



BSI Standards Publication

Hydraulic fluid power — Four-screw, one-piece square flange connections for use at pressures of 42 MPa, DN 25 to 80

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**Hydraulic fluid power — Four-
screw, one-piece square flange
connections for use at pressures of 42
MPa, DN 25 to 80**

*Transmissions hydrauliques — Brides de raccordement carrées
monobloc à quatre vis pour des pressions d'utilisation de 42
MPa, DN 25 à 80*



Reference number
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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 4, *Connectors and similar products and components*.

This second edition cancels and replaces the first edition ([ISO 6164:1994](http://www.iso.org/iso/6164:1994)), which has been technically revised.

The following are the main changes made since the previous edition:

- The 25 MPa flange series have been removed from the document due to same envelope dimensions versus the 40 MPa series.
- The sizes DN 10 to DN 19 have been removed from the document. These sizes are typically covered by tube fittings rather than flanges.
- The working pressure was increased from 40 MPa to 42 MPa to be in line with common hose working pressures.
- The design factor from 2,5 was increased to 4 including verification testing.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. Components are interconnected through their ports and associated fluid conductor connector ends.

Hydraulic fluid power — Four-screw, one-piece square flange connections for use at pressures of 42 MPa, DN 25 to 80

1 Scope

This document gives general and dimensional specifications for flanged heads, flange clamps, ports and mounting surfaces applicable to four-screw, one-piece square flange clamp type tube connectors and hose fittings for use at a pressure of 42 MPa [420 bar¹⁾]. It also specifies the dimensions of the seals to be used, as well as the grooves that house the seals.

These connections are intended for application in hydraulic systems on industrial and commercial products where it is desired to avoid the use of threaded connectors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[ISO 48](#), *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

[ISO 261](#), *ISO general purpose metric screw threads — General plan*

ISO 724, ISO general-purpose metric screw threads — Basic dimensions

[ISO 898-1](#), *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*

[ISO 1302](#), *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

[ISO 2768-1](#), *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

[ISO 3601-1](#), *Fluid power systems — O-rings — Part 1: Inside diameters, cross-sections, tolerances and designation codes*

[ISO 3601-3](#), *Fluid power systems — O-rings — Part 3: Quality acceptance criteria*

[ISO 4017](#), *Fasteners — Hexagon head screws — Product grades A and B*

[ISO 4762](#), *Hexagon socket head cap screws*

[ISO 5598](#), *Fluid power systems and components — Vocabulary*

[ISO 7089](#), *Plain washers — Normal series — Product grade A*

[ISO 9227](#), *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 10763, Hydraulic fluid power — Plain-end, seamless and welded precision steel tubes — Dimensions and nominal working pressures

1) 1 bar = 0,1 MPa = 10⁵ Pa; 1 Pa = 1 N/m².

[ISO 19879](#), *Metallic tube connections for fluid power and general use — Test methods for hydraulic fluid power connections*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 5598](#) apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Material

WARNING — Users of this document shall ensure that suitable material is chosen for the port to maintain the required working pressure, if carbon steel is not used. Also, the tube material and wall thickness depend on the selected working pressure and tube diameter. Tube dimensions shall be calculated in accordance with [ISO 10763](#).

4.1 Flange clamps, (see [Figure 2](#)) which shall be of ferrous material with the following properties in the finished condition:

- minimum yield strength: 330 MPa;
- minimum elongation at fracture: 5 %.

4.2 Flanged heads, which shall be of ferrous material with the following properties in the finished condition:

- minimum yield strength: 330 MPa;
- minimum elongation at fracture: 10 %.

4.3 Screws. Unless otherwise specified, one of the following screw options shall be used:

a) hexagon head screws conforming to [ISO 4017](#) of property class 10.9 (minimum) in accordance with [ISO 898-1](#);

or

b) socket head screws conforming to [ISO 4762](#) of property class 10.9 (minimum) in accordance with [ISO 898-1](#).

4.4 O-rings. Unless otherwise specified, the O-rings shall be made of NBR (nitrile) with a hardness of (90 ± 5) IRHD, measured in accordance with [ISO 48](#), for use at the pressure and temperature requirements given in [Clause 8](#) and for testing. The O-rings specified in [Table B.1](#) shall conform to the dimensions given in [ISO 3601-1](#) for the relevant size code. They shall also conform to tolerance class A in [ISO 3601-1](#) and shall meet or exceed the O-ring quality acceptance criteria for grade N of [ISO 3601-3](#). If the flange connection will be used at temperatures higher than specified in [Clause 8](#), O-rings made of materials that meet the higher temperature requirements shall be used.

NOTE Connectors conforming to this document contain elastomeric seals. Unless otherwise specified, connectors are made and delivered with elastomeric seals for use within the specified working temperature range with petroleum base hydraulic fluids. The use of these connectors and elastomeric seals with other hydraulic fluids might result in a reduced working temperature range or might render the connectors unsuitable for the application. Manufacturers can supply, upon request, connectors with elastomeric seals for use with hydraulic fluids other than petroleum base hydraulic fluids which will meet the specified working temperature range of the connectors.

5 Selection criteria

The following specifications supplement the dimensional data contained in [Tables 1 to 4](#) with respect to all unspecified details:

- a) The nominal matching flange size clamp shall be selected for the matching port size from [Figures 3 and Table 3](#).
- b) The flanged head size, shown in [Figure 4](#) and [Table 4](#), shall be selected in accordance with the size selected for the flange clamps and ports.
- c) O-rings shall be selected conforming to the dimensions given in [ISO 3601-1](#) and corresponding to the size code in [Annex B, Table B.1](#).
- d) Metric screws shall be selected corresponding to the sizes and lengths indicated in [Table 1](#).
- e) Screw type shall be designated according to [4.3](#) as well as thread size and length of screws.
- f) Designate square flange connector sizes by the nominal flange size that corresponds to the maximum diameter of the bore through the flanged head.

6 Tolerances

6.1 Unless otherwise specified, tolerances shall be in accordance with ISO 2768-m (medium).

6.2 Dimensions and tolerances given in the tables apply to the finished parts, plated or otherwise processed, as specified by agreement between purchaser and manufacturer.

7 Corrosion protection

7.1 The external surface of all carbon steel flange clamps and all carbon steel flanged heads, except weld-on flanged heads, shall be protected with an appropriate coating to pass a minimum 72 h salt spray test in accordance with [ISO 9227](#), unless otherwise agreed upon by the supplier and purchaser. Weld-on flanged heads shall be protected from corrosion by an oil film, phosphate coating or by other means that do not negatively affect weldability. This protection shall meet or exceed a 16 h neutral salt spray test in accordance with [ISO 9227](#), unless otherwise agreed upon by the supplier and purchaser.

7.2 Screws shall be protected from corrosion by an oil film, phosphate coating, or other means that do not encourage hydrogen embrittlement, to meet or exceed the requirements of a 16 h neutral salt spray test in accordance with [ISO 9227](#).

7.3 Appearance of red rust during the above salt spray tests shall be considered failure, except for in the following locations:

- all internal passages;
- edges;
- areas where the parts are suspended or affixed in the test chamber and condensate can accumulate.

7.4 Parts conforming to this document shall not be cadmium plated. Hexavalent chromate coatings are not preferred for commercial and industrial usage for environmental reasons. Changes in plating can affect assembly torques and require requalification.

7.5 Internal fluid passages shall be protected from corrosion during storage and shipping.

7.6 All connection components shall be free from all hanging burrs, loose scale and slivers that might become dislodged in use, and from all other defects that might affect their serviceability. All machined surfaces shall have a surface roughness value of [ISO 1302](#)-MRR Ra 6,3, except where otherwise specified.

7.7 A smooth sealing surface shall be provided. Annular tool marks up to a surface roughness value of [ISO 1302](#)-MRR Ra 3,2 are permitted (see [Figure 4](#) Footnote a for additional information).

7.8 For more specific finish requirements, see [Figures 1](#) to [4](#).

8 Pressure/temperature requirements

8.1 Surges of pressure higher than the nominal ratings will reduce the ability of the flange connections to retain the hydraulic fluid. This should be taken into account in the design of the hydraulic system.

Flange connections conforming to this document shall be subjected to the burst and cyclic endurance tests specified in [ISO 19879](#) (test assembly type 1 with 2 straight connections or type 4) to verify that they meet the specified pressure/temperature requirements.

8.2 Flange connections conforming to this document and made of carbon steel shall be suitable for use at the working pressures given in [Table 1](#) when used at temperatures between -40 °C and $+120\text{ °C}$. Flange connections conforming to this document shall not be assembled at temperatures lower than -20 °C .

8.3 Flange connections conforming to this document and made of stainless steel shall be suitable for use at the working pressures given in [Tables 1](#) or [2](#) when used at temperatures between -60 °C and $+100\text{ °C}$. Higher temperatures require reduction of the pressure ratings in agreement with the manufacturer. Flange connections conforming to this document shall not be assembled at temperatures lower than -20 °C .

9 Marking

9.1 The flanged head shall be permanently marked, at the minimum, with the following:

- a) the manufacturer's name or trademark, and
- b) nominal size.

9.2 The flanged clamp shall be permanently marked, at the minimum, with the following:

- a) the manufacturer's name or trademark, and
- b) nominal size.

10 Designation of flange connections and their parts

NOTE Only flange clamps are typically ordered using the given designations; the designations of ports and flanged heads are used only to describe these parts, because they are features of a more complex part, e.g. manifold or connector.

10.1 Flange clamps shall be designated by:

- a) "clamp", as appropriate;
- b) reference to this document, followed by a spaced hyphen;
- c) the DN size designation, separated by a multiplication symbol without spacing.

EXAMPLE Square flange clamp size DN 32

Clamp ISO 6164 — FC×32

10.2 Flange ports shall be designated by:

- a) “port”;
- b) reference to this document, followed by a spaced hyphen;
- c) flange size of related connector, without the DN size designation.

EXAMPLE Port for a flange connection of size 70

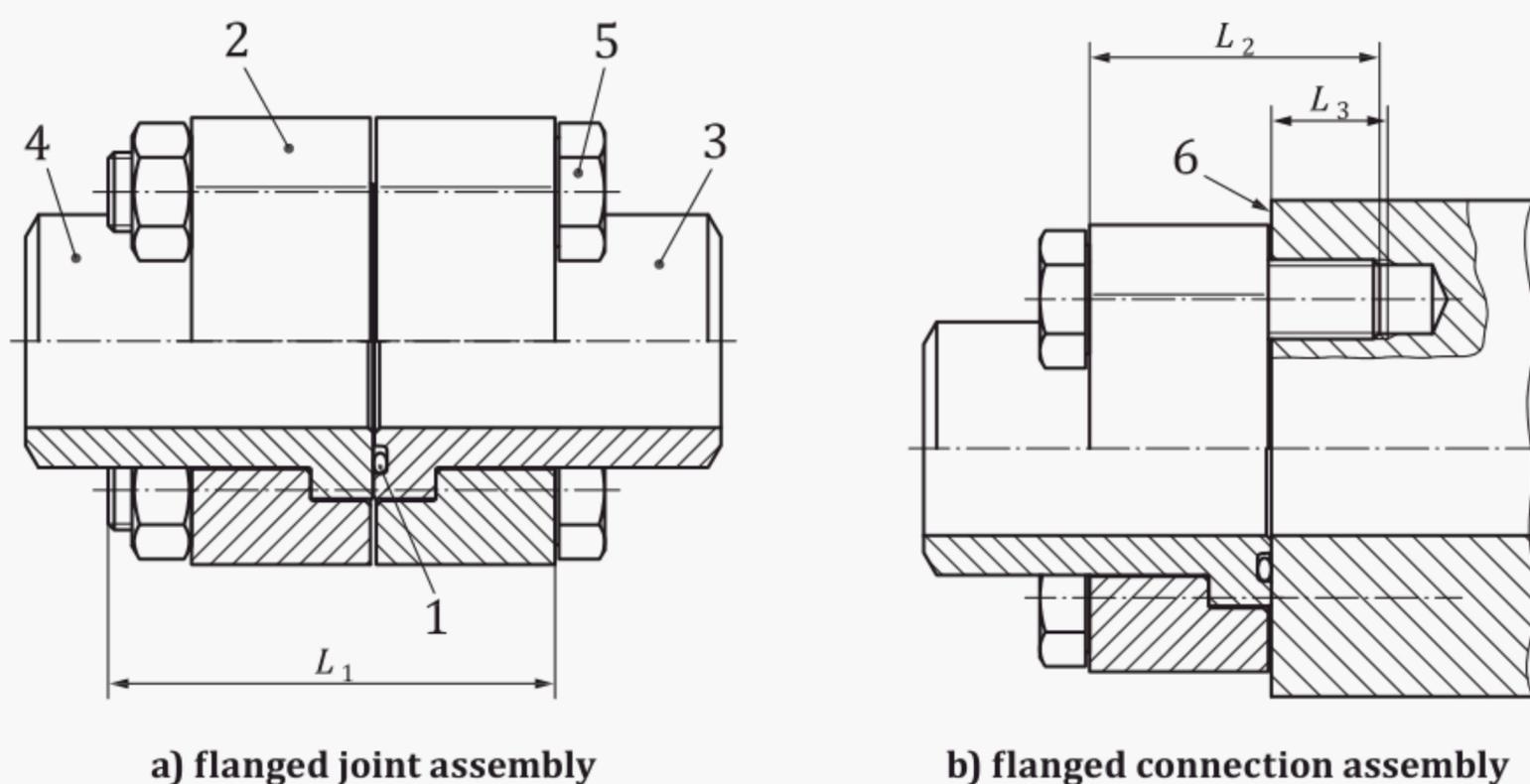
Port ISO 6164 — P70

10.3 Flanged heads shall be designated by:

- a) “head”;
- b) ISO 6164 followed by a spaced hyphen;
- c) FHG (with groove) or FH (without groove) and the DN size designation, separated by a multiplication symbol without spacing.

EXAMPLE Flanged head with groove for a flange connection of size 56

Head ISO 6164 — FHG×56



Key

- 1 O-ring seal
- 2 square flange clamp
- 3 flanged head with groove FHG
- 4 flanged head without groove FH
- 5 screw
- 6 port surface

Figure 1 — Assembled square flange connection, tube to tube and tube to port

The use of hardened washers is recommended. Washers, if used, shall conform to [ISO 7089](#) with a hardness of HV300 and be sized for the corresponding screw.

Table 1 — Dimensions and maximum working pressures for square flange assemblies

Dimensions in millimetres

Nominal size DN	L_1 Screw length	L_2^a Screw length	L_{3min} Thread length ^a	t_1 Screw thread ^b	Screws of property class 10.9	
					Maximum working pressure MPa (bar)	Minimum burst pressure MPa (bar)
25	65	40	15,5	M10×1,5	42 (420)	168 (1 680)
32	75	50	20,5	M12×1,75	42 (420)	168 (1 680)
38	90	60	24,5	M16×2	42 (420)	168 (1 680)
51	100	65	25,5	M16×2	42 (420)	168 (1 680)
56	130	80	31	M20×2,5	42 (420)	168 (1 680)
63	140	90	39 ^c	M24×3	42 (420)	168 (1 680)
70	150	100	41 ^c	M24×3	42 (420)	168 (1 680)
80	180	120	51 ^c	M30×3,5	42 (420)	168 (1 680)

^a Thread and screw lengths are calculated for steel; use of other port materials can require different screw and thread lengths.

^b Thread in accordance with ISO 724, with coarse pitch in accordance with [ISO 261](#).

^c Screw length L_1 and port thread depth L_3 are increased in comparison to [ISO 6164:1994](#).

CAUTION — It is important that all screws be lightly torqued before applying the final torque values, to avoid breaking the flange during installation. See [Annex A](#) for further instructions.

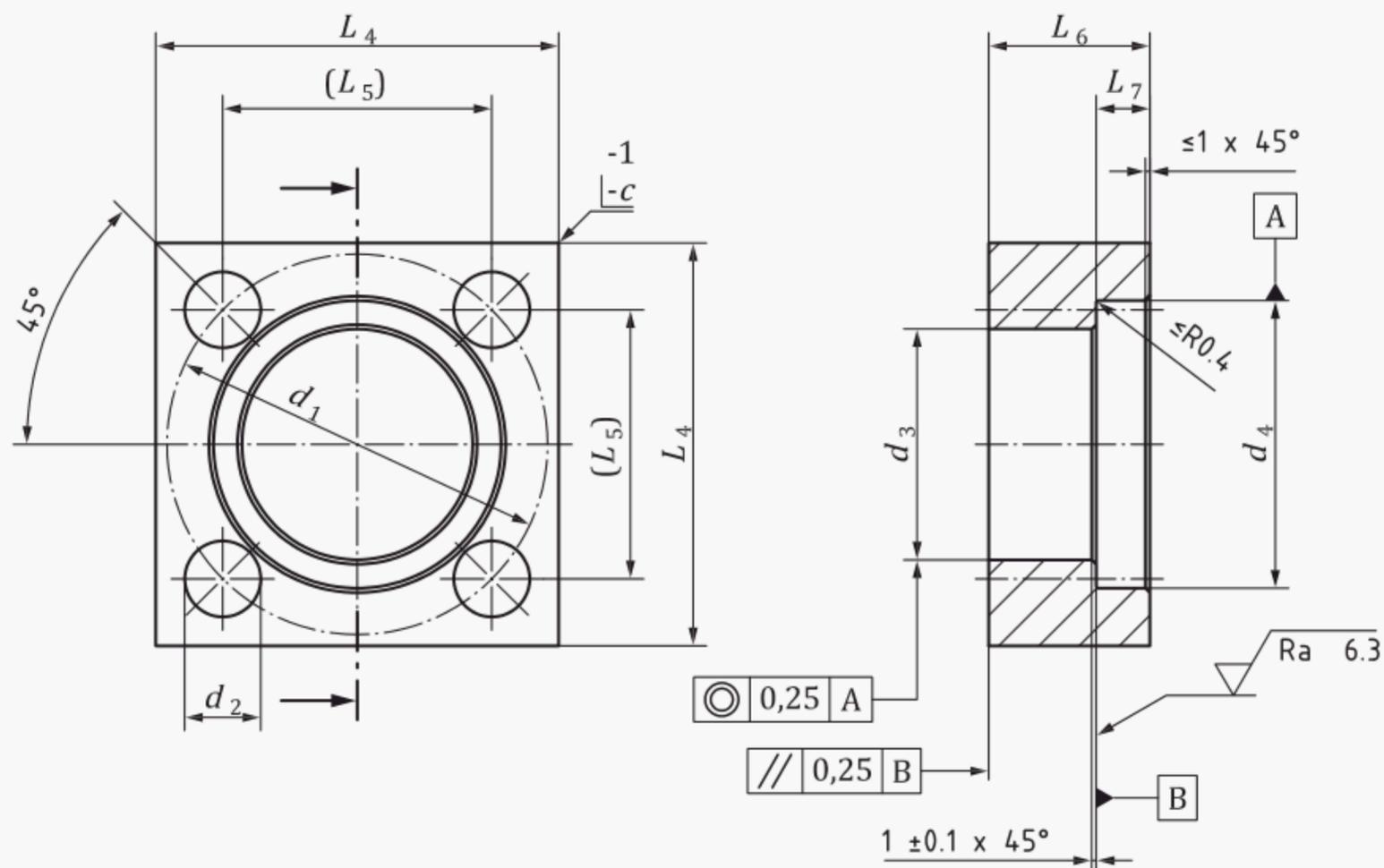


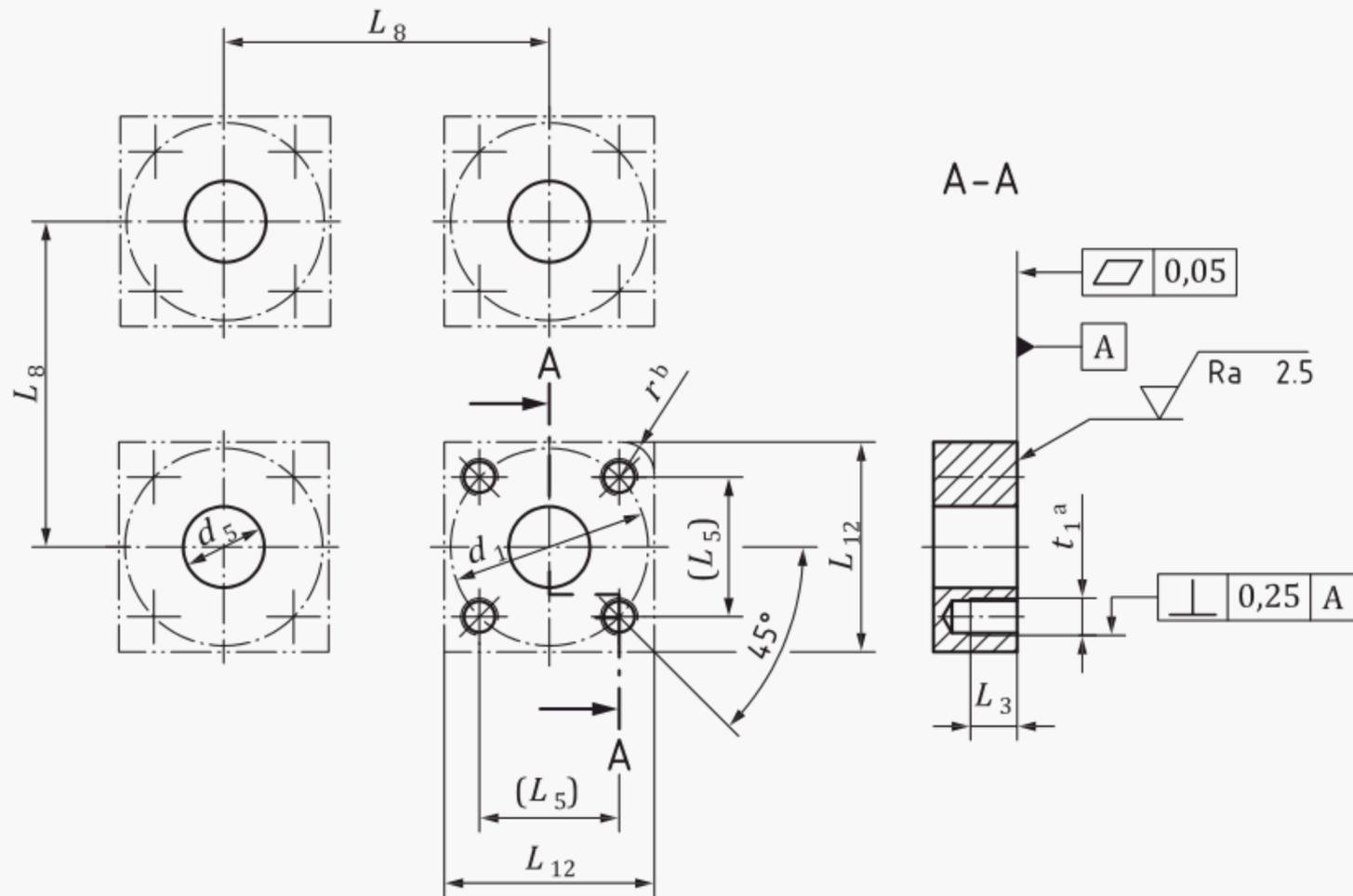
Figure 2 — Square flange clamp (FC)

Table 2 — Dimensions of square flange clamps

Dimensions in millimetres

Nominal size	d_1	d_2^a	d_3	d_4	L_4	L_5	L_6	L_7	c
DN	$\pm 0,2$	H13	H11	H12				0% $-0,25$	
25	62	11	38,9	48,4	65	43,8	25	8,5	10
32	73	13	44,6	54,8	75	51,6	30	9,3	12
38	85	17	51,6	64,3	90	60,1	36	11,5	14
51	98	17	67,6	80,2	100	69,3	40	11,5	16
56	118	21	80,5	95	120	83,4	50	15,5	20
63	145	25	90,5	111	150	102,5	52	16,1	20
70	160	25	102,5	120	160	113,1	60	17,5	20
80	175	31	114,5	136	180	123,7	70	21	24

^a In accordance with [ISO 273](#), medium series.



Key

- a 4 threaded holes t_1 on the port with full thread length L_3
- b if the port is recessed, projections within this area can cause interference

Figure 3 — Port dimensions for square flange port

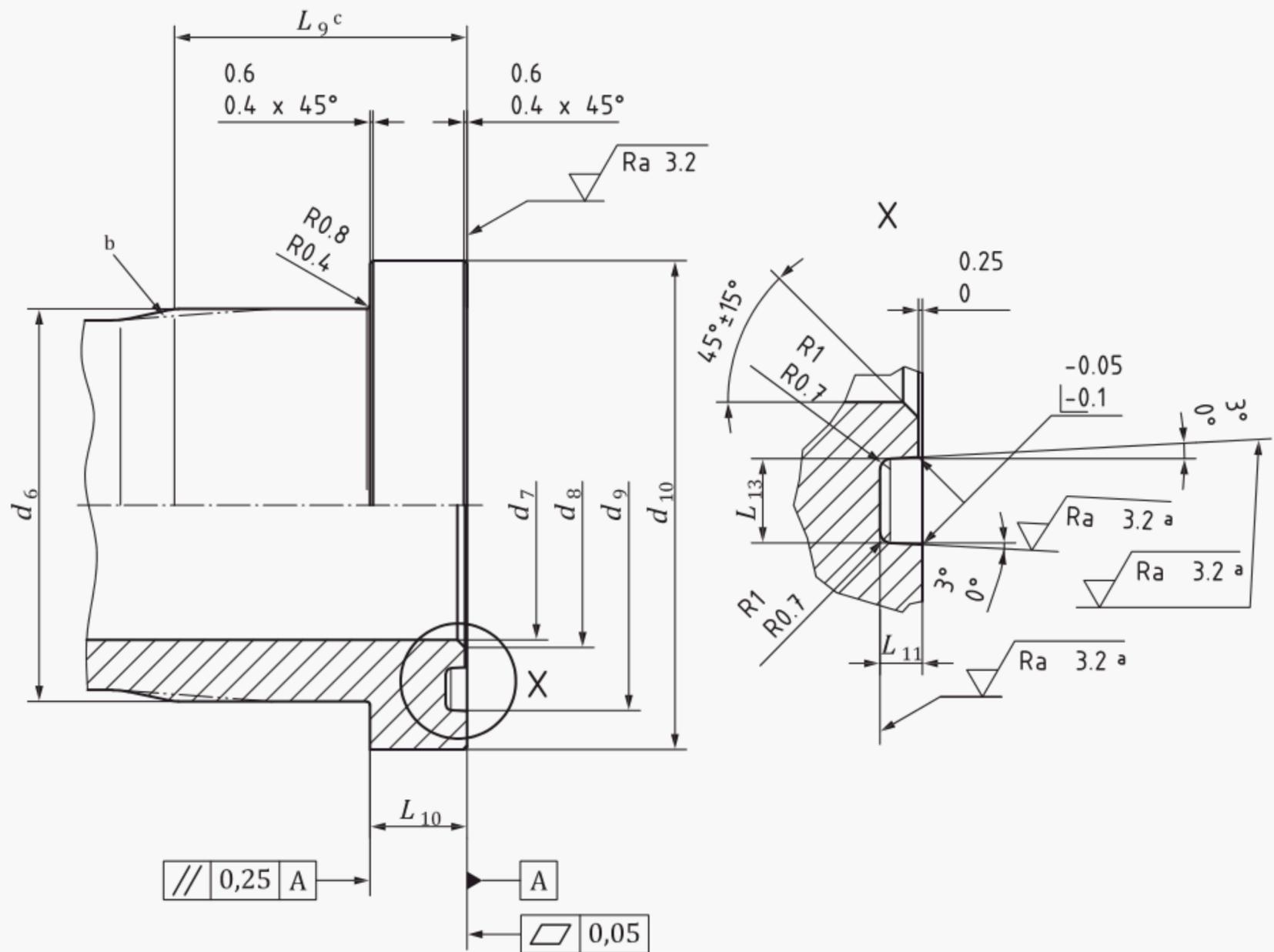
Table 3 — Dimensions of flange ports and flange pad widths

Dimensions in millimetres

Nominal size DN	d_1 $\pm 0,2$	d_5 $+0/-1,5$	L_3	L_5	L_8 min	L_{12} min	r^a max	t_1
25	62	23	see Table 1 L_3	43,8	68	65,3	10	see Table 1 t_1
32	73	29		51,6	80	75,3	12	
38	85	35		60,1	95	90,3	14	
51	98	45		69,3	105	100,3	16	
56	118	54		83,4	125	120,3	20	
63	145	58		102,5	155	150,5	20	
70	160	66		113,1	165	160,5	20	
80	175	74		123,7	185	180,5	24	

WARNING — Users of this document should ensure that suitable material is chosen for the port to maintain the required working pressure, if carbon steel is not used.

^a Optional corner breaks may also be used. If the port is recessed, projections within this area can cause interference.



Key

- a annular (circumferential) tool marks up to a surface roughness value of [ISO 1302](#)-MRR Ra 3,2 are acceptable. Scratches with a width greater than 0,13 mm running perpendicular, radial, or spiral to the connector inside diameter on the bottom and outside diameter of the O-ring groove are not acceptable. Surfaces with no depth or height are acceptable
- b optional contour
- c connector design beyond L_9 length is optional, provided adequate clearance for installing screws is maintained

Figure 4 — Flanged head

Table 4 — Dimensions of flanged heads

Dimensions in millimetres

Nominal size	d_6	d_7	d_8	d_9	d_{10}	L_9	L_{10}	L_{11}	L_{13}
DN	max.	max.	max.	$\pm 0,1$	$\pm 0,25$	ref.	$\pm 0,15$	$\pm 0,05$	$\pm 0,25$
25	38	23	25	39,2	47,6	27	9,5	2,75	5,4
32	44	29	30	43,9	54	32	10,3	2,75	5,4
38	51	35	37	53,2	63,5	38	12,6	2,75	5,4
51	67	45	47	65,8	79,4	42	12,6	4,25	7,7
56	80	54	56	78,3	94,2	52	16,5	4,25	7,7
63	90	58	60	84,5	110	56	18	4,25	7,7
70	102	66	68	93,8	119	65	20	4,25	7,7

Nominal size	d_6	d_7	d_8	d_9	d_{10}	L_9	L_{10}	L_{11}	L_{13}
DN	max.	max.	max.	$\pm 0,1$	$\pm 0,25$	ref.	$\pm 0,15$	$\pm 0,05$	$\pm 0,25$
80	114	74	76	97	135	75	23,5	4,25	7,7

Annex A (informative)

Assembly procedures and screw torque levels for flange connections conforming to this document

- A.1** Ensure that the flange connection selected meets the requirements of the application, e.g. rated pressure.
- A.2** Ensure that the flange components and ports conform to this document and that the correct screw sizes and lengths are used.
- A.3** Ensure that all sealing and surface interfaces are free of burrs, nicks, scratches and any foreign material.
- A.4** To help minimize O-ring fall out, lubricate the O-ring with a light coat of the hydraulic fluid used in the system or a compatible oil, when necessary. Take special care, as excess lubricant may seep out of the joint and lead to a false indication of leakage.
- A.5** Position the flanged head and the flange clamps. Lubricate the screws on the thread portion and under the head portion. Use MoS₂ type lubricant. The use of paste lubricant with solid antifriction particles such as MoS₂ is recommended.
- A.6** Hand tighten the screws in the sequence shown in [Figure A.1](#), to ensure uniform contact at all four screw locations to prevent the flange from tipping, which can lead to the flange breaking during application of final torque.

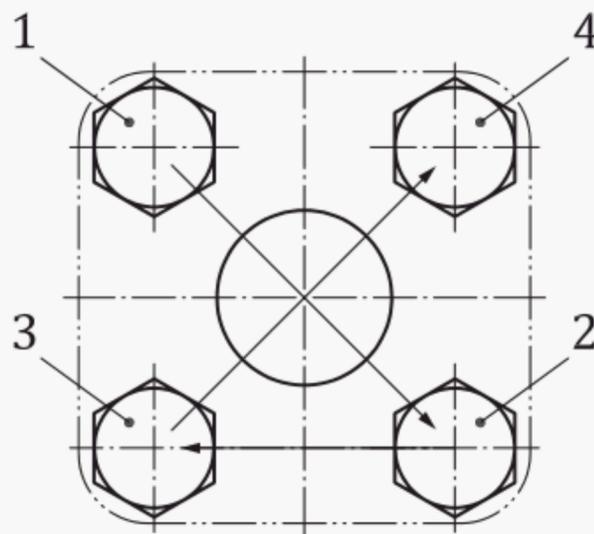


Figure A.1 — Screw tightening sequence

- A.7** Torque the screws in the sequence shown in [Figure A.1](#) in two or more increments by selecting the screw torque level and the relevant wrench size from [Table A.1](#).

Table A.1 — Wrench sizes for assembling flange connections that conform to this document

Dimensions in millimetres

Nominal size DN	Maximum working pressure MPa (bar)	Thread ^a	Screw torque ^b Nm +10 % 0	Metric wrench	
				For hexagon head screw mm	For socket head screw mm
25	42 (420)	M10×1,5	60	16	8
32	42 (420)	M12×1,75	95	18	10
38	42 (420)	M16×2	220	24	14
51	42 (420)	M16×2	250	24	14
56	42 (420)	M20×2,5	450	30	17
63	42 (420)	M24×3	720	36	19
70	42 (420)	M24×3	800	36	19
80	42 (420)	M30×3,5	1 420	46	22

^a Coarse thread in accordance with ISO 724.

^b These torques are only a guide when using lubricated screws of property class 10.9, calculated with a coefficient of friction $f = 0,1$.

Annex B (informative)

O-ring designation codes and dimensions

Table B.1 — Designation codes and dimensions of O-rings used in this document (for reference only)

Dimensions in millimetres

Nominal size DN	ISO 3601-1 size code	ISO 3601-1 designation code	Inside diameter mm	Cross- section mm
25	219	O-ring-ISO 3601-1-219A-32,92 × 3,53-N	32,92	3,53
32	222	O-ring-ISO 3601-1-222A-37,69 × 3,53-N	37,69	
38	225	O-ring-ISO 3601-1-225A-47,22 × 3,53-N	47,22	
51	331	O-ring-ISO 3601-1-331A-56,52 × 5,33-N	56,52	5,33
56	335	O-ring-ISO 3601-1-335A-69,22 × 5,33-N	69,22	
63	337	O-ring-ISO 3601-1-337A-75,57 × 5,33-N	75,57	
70	340	O-ring-ISO 3601-1-340A-85,09 × 5,33-N	85,09	
80	341	O-ring-ISO 3601-1-341A-88,27 × 5,33-N	88,27	

Bibliography

- [1] [ISO 273](#), *Fasteners — Clearance holes for bolts and screws*
- [2] [ISO 80000-1](#), *Quantities and units — Part 1: General*
- [3] [ISO 1101](#), *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*
- [4] [ISO 6162-1](#), *Hydraulic fluid power — Flange connections with split or one-piece flange clamps and metric or inch screws — Part 1: Flange connectors, ports and mounting surfaces for use at pressures of 3,5 MPa (35 bar) to 35 MPa (350 bar), DN 13 to DN 127*
- [5] [ISO 6162-2](#), *Hydraulic fluid power — Flange connections with split or one-piece flange clamps and metric or inch screws — Part 2: Flange connectors, ports and mounting surfaces for use at a pressure of 42 MPa (420 bar), DN 13 to DN 76*
- [6] [ISO 6892-1](#), *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*
- [7] [ISO 13715](#), *Technical product documentation — Edges of undefined shape — Indication and dimensioning*
- [8] SAE J515, *Specification for Hydraulic O-Ring Materials, Properties, and Sizes for Metric and Inch Stud Ends, Face Seal Fittings and Four-Screw Flange Tube Connections*

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