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Second edition
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Industrial valves — Multi-turn valve actuator attachments

Robinetterie industrielle — Raccordement des actionneurs multitours aux appareils de robinetterie

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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).

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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 153, *Valves*.

This second edition cancels and replaces the first edition (ISO 5210:1991), which has been technically revised with the following changes:

a) extension of flange sizes;

b) introduction of groups C and D for assemblies capable of transmitting torque, in 7.4 and 7.5;

c) introduction of linear actuator in 7.6.

Introduction

The purpose of this document is to establish certain basic requirements for the attachment of multi-turn actuators, in order to define the interface between actuator and valve.

This document has, in general, to be considered in conjunction with the specific requirements which may be agreed between the parties concerned.

Industrial valves — Multi-turn valve actuator attachments

1 Scope

This document specifies the requirements for the attachment of multi-turn actuators to valves.

Throughout this document, “actuator” may be understood as “actuator and/or gearbox” providing a multi-turn and/or linear output.

It specifies:

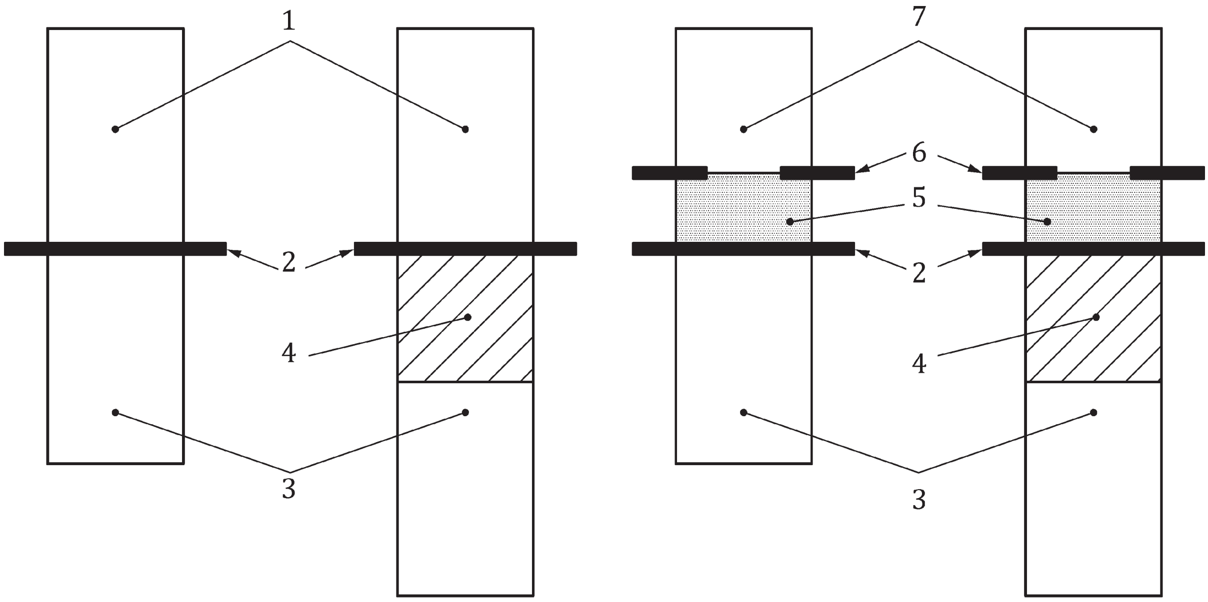
— flange dimensions necessary for the attachment of actuators to industrial valves [see Figure 1 a)] or to intermediate supports [see Figure 1 b)];

— those driving component dimensions of actuators which are necessary to attach them to the driven components;

— reference values for torque and thrust for flanges having the dimensions specified in this document.

NOTE 1 In this document, the term “valve” may also be understood to include “valve with an intermediate support” [see Figure 1 b)].

NOTE 2 When a combination of a multi-turn actuator and separate multi-turn/linear gearbox is coupled to form an actuator, the multi-turn attachment to the gearbox is in accordance with this document [see Figures 1 c) and 1 d)]. A combination of a multi-turn actuator with integral multi-turn/linear gearbox supplied as an actuator is in accordance with Figures 1 a) and 1 b).



a) b) c) d)

a) Direct interface **b) Intermediate support interface** **c) Direct interface (when combination of a multi-turn actuator and multi-turn/linear gearbox)** **d) Intermediate support interface (when combination of a multi-turn actuator and a multi-turn/linear gearbox)**

Key

1 multi-turn/linear actuator
2 interface (see ISO 5210)
3 valve
4 intermediate support
5 gearbox
6 interface (see ISO 5210)
7 multi-turn actuator

Figure 1 — Interface between multi-turn/linear actuator and valve

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 273, *Fasteners — Clearance holes for bolts and screws*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 http://www.iso.org/obp

3.1
actuator
any device designed for attachment to a general purpose industrial valve in order to provide for the operation of the valve

Note 1 to entry: The device is designed to operate using motive energy which may be electrical, pneumatic, hydraulic, manual, etc., or a combination of these. Movement is limited by travel, torque and/or thrust.

3.2
multi-turn actuator
actuator which transmits torque to the valve for at least one revolution and may be capable of withstanding thrust

Note 1 to entry: An actuator may be a combination of a multi-turn actuator and multi-turn gearbox.

3.3
linear actuator
actuator which transmits thrust to the valve for a defined linear stroke

Note 1 to entry: An actuator may be a combination of a multi-turn actuator and linear gearbox.

3.4
torque
turning moment transmitted through the mounting flanges and couplings

Note 1 to entry: Torque is expressed in newton-metres.

3.5
thrust
axial force transmitted through the mounting flanges and couplings

Note 1 to entry: Thrust is expressed in kilonewtons.

4 Maximum torques and thrusts

The torque and thrust shall comply with the values listed in Table 1 which represent the maximum torques and thrusts which can be transmitted simultaneously through the mounting flanges and couplings. They are based upon specified criteria.

Table 1 — Maximum torque and thrust values

Flange type	Torque Nm	Thrust kN
F05	20	10
F07	40	20
F10	100	40
F12	250	70
F14	400	100
F16	700	150
F25	1 200	200
F30	2 500	325
F35	5 000	700
F40	10 000	1 100
F48	20 000	2 000
F60	40 000	4 000

The values specified in Table 1 have been defined on the basis of bolts in tension at a stress of 290 MPa and a coefficient of friction of 0,2 between the mounting interface. All variations in these defined parameters lead to variations of the transmittable torque and/or thrust values. See Annex A for an explanation on the calculation method.

The selection of flange size for a particular application should take account of additional torques and/or thrust that may be generated at the valve stem because of sizing, safety factors, inertia or other similar factors. Specifically, the torque and thrust generated at the maximum output torque and/or thrust of the selected actuator shall be calculated and considered in the selection of the flange along with the ability of the valve and actuator to withstand such torque and thrust forces.

5 Flange dimensions

Flanges for actuator attachment shall comply with the dimensions shown in Figure 2 and given in Table 2. The method of attachment shall be by means of studs or through bolting. When through bolting is used, the diameter of the clearance holes shall permit the use of bolts of a size given by the corresponding dimension d_4 in Table 2.

Holes for the studs/bolts shall be positioned off-centre (see Figure 3 and Table 3), shall be equi-spaced and shall conform to the requirements of ISO 273.

The interface on the valve shall have a recess corresponding to the diameter d_2. A spigot on the actuator is optional.

The minimum values for dimension h_2 shown in Table 2 apply to flanges having material of proof stress $R_e \geq 200$ MPa. The minimum values for dimension h_2 applied to flanges having materials of proof stress $R_e \leq 200$ MPa shall be agreed between manufacturer and purchaser. The minimum values for dimension h_3 shall be at least $1 \times d_4$.

Dimension d_1 has been based on providing sufficient landing for the nuts and bolt heads where applicable. Such landing is defined as a radius from the bolt hole centre with the dimension $(d_1 - d_3) / 2$, and is a minimum. The flange shape of both valve and actuator outside these areas of landing is left to the option of the manufacturer.

The dimensions and bolting material are based on bolts in tension at a maximum stress of 290 MPa. On agreement, between the manufacturer/supplier and purchaser, bolting material with different tensile strength can be used, with no dimensional changes but with potential variation of the transmittable torque and thrust value.

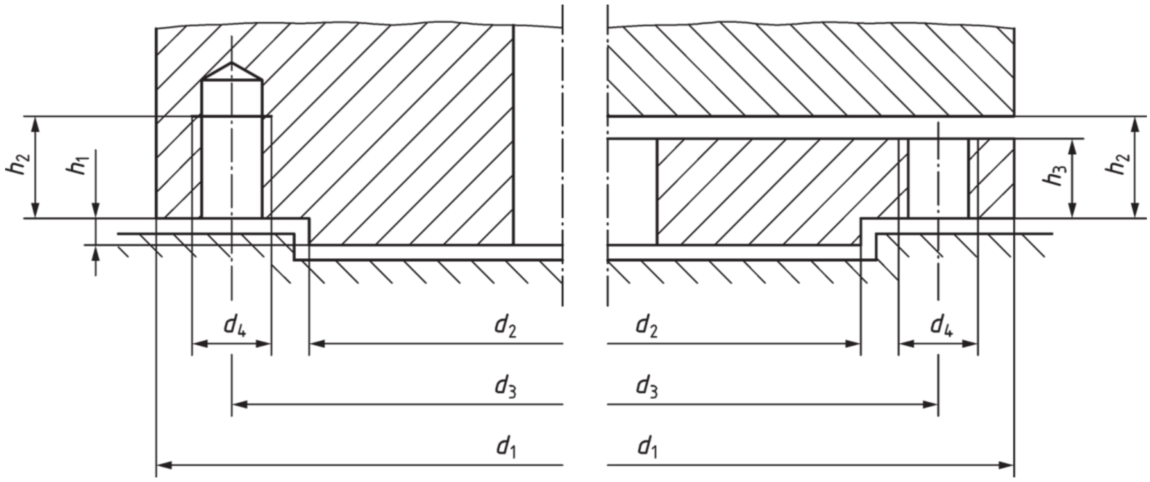


Figure 2 — Flange dimensions

Table 2 — Flange dimensions

Dimensions in millimetres

Flange type	Dimensions							Number of studs or bolts
	d_1 min.	d_2 [a]	d_3	d_4	h_1 max.	h_2 min.	h_3 min.	n
F05	Ø65	Ø35	Ø50	M6	3	9	6	4
F07	Ø90	Ø55	Ø70	M8	3	12	8	4
F10	Ø125	Ø70	Ø102	M10	3	15	10	4
F12	Ø150	Ø85	Ø125	M12	3	18	12	4
F14	Ø175	Ø100	Ø140	M16	4	24	16	4
F16	Ø210	Ø130	Ø165	M20	5	30	20	4
F25	Ø300	Ø200	Ø254	M16	5	24	16	8
F30	Ø350	Ø230	Ø298	M20	5	30	20	8
F35	Ø415	Ø260	Ø356	M30	5	45	30	8
F40	Ø475	Ø300	Ø406	M36	8	54	36	8
F48	Ø560	Ø370	Ø483	M36	8	54	36	12
F60	Ø686	Ø470	Ø603	M36	8	54	36	20

[a] d_2 shall be manufactured within the diameter tolerance f8.

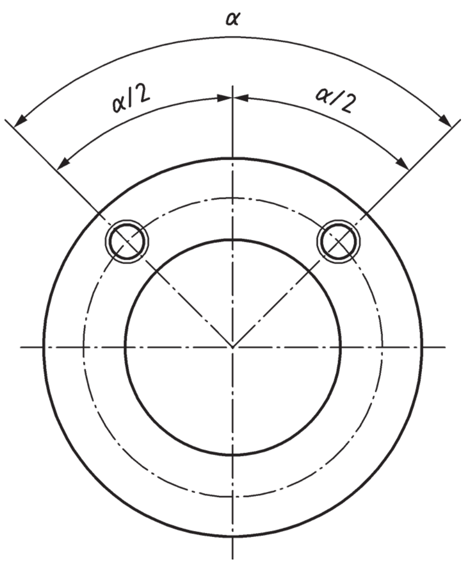


Figure 3 — Positions of the holes for the studs/bolts

Table 3 — Positions of holes

Flange type	$\alpha/2$
F05 to F16	45°
F25 to F40	22,5°
F48	15°
F60	9°

6 Designation

Flanges are designated by flange type according to Table 1.

7 Dimensions of driving and driven components

7.1 General

The dimensions of the driving and driven components shall comply with the dimensions given in Tables 4 to 8.

The depth of engagement of the valve-driven component into the actuator drive component and the surface area of contact between the faces of the actuator drive component and the faces of the valve-driven component, should be considered to ensure that the stresses caused by contact do not exceed the capability of the component materials. In some cases it may be necessary to use materials with superior mechanical properties and/or to reduce the output torque of the actuator.

7.2 Dimensions for assemblies capable of transmitting both torque and thrust: Group A

Dimensions for assemblies of group A shall be as shown in Figures 4 and 5, and given in Table 4.

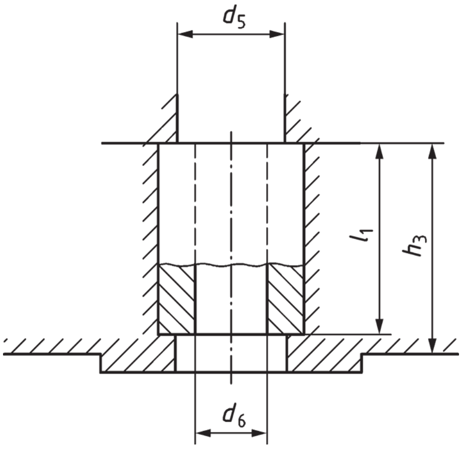
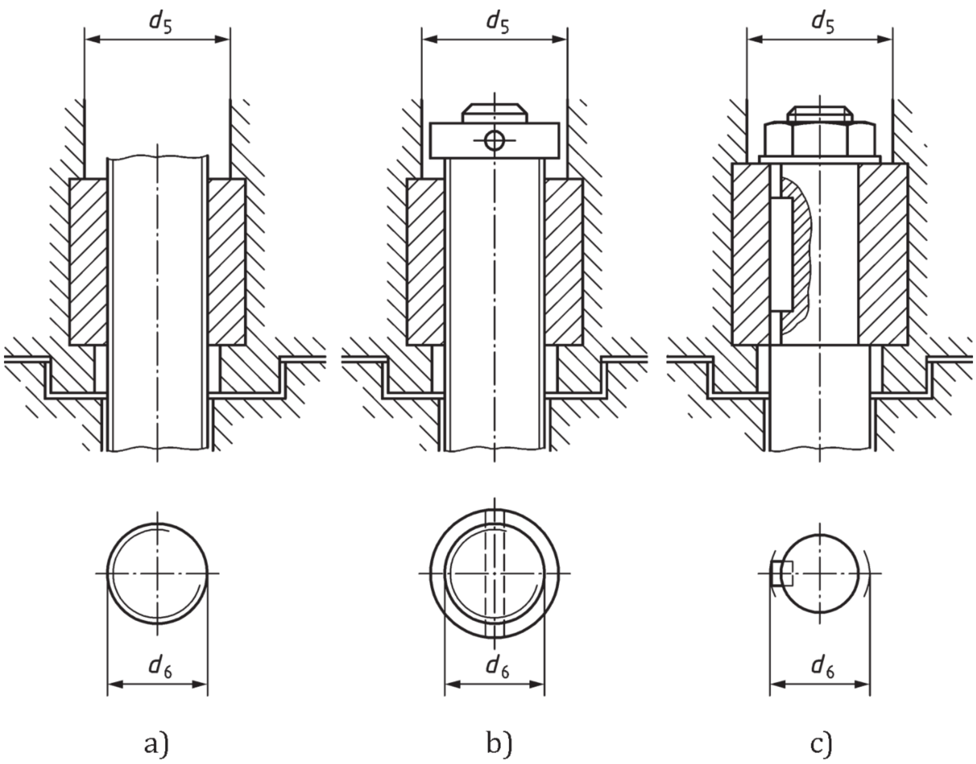


Figure 4 — Driving component, group A



a) Example for rising stem **b) Example for rising stem with limit stop** **c) Example for non-rising stem**

Figure 5 — Examples for rising and non-rising stem — Driven component, group A

For rising stem dimension d_5 permits clearance for the rising and non-rotating stem and for any device to restrict the downward travel of the valve stem.

For non-rising stem dimension d_5 permits the clearance of the stem-locking and thrust-taking components of the non-rising and rotating stem.

Table 4 — Dimensions for group A drive components

Dimensions in millimetres

Flange type	d_6 min.[a]	d_6 max.[a]	l_1 min.	h_3 max.
F05	Ø18	Ø22	20	40
F07	Ø20	Ø26	25	60
F10	Ø28	Ø40	40	80
F12	Ø32	Ø48	48	95
F14	Ø36	Ø55	55	110
F16	Ø44	Ø75	70	135
F25	Ø60	Ø85	90	150
F30	Ø80	Ø100	110	175
F35	Ø100	Ø150	150	250
F40	Ø120	Ø175	180	325
F48	Ø120	Ø175	180	350
F60	Ø120	Ø180	180	400

[a] The driving component is capable of accepting a diameter up to and including the values d_6 min. shown in Figure 4. Without being a requirement, the driving component may accept larger diameters up to the values of d_6 max.

7.3 Dimensions for assemblies capable of transmitting torque only: Group B

Dimensions for assemblies of group B shall be as shown in Figures 6 and 7, and given in Table 5.

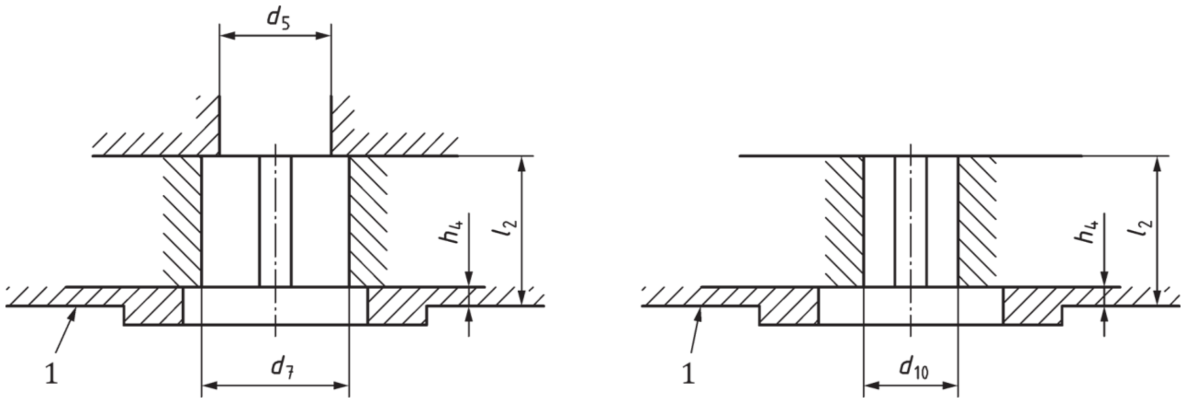
Group B is divided into four sub-groups, where the diameter d of the output drive is defined as follows:

— Type B1: $d = d_7$ H9;

— Type B2: $d \le d_7$;

— Type B3: $d = d_{10}$ H9;

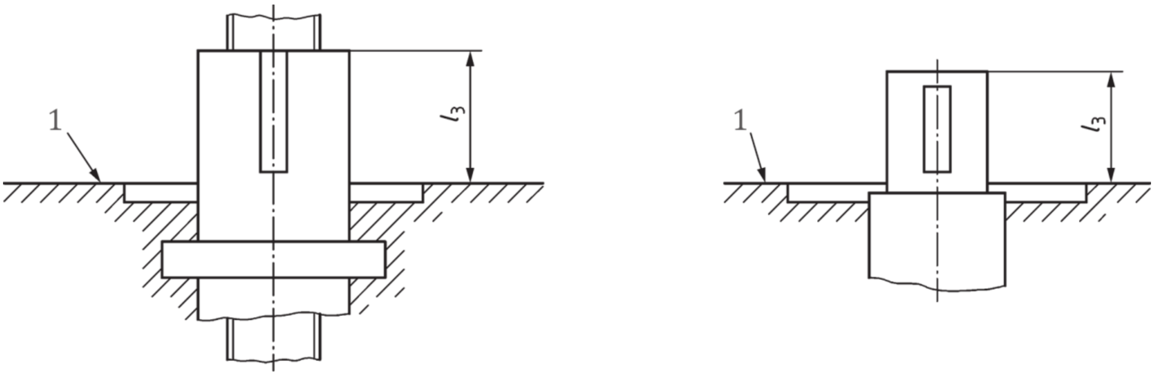
— Type B4: $d \le d_{10}$ max.



Key

1 flange

Figure 6 — Driving components, group B



Key

1 interface

Figure 7 — Driven components, group B

NOTE In order to ensure that no interference can occur between the driving component and the driven component, it is necessary to limit the length of the driven component l_3 above the interface so that there is an appropriate clearance between both parts.

Table 5 — Dimensions for group B drive components

Dimensions in millimetres

Flange type	d_5 min	d_7 [b]	d_{10} [a, b]	d_{10} max.	h_4 max.	l_2 min.
F05	Ø18	Ø22	—	—	3	30
F07	Ø22	Ø28	Ø16	Ø25	3	35
F10	Ø30	Ø42	Ø20	Ø35	3	45
F12	Ø35	Ø50	Ø25	Ø40	3	55
F14	Ø40	Ø60	Ø30	Ø45	4	65
F16	Ø50	Ø80	Ø40	Ø60	5	80
F25	Ø65	Ø100	Ø50	Ø75	5	110
F30	Ø85	Ø120	Ø60	Ø90	5	130
F35	Ø110	Ø160	Ø80	Ø120	5	180
F40	Ø130	Ø180	Ø100	Ø160	8	200
F48	Ø160	Ø220	—	—	8	250
F60	Ø180	Ø280	—	—	8	310

[a] The driving component shall be capable of accepting a diameter up to and including the values d_{10} shown in Figure 6. Without being a requirement, the driving component may accept larger diameters up to the values of d_{10} max.

[b] d_7 and d_{10} shall be manufactured within the diameter tolerance H9.

7.4 Dimensions for assemblies capable of transmitting torque only: Group C

Dimensions for assemblies of group C shall be as shown in Figure 8 and given in Table 6.

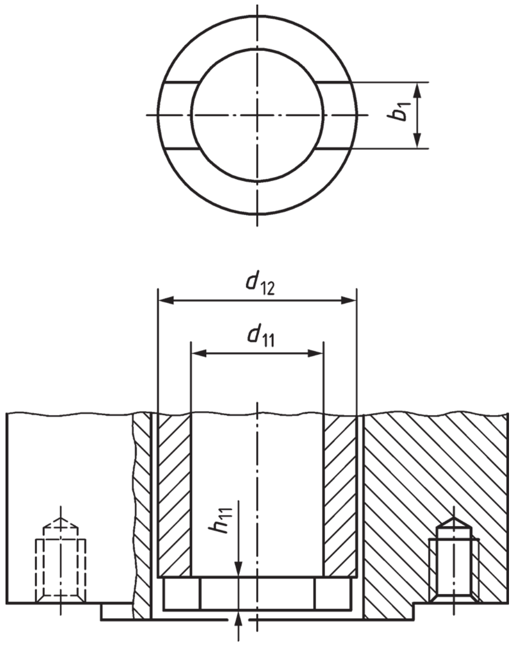


Figure 8 — Driving components, group C

Table 6 — Dimensions for group C drive components

Dimensions in millimetres

Flange type	d_{11} min.	d_{12}	h_{11}	b_1[a]
F10	Ø28	Ø42	7	14
F14	Ø38	Ø60	8	20
F16	Ø47	Ø80	10	24
F25	Ø64	Ø100	11	30
F30	Ø75	Ø120	13	40
F35	Ø105	Ø160	17	45
F40	Ø125	Ø180	20	50

[a] b_1 shall be manufactured within the linear tolerance H11.

7.5 Dimensions for assemblies capable of transmitting torque only: Group D

Dimensions for assemblies of group D shall be as shown in Figure 9 and given in Table 7.

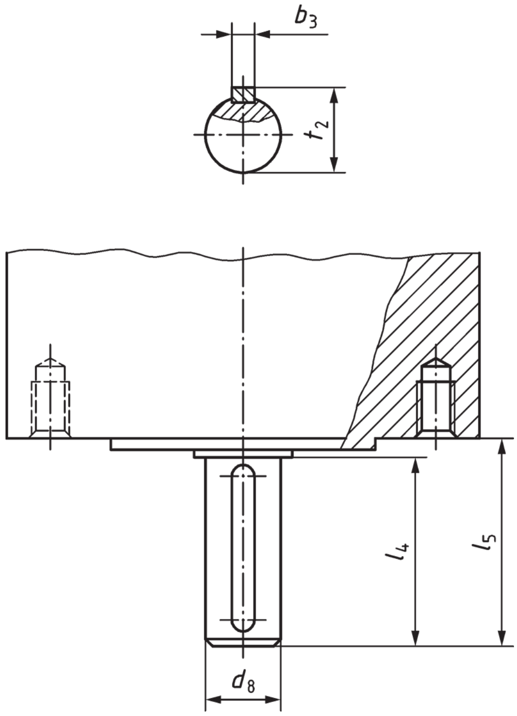


Figure 9 — Driving components, group D

Table 7 — Dimensions for group D drive components

Dimensions in millimetres

Flange type	d_8 [a]	l_4	l_5	b_3 [b]	t_2
F10	Ø20	50	55	6	22,5
F14	Ø30	70	76	8	33
F16	Ø40	90	97	12	43
F25	Ø50	110	117	14	53,5
F30	Ø60	120	127	18	64
F35	Ø80	120	127	22	85
F40	Ø100	150	164	28	106

[a] d_8 shall be manufactured within the diameter tolerance g8.

[b] b_3 shall be manufactured within the linear tolerance h9.

7.6 Dimensions for assemblies capable of transmitting thrust only: Group Linear actuators

For linear actuators, unless otherwise agreed between the manufacturer/supplier and the purchaser, the dimensions of the attachment shall comply with those given in Figure 10 and Table 8.

Dimensions d_1, d_2, d_3, h_1 and h_3 shall be according to Clause 5. The through hole d_5 shall be chosen according to the bolt diameter d_4 corresponding to Figure 2 and Table 2.

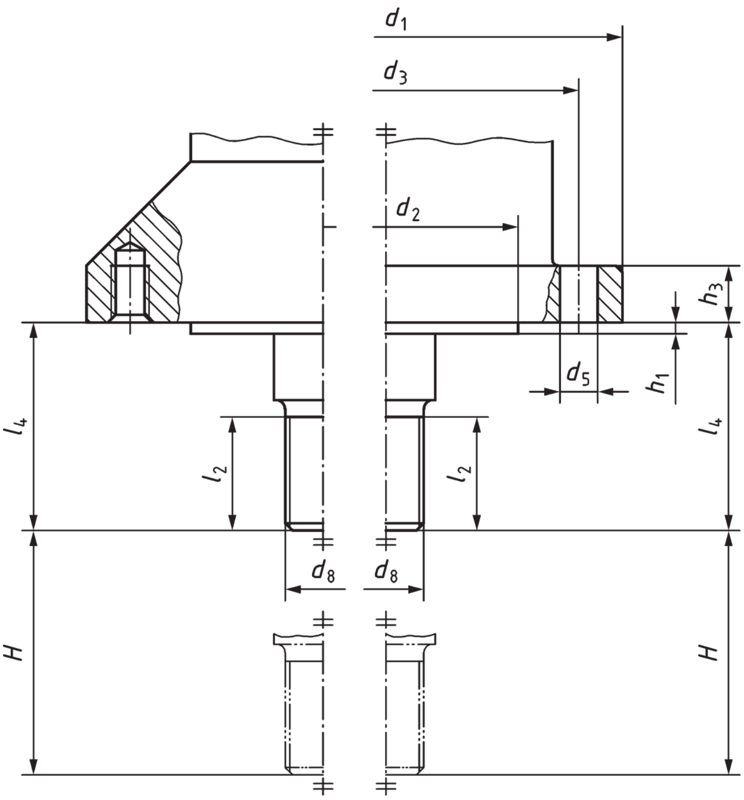


Figure 10 — Dimensions of linear output drive

Table 8 — Data and dimensions of output drive for linear actuators

Flange type	**Thrust rating** kN	l_2	l_4	d_8	**H**[a] **min. stroke** mm
F05	10	20	45	M12 × 1,25	20
F07	20	25	50	M16 × 1,5	40
F10	40	30	55	M20 × 1,5	60
F12	70	35	65	M24 × 1,5	60
F14	100	55	80	M36 × 3	80
F16	150	65	90	M42 × 3	100
F25	200	75	100	M48 × 3	120
F30	325	90	120	M56 × 4	140
F35	700	120	150	M80 × 4	160

[a] The maximum stroke is provided by the manufacturer/supplier.

Annex A
(informative)

Explanation of calculations

A.1 Basis of torque and thrust values for flange sizes

For each designated flange size, a maximum transmissible torque and thrust value is established by this document. For each flange size, geometrical design and sizing principles were established where possible.

The calculation method, given in Formulae (A.1) and (A.2), establishes the maximum transmissible torque and thrust per flange size. The resulting values are supported by other calculation methods provided by existing standards.

Flanges with maximum transmissible torque and/or thrust values that diverge from this calculation method are established in the market.

Since the interface only transfers torque by static friction and the bolted connection is not designed for shear stresses, a safety against slipping can be derived with the defined bolt tensile stress of 290 MPa and specification of the coefficient of friction 0,2 using the formula:

$$T_R = n \times \mu \times F_{Kl} \times \frac{d_3}{2\ 000} \quad \text{(A.1)}$$

and

$$F_{Kl} = \sigma_{zul} \times A_S - \frac{F_{ax}}{n} \quad \text{(A.2)}$$

where

μ is the coefficient of friction;

σ_{zul} is the actual bolt tensile stress, in MPa, and should be less than the bolt material tensile strength;

A_S is the tensile stress area, in mm^2;

d_3 is the pitch circle diameter, in mm;

F_{ax} is the applicable output thrust, in N;

F_{Kl} is the clamping force per bolt, in N;

n is the number of screws, studs or bolts;

T_R is the applicable output torque, in Nm.

NOTE This calculation was used to derive the maximum flange torque and thrust values in Table 1 and is not qualified for any design proofs. Nor is it intended to replace engineering calculations defined by national standards or regulations.

A.2 Coefficient of friction of 0,2

Through national standards, regulations and experience within the valve industry, a coefficient of friction 0,2 in the contact area [interfaces (see Figure 1, keys 2 and 6)] of flanges between actuator and valve became established.

A.3 Tension stress bolts

The bolt quality, method of tightening and application factors are the basis for the bolt tension stress of 290 MPa.

This value is calculated using 90 % of the yield strength of a bolt quality (8.8) and assuming that the bolts are tightened with a torque wrench (tightening factor 1,6) and an application factor (1,25) for relaxation.

The bolt quality 8.8 defines

— R_m = 800 MPa, and

— R_e = 80 % × R_m = 640 MPa.

The tension stress of the bolt can be calculated as 290 MPa = R_e × 90 % / 1,6 / 1,25.

A.4 Sizing — Consideration of thrust

Thrust is the significant force developed in actuating linear valves by multi-turn output actuators. The thrust developed is a function of the output torque of the selected actuator and the valve stem factor of the valve (determined by stem diameter, thread type, pitch/lead and coefficient of friction).

The thrust developed under all torque conditions should be considered in order to not cause structural failure.

To ensure that the correct flange is selected and that the valve structure, actuator and attachments can withstand the maximum thrust developed, the output torque of the selected actuator should be used to calculate the actual thrust developed.

There is a danger that sizing will be based solely on the valve required torque to which safety factors are applied, resulting in an actuator being selected with an output torque significantly above the valve required torque. As thrust increases proportionally with the increase in output torque, it will exceed the valve required thrust. The resulting thrust should be communicated to the valve manufacturer/supplier or valve actuator integrator for consideration as to the strength of the valve structure, interface flange selection and fixings, etc.

Bibliography

[1] ISO 5211, *Industrial valves — Part-turn actuator attachments*

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