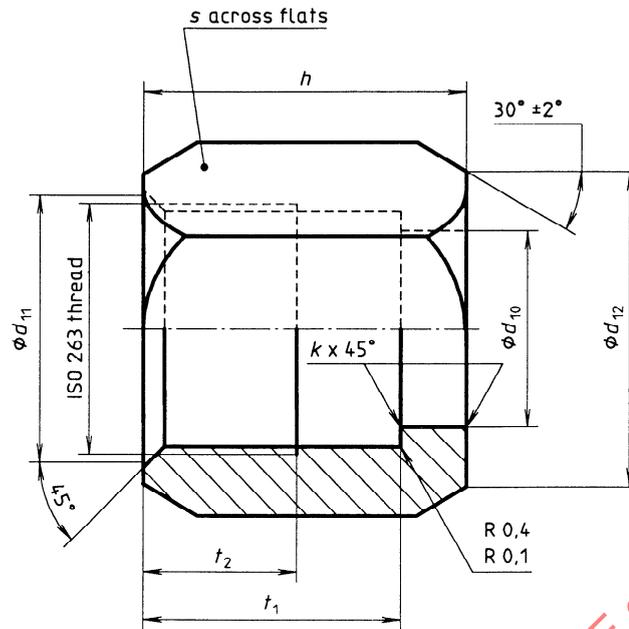


Figure 10 — Tube nut (N)

Table 7 — Dimensions of tube nuts

Dimensions in millimetres

Tube OD	ISO 263 thread ¹⁾	Thread minor diameter		d_{10}		d_{11}	d_{12}	h	k	s	t_1	t_2
		min.	max.	nom.	tol.	$\pm 0,2$	$\pm 0,3$	$\pm 0,3$	$\pm 0,1$		$\pm 0,3$	min.
6	7/16 - 20 UNF	9,86	9,99	7,72	$+0,10$ 0	11,5	13,5	15,5	0,15	14	13,5	7,5
8	1/2 - 20 UNF	11,46	11,59	9,47		13	16,5	17	0,15	17	14,7	8,3
10	9/16 - 18 UNF	12,90	13,03	11,15		14,6	18,5	18,3	0,25	19	15,3	8,3
12	3/4 - 16 UNF	17,48	17,61	14,43		19,4	21,5	21,3	0,25	22	18,4	9,4
16	7/8 - 14 UNF	20,42	20,55	17,68	$+0,13$ 0	22,6	26,5	24,6	0,25	27	20,8	11,6
20	1 1/16 - 12 UN	24,87	25,00	21,13		27,3	31,5	25,9	0,25	32	22	11,8
25	1 5/16 - 12 UN	31,22	31,35	27,61		33,7	40,5	28,4	0,25	41	24,4	14,2
32	1 5/8 - 12 UN	39,14	39,27	34,14	$+0,15$ 0	41,6	49,5	31	0,25	50	25,8	14,2
38	1 7/8 - 12 UN	45,49	45,62	41		48	59,5	35,8	0,25	60	29,7	16,7
50	2 1/2 - 12 UN	61,37	61,50	54,97		63,8	74,5	44,2	0,4	75	37,1	21,3

1) For basic dimensions of threads, see ISO 725, except that the minimum thread minor diameter is increased by 0,15 mm for all sizes; refer to the thread minor diameter column in this table; also see provisions for screw threads in ISO 5864, class 2B.

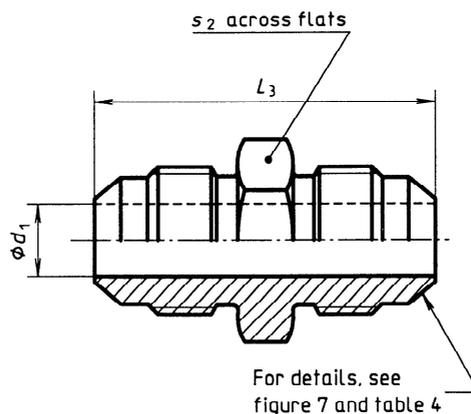


Figure 11 — Straight union fitting (S)

Table 8 — Dimensions of straight union fittings

Dimensions in millimetres

Tube OD	ISO 263 thread ¹⁾	d_1 H13	s_2	L_3 $\pm 0,8$
6	7/16 - 20 UNF	4,4	12	35
8	1/2 - 20 UNF	6	14	35
10	9/16 - 18 UNF	7,5	17	36
12	3/4 - 16 UNF	9,9	19	41
16	7/8 - 14 UNF	12,3	24	48
20	1 1/16 - 12 UN	15,5	27	55
25	1 5/16 - 12 UN	21,5	36	57
32	1 5/8 - 12 UN	27,5	46	61,5
38	1 7/8 - 12 UN	33	50	70
50	2 1/2 - 12 UN	45	65	86,5

1) For basic dimensions of threads, see ISO 725; also see provisions for screw threads in ISO 5864, class 2A.

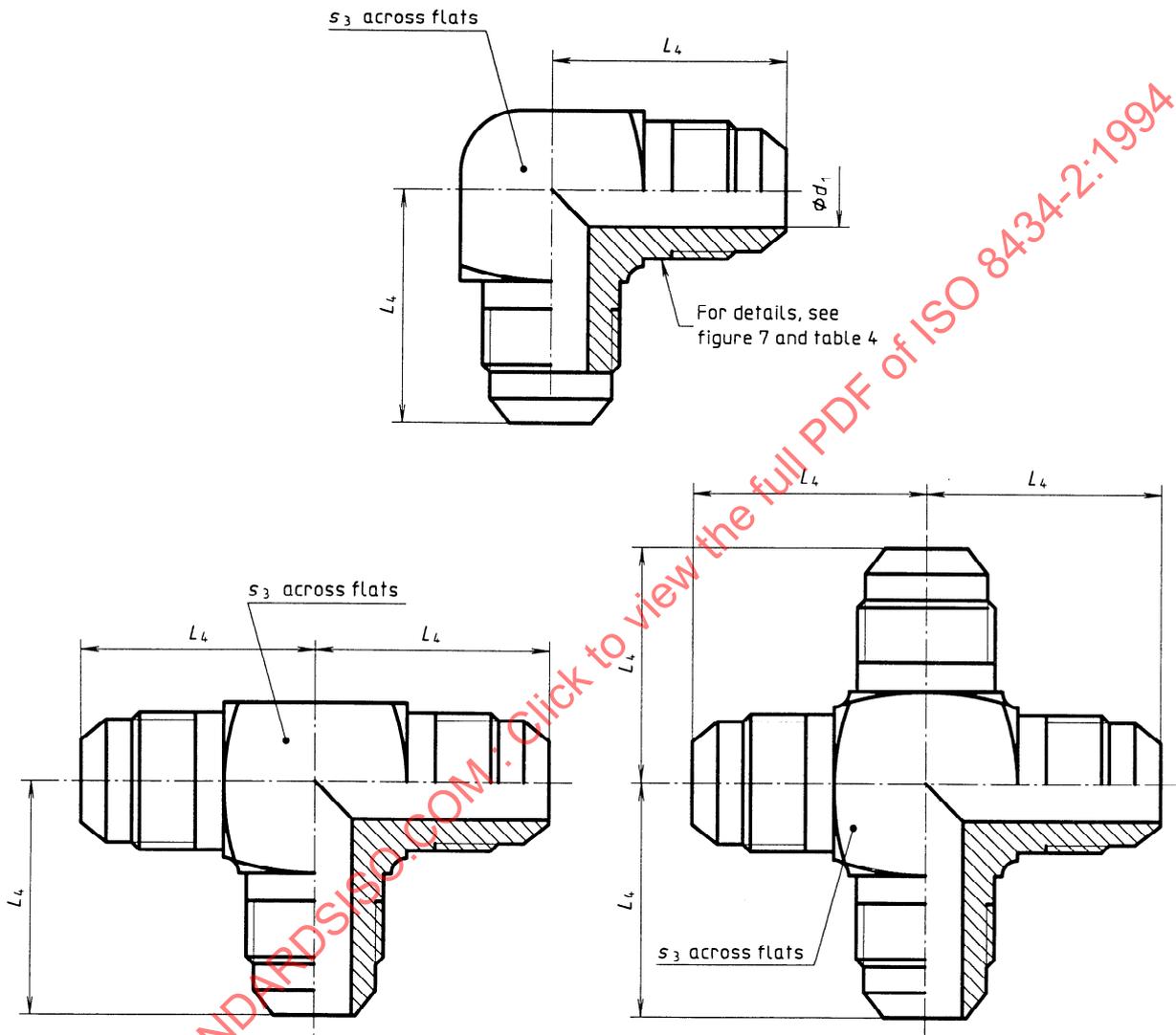


Figure 12 — Elbow (E), tee (T) and cross (K) union fittings

Table 9 — Dimensions of elbow, tee and cross union fittings

Dimensions in millimetres

Tube OD	ISO 263 thread ¹⁾	d_1	L_4	s_3	
		H13	± 1	Forged fitting	Fitting machined from barstock
6	7/16 - 20 UNF	4,4	22,5	12	14
8	1/2 - 20 UNF	6	24	13	17
10	9/16 - 18 UNF	7,5	27	14	22
12	3/4 - 16 UNF	9,9	32	19	22
16	7/8 - 14 UNF	12,3	37	22	30
20	1 1/16 - 12 UN	15,5	42	27	36
25	1 5/16 - 12 UN	21,5	46	33	41
32	1 5/8 - 12 UN	27,5	52,5	41	55
38	1 7/8 - 12 UN	33	59	48	60
50	2 1/2 - 12 UN	45	77,5	65	85

1) For basic dimensions of threads, see ISO 725; also see provisions for screw threads in ISO 5864, class 2A.

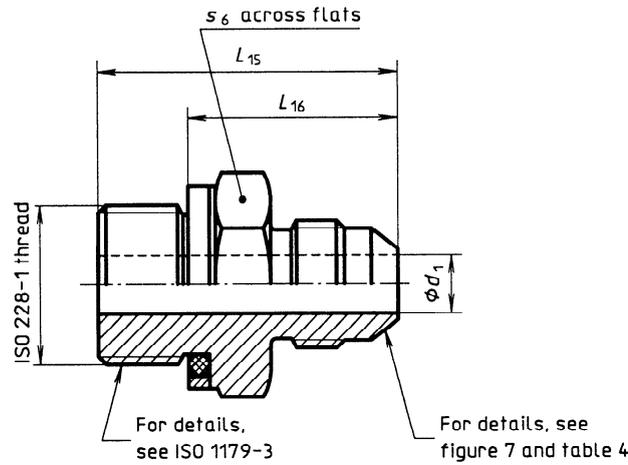


Figure 13 — Stud fitting (SDS) with ISO 1179-3 non-adjustable stud ends

Table 10 — Dimensions of stud fittings with ISO 1179-3 non-adjustable stud ends

Dimensions in millimetres

Tube OD	ISO 228-1 thread	d_1 H13	L_{15} $\pm 0,8$	L_{16} ref.	s_6
6	G 1/8 - A	4,4	29	22,5	14
8	G 1/4 - A	6	32	22,5	19
10	G 1/4 - A	7,5	32	22,5	19
12	G 3/8 - A	9,9	36	26,5	22
16	G 1/2 - A	12,3	44	31	27
20	G 3/4 - A	15,5	47,5	35	36
25	G 1 - A	21,5	53,5	37,5	41
32	G 1 1/4 - A	27,5	57	41	50
38	G 1 1/2 - A	33	61	45	55
50	G 2 - A	45	—	45,5	70

NOTES

- 1 Sealing method in accordance with manufacturer's recommendation.
- 2 Fittings with non-adjustable stud ends in accordance with ISO 1179-3 shall not be used for new designs in hydraulic fluid power applications.

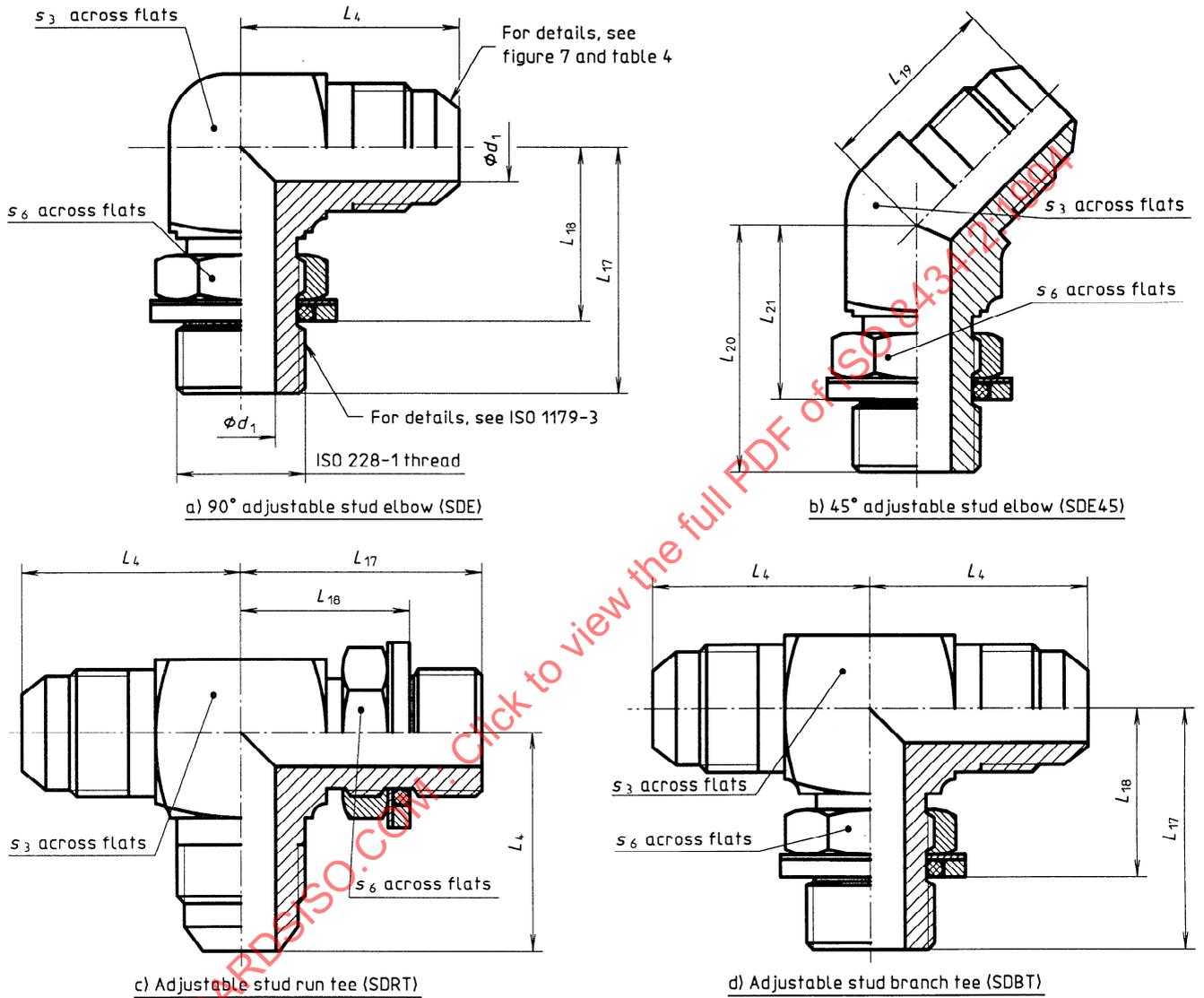


Figure 14 — Stud fittings with ISO 1179-3 adjustable stud ends

Table 11 — Dimensions of stud fittings with ISO 1179-3 adjustable stud ends

Dimensions in millimetres

Tube OD	ISO 228-1 thread	d_1 H13	L_4 ± 1	L_{17} ± 1	L_{18} ref.	L_{19} ± 1	L_{20} ± 1	L_{21} ref.	s_3	s_6
6	G 1/8 - A	4,4	22,5	26,5	20	18,5	26,5	20	12	14
8	G 1/4 - A	6	24	32	21,5	19,5	26,5	20	14	19
10	G 1/4 - A	7,5	27	32	21,5	21	29	19,5	14	19
12	G 3/8 - A	9,9	32	37	26,5	25	33	23,5	19	22
16	G 1/2 - A	12,3	37	43	30	28	38,5	25,5	22	27
20	G 3/4 - A	15,5	42	49,5	36,5	32,5	44	31	27	36
25	G 1 - A	21,5	46	52	36	37,5	47	31	33	41
32	G 1 1/4 - A	27,5	52,5	57	41	40,5	48	32	41	50
38	G 1 1/2 - A	33	59	60,5	44,5	45	48	32	48	55
50	G 2 - A	45	77,5	—	—	56,5	47	31	65	70

NOTE — Fittings with stud ends in accordance with ISO 1179-3 shall not be used for new designs in hydraulic fluid power applications.

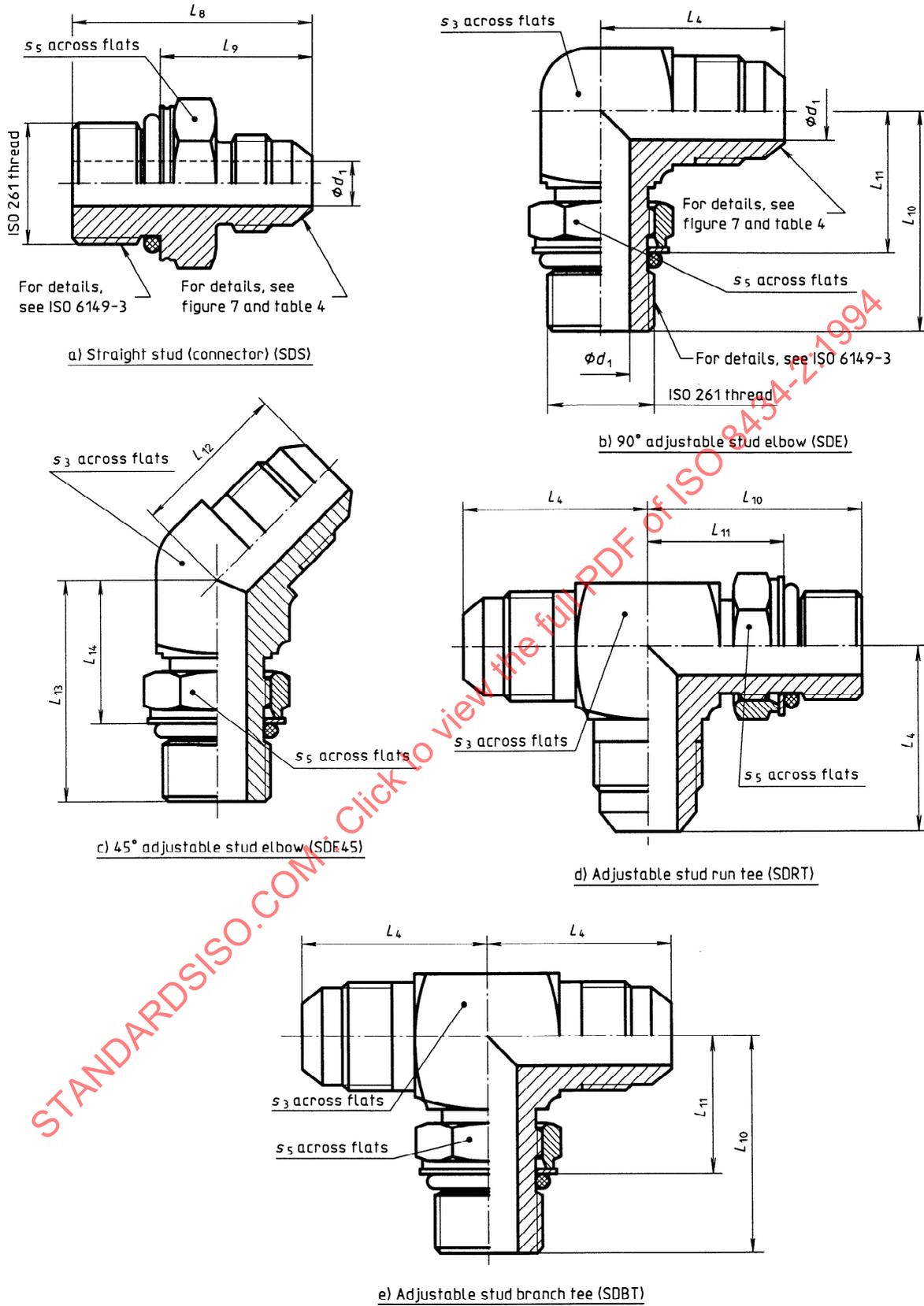


Figure 15 — Stud fittings with ISO 6149-3 adjustable and non-adjustable stud ends

Table 12 — Dimensions of stud fittings with ISO 6149-3 non-adjustable and adjustable stud ends

Dimensions in millimetres

Tube OD	ISO 261 thread	d_1 H13	L_4 ± 1	L_8 $\pm 0,8$	L_9 ref.	L_{10} ± 1	L_{11} ref.	L_{12} ± 1	L_{13} ± 1	L_{14} ref.	s_3	s_5
6	M10 × 1,5	4,4	22,5	30	21	27	18	18,5	27	18	12	14
8	M12 × 1,5	6	24	31	21	30,5	20,5	19,5	27	18	13	17
10	M14 × 1,5	7,5	27	31	21	33,5	23,5	21	28	18	14	19
12	M16 × 1,5	9,9	32	36	24	38	26,5	25	33	21,5	19	22
16	M22 × 1,5	12,3	37	43,5	29,5	42,5	28,5	28	37,5	23,5	22	27
20	M27 × 2	15,5	42	49,5	32,5	51	34	32,5	46	29	27	32
25	M33 × 2	21,5	46	51,5	34,5	53	36	37,5	45,5	28,5	33	41
32	M42 × 2	27,5	52,5	55,5	38	58	40,5	40,5	47,5	30	41	50
38	M48 × 2	33	59	61	41,5	63,5	44	45	49,5	30	48	55
50	M60 × 2	45	77,5	—	—	78	57	56,5	50	28,5	65	65

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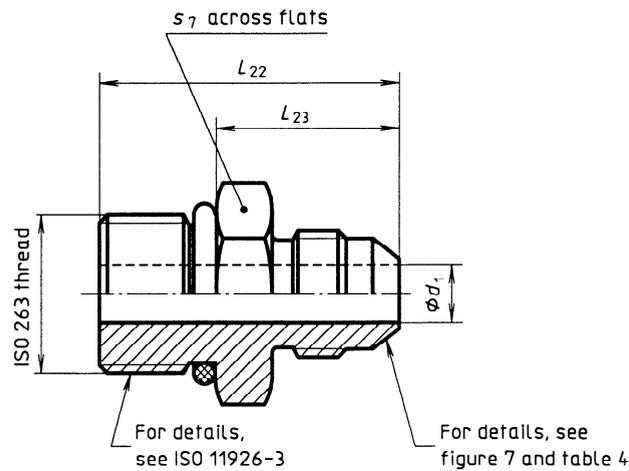


Figure 16 — Stud fitting (SDS) with ISO 11926-3 non-adjustable stud ends

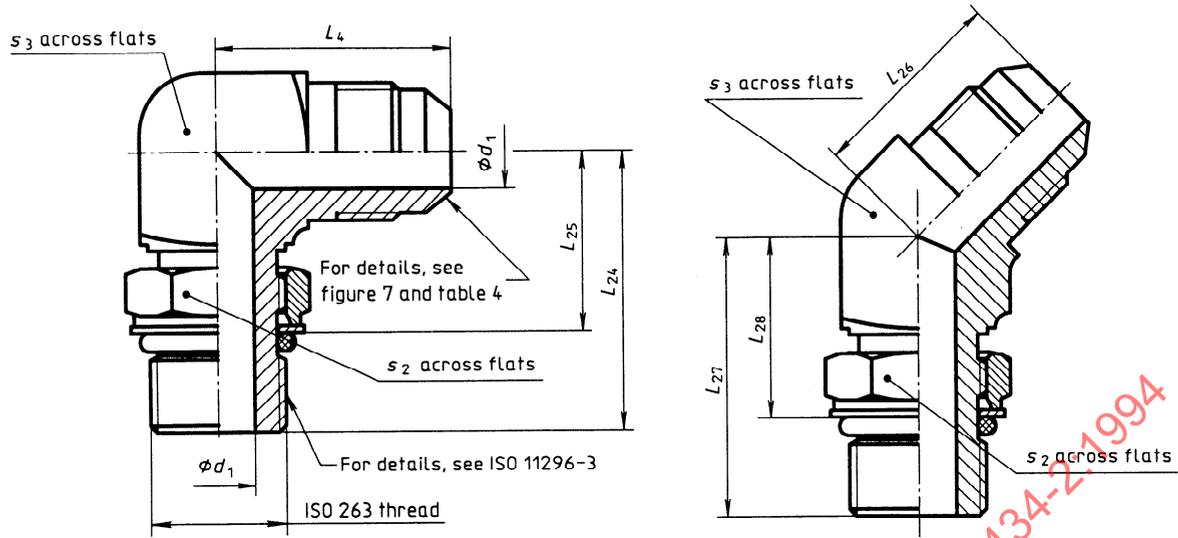
Table 13 — Dimensions of stud fittings with ISO 11926-3 non-adjustable stud ends

Dimensions in millimetres

Tube OD	ISO 263 thread ¹⁾	d_1 H13	L_{22} $\pm 0,8$	L_{23} ref.	s_7
6	7/16 - 20 UNF	4,4	31	22	14
8	1/2 - 20 UNF	6	31	22	17
10	9/16 - 18 UNF	7,5	33	23	17
12	3/4 - 16 UNF	9,9	37,5	26,5	22
16	7/8 - 14 UNF	12,3	43	30,5	27
20	1 1/16 - 12 UN	15,5	50	35	32
25	1 5/16 - 12 UN	21,5	52	36,5	41
32	1 5/8 - 12 UN	27,5	55	40	50
38	1 7/8 - 12 UN	33	60	45	55
50	2 1/2 - 12 UN	45	70,5	55,5	70

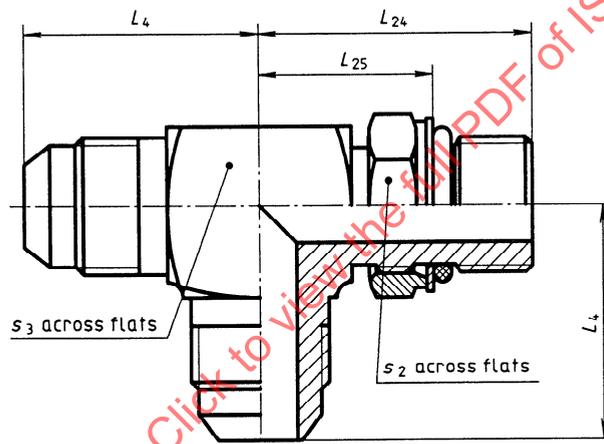
NOTE — Fittings with non-adjustable stud ends in accordance with ISO 11926-3 shall not be used for new designs in hydraulic fluid power applications.

1) For basic dimensions of threads, see ISO 725; also see provisions for screw threads in ISO 5864, class 2A.

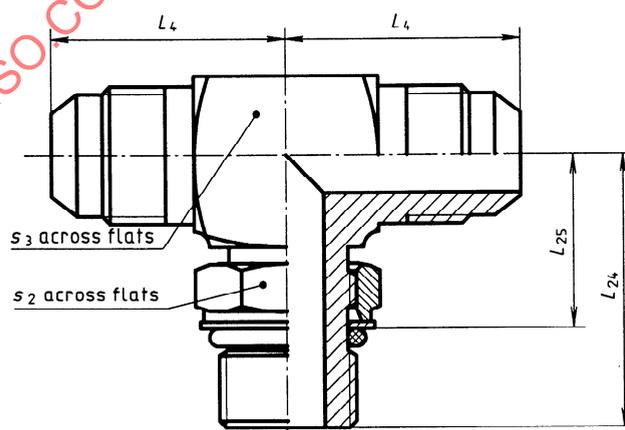


a) 90° adjustable stud elbow (SDE)

b) 45° adjustable stud elbow (SDE45)



c) Adjustable stud run tee (SDRT)



d) Adjustable stud branch tee (SDBT)

Figure 17 — Stud fittings with ISO 11296-3 adjustable stud ends

Table 14 — Dimensions of stud fittings with ISO 11926-3 adjustable stud ends

Dimensions in millimetres

Tube OD	ISO 263 thread ¹⁾	d_1	L_4	L_{24}	L_{25}	L_{26}	L_{27}	L_{28}	s_2	s_3	
		H13	± 1	± 1	ref.	± 1	± 1	ref.		Forged fitting	Fitting machined from barstock
6	7/16 - 20 UNF	4,4	22,5	26	16,5	18,5	26,5	17	14	12	14
8	1/2 - 20 UNF	6	24	28,5	18	19,5	26,5	17	17	13	17
10	9/16 - 18 UNF	7,5	27	32	21	21	29	17,5	17	14	22
12	3/4 - 16 UNF	9,9	32	37	24,5	25	33	20,5	22	19	22
16	7/8 - 14 UNF	12,3	37	43	29	28	38,5	24,5	27	22	30
20	1 1/16 - 12 UN	15,5	42	49,5	33	32,5	44	27,5	32	27	36
25	1 5/16 - 12 UN	21,5	46	52	35,5	37,5	47	30,5	41	33	41
32	1 5/8 - 12 UN	27,5	52,5	57	40,5	40,5	48,5	32	50	41	55
38	1 7/8 - 12 UN	33	59	60,5	44	45	48,5	32	55	48	60
50	2 1/2 - 12 UN	45	77,5	73,5	57	56,5	47	30,5	70	65	85

NOTE — Fittings with stud ends in accordance with ISO 11926-3 shall not be used for new designs in hydraulic fluid power applications.

1) For basic dimensions of threads, see ISO 725; also see provisions for screw threads in ISO 5864, class 2A.

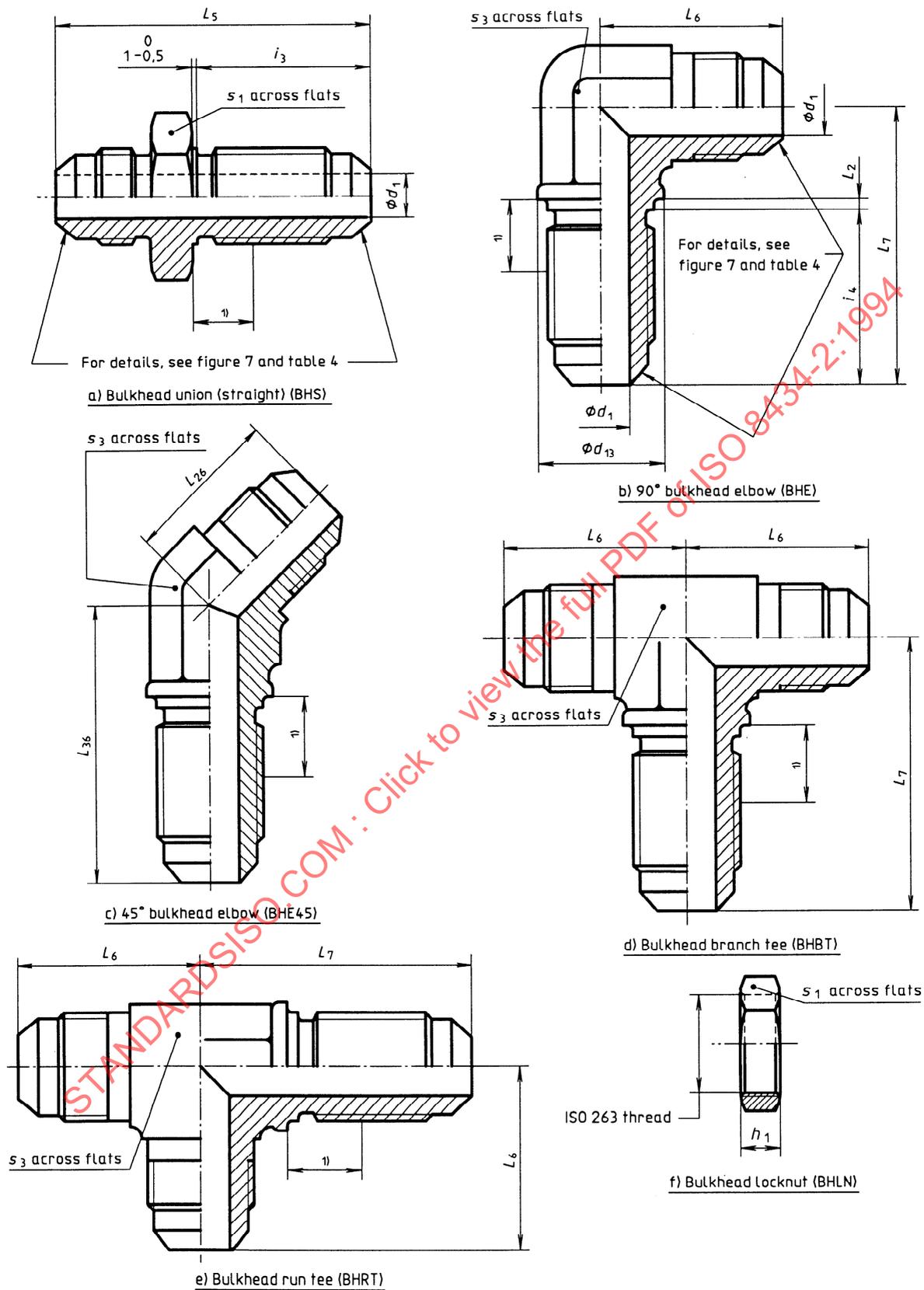


Figure 18 — 37° flared bulkhead union fittings and locknuts