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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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 153, *Valves*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 69, *Industrial valves*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 5210:2017), which has been technically revised.

The main changes are as follows:

- dimensions and tolerances for keys and keyways were added in a new [Annex B](#);
- a reference to the new [Annex B](#) was added in [7.3](#) and [7.5](#);
- editorial changes were made.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

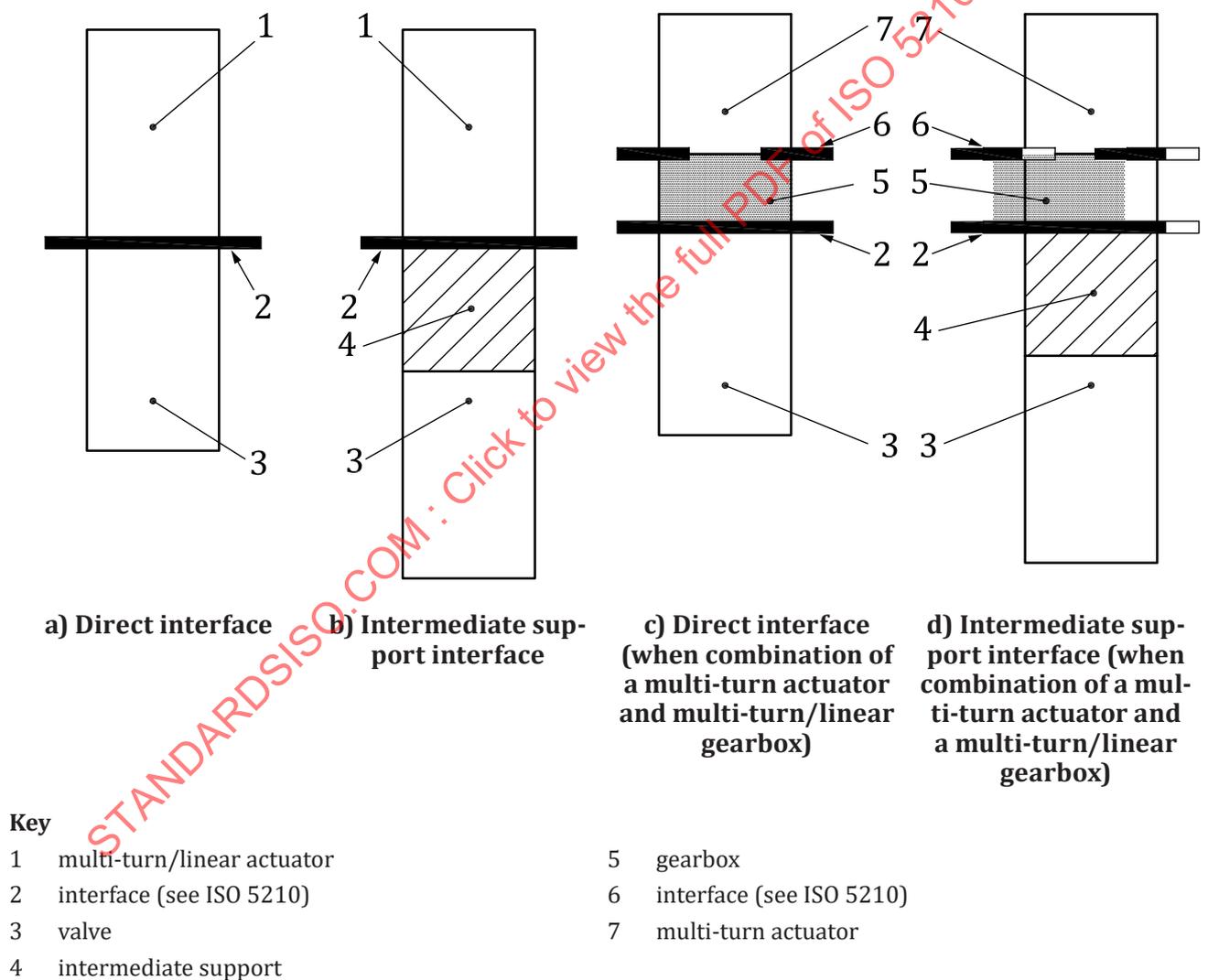
## Introduction

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 is, in general, considered in conjunction with the specific requirements which may be agreed between the parties concerned.

NOTE 1 In this document, the term “valve” can 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](#)).



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

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# 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” can 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.

## 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 terminology databases for use in standardization at the following addresses:

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

### 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* ([3.4](#)) and/or *thrust* ([3.5](#)).

### 3.2

#### **multi-turn actuator**

*actuator* ([3.1](#)) which transmits *torque* ([3.4](#)) to the valve for at least one revolution and may be capable of withstanding *thrust* ([3.5](#))

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

**3.3  
linear actuator**

actuator (3.1) which transmits thrust (3.5) to the valve for a defined linear stroke

Note 1 to entry: An actuator may be a combination of a multi-turn actuator (3.2) 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.

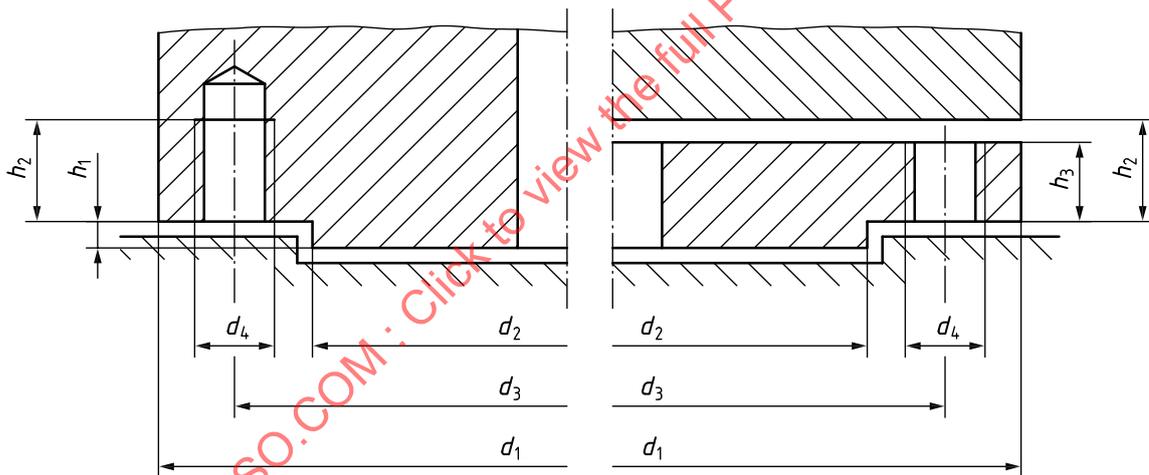


Figure 2 — Flange dimensions

Table 2 — Flange dimensions

Dimensions in millimetres

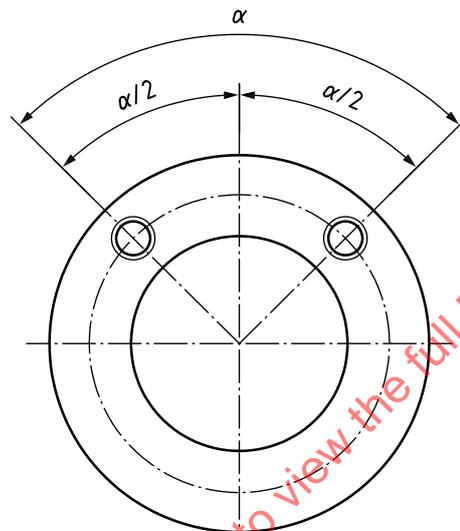
Flange type	Dimensions							Number of studs or bolts $n$
	$d_1$ min.	$d_2^a$	$d_3$	$d_4$	$h_1$ max.	$h_2$ min.	$h_3$ min.	
F05	Ø65	Ø35	Ø50	M6	3	9	6	4
F07	Ø90	Ø55	Ø70	M8	3	12	8	4
F10	Ø125	Ø70	Ø102	M10	3	15	10	4
F12	Ø150	Ø85	Ø125	M12	3	18	12	4
F14	Ø175	Ø100	Ø140	M16	4	24	16	4
F16	Ø210	Ø130	Ø165	M20	5	30	20	4
F25	Ø300	Ø200	Ø254	M16	5	24	16	8

<sup>a</sup>  $d_2$  shall be manufactured within the diameter tolerance f8.

**Table 2 (continued)**

Flange type	Dimensions							Number of studs or bolts <i>n</i>
	$d_1$ min.	$d_2^a$	$d_3$	$d_4$	$h_1$ max.	$h_2$ min.	$h_3$ min.	
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

<sup>a</sup>  $d_2$  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](#).

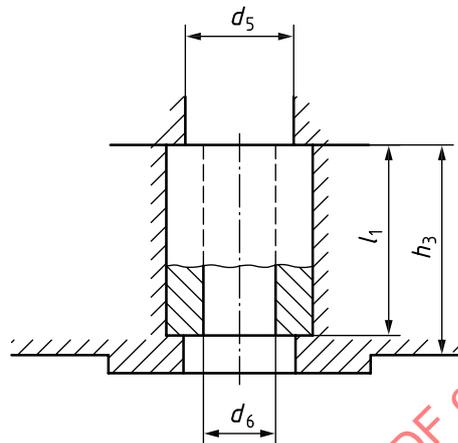
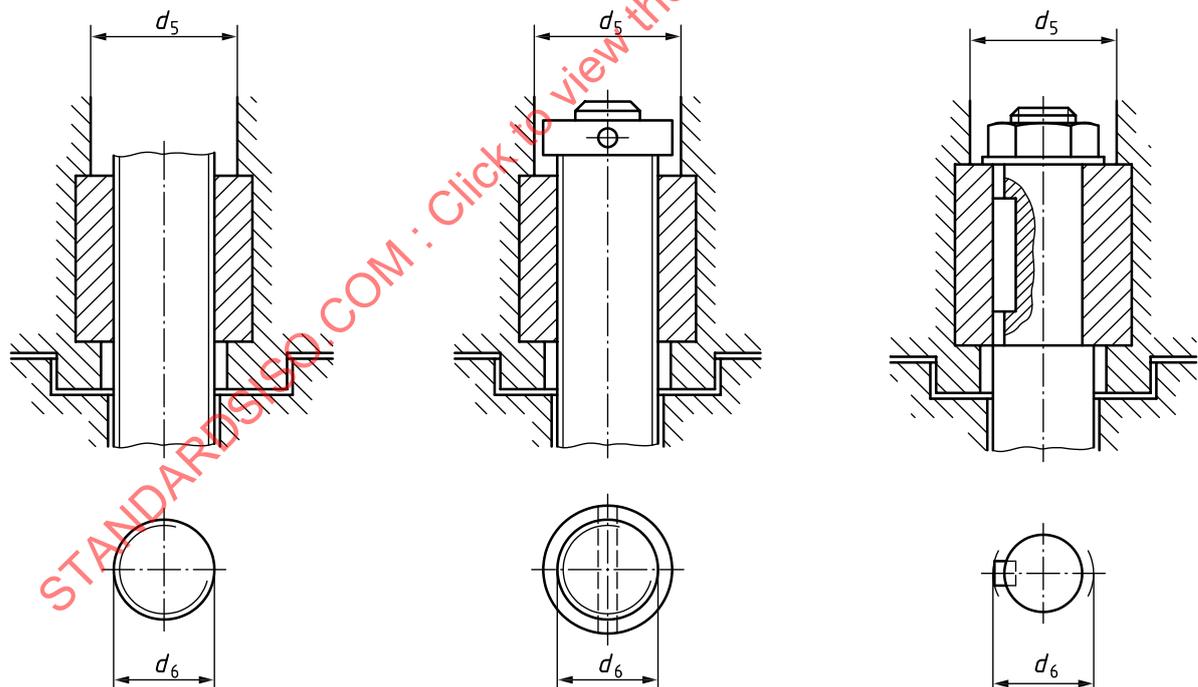


Figure 4 — Driving component, group A



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. <sup>a</sup>	$d_6$ max. <sup>a</sup>	$l_1$ 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

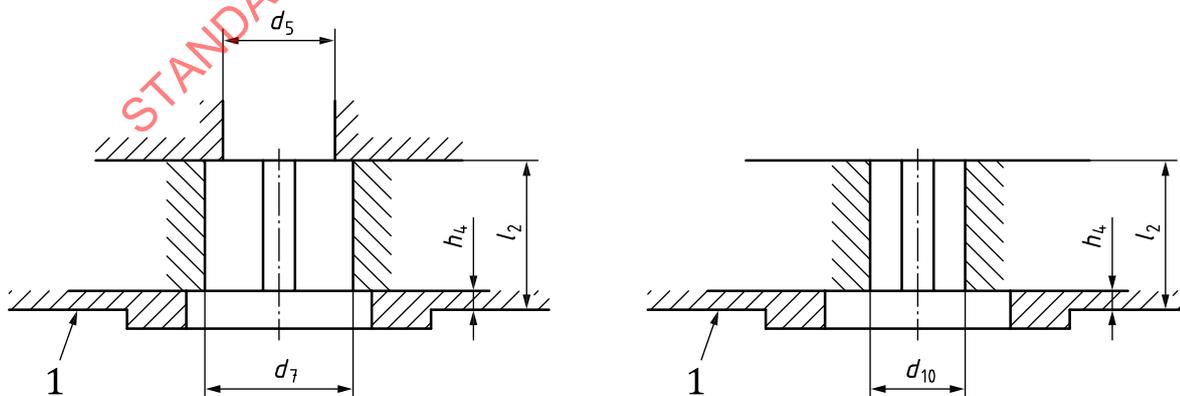
<sup>a</sup> The driving component is capable of accepting a diameter up to and including the values  $d_6$  min. shown in Figure 4. Without being a requirement, the driving component may accept larger diameters up to the values of  $d_6$  max.

**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. Dimensions of keys and keyways shall conform with those given in Annex B.

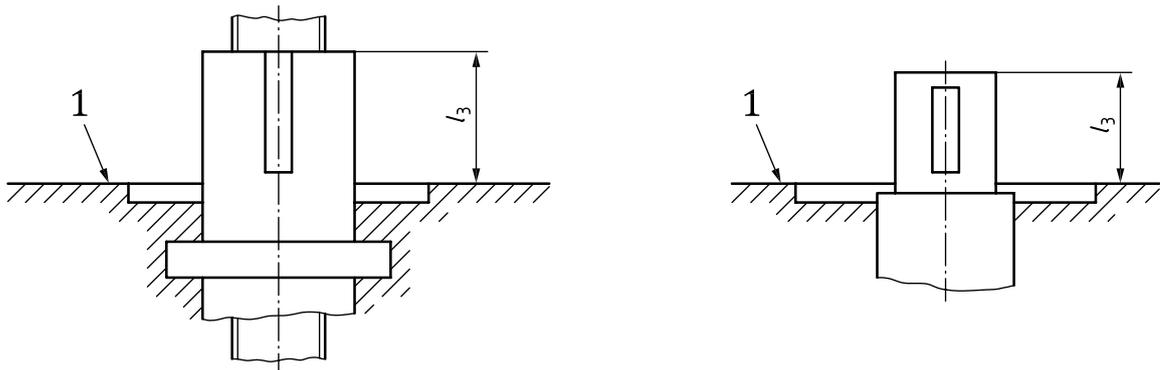
Group B is divided into four sub-groups, where the diameter  $d$  of the output drive is defined as follows:

- Type B1:  $d = d_7$  H9;
- Type B2:  $d \leq d_7$ ;
- Type B3:  $d = d_{10}$  H9;
- Type B4:  $d \leq d_{10}$  max.



**Key**  
1 flange

**Figure 6 — Driving components, group B**

**Key**

1 interface

**Figure 7 — Driven components, group B**

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.	$d_7^b$	$d_{10}^{a, h}$	$d_{10}$ 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

<sup>a</sup> 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.

<sup>b</sup>  $d_7$  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.

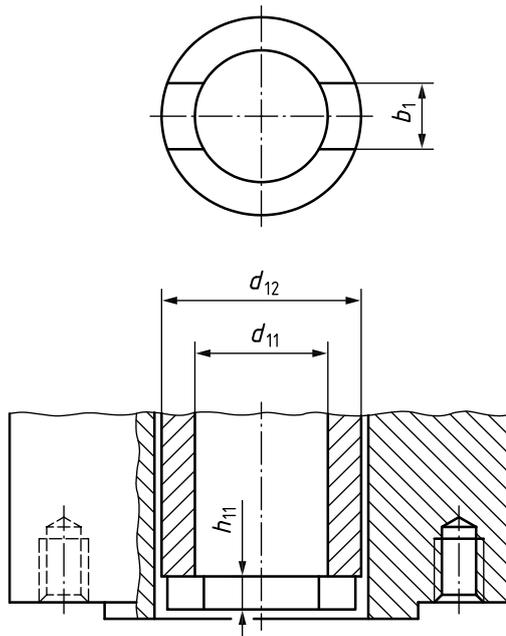


Figure 8 — Driving components, group C

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

<sup>a</sup>  $b_1$  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](#). Dimensions of keys and keyways shall conform with those given in [Annex B](#).

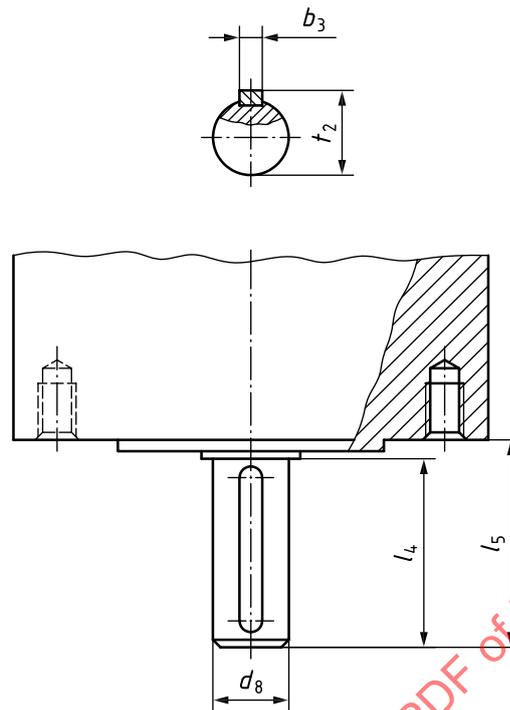


Figure 9 — Driving components, group D

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

<sup>a</sup>  $d_8$  shall be manufactured within the diameter tolerance g8.  
<sup>b</sup>  $b_3$  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](#).

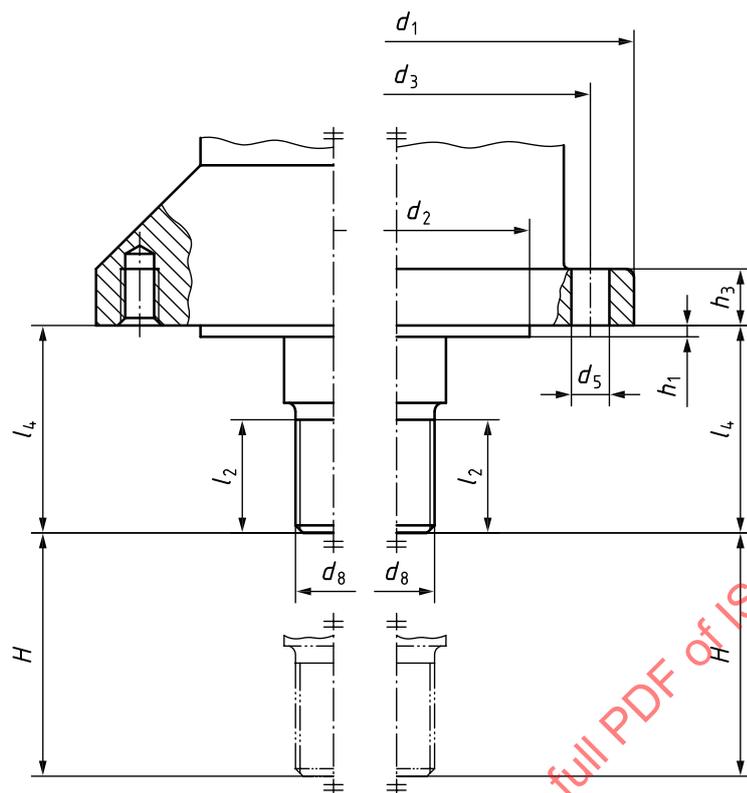


Figure 10 — Dimensions of linear output drive

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

<sup>a</sup> 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 formulae:

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

and

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

where

$\mu$  is the coefficient of friction;

$\sigma_{zul}$  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<sup>2</sup>;

$d_3$  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
- $R_e = 80 \% \times R_m = 640$  MPa.

The tension stress of the bolt can be calculated as  $290 \text{ MPa} = R_e \times 90 \% / 1,6 / 1,25$ .

## 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.

## Annex B (normative)

### Dimensions of keys and keyways

#### B.1 Basis for keys and keyways dimensioning

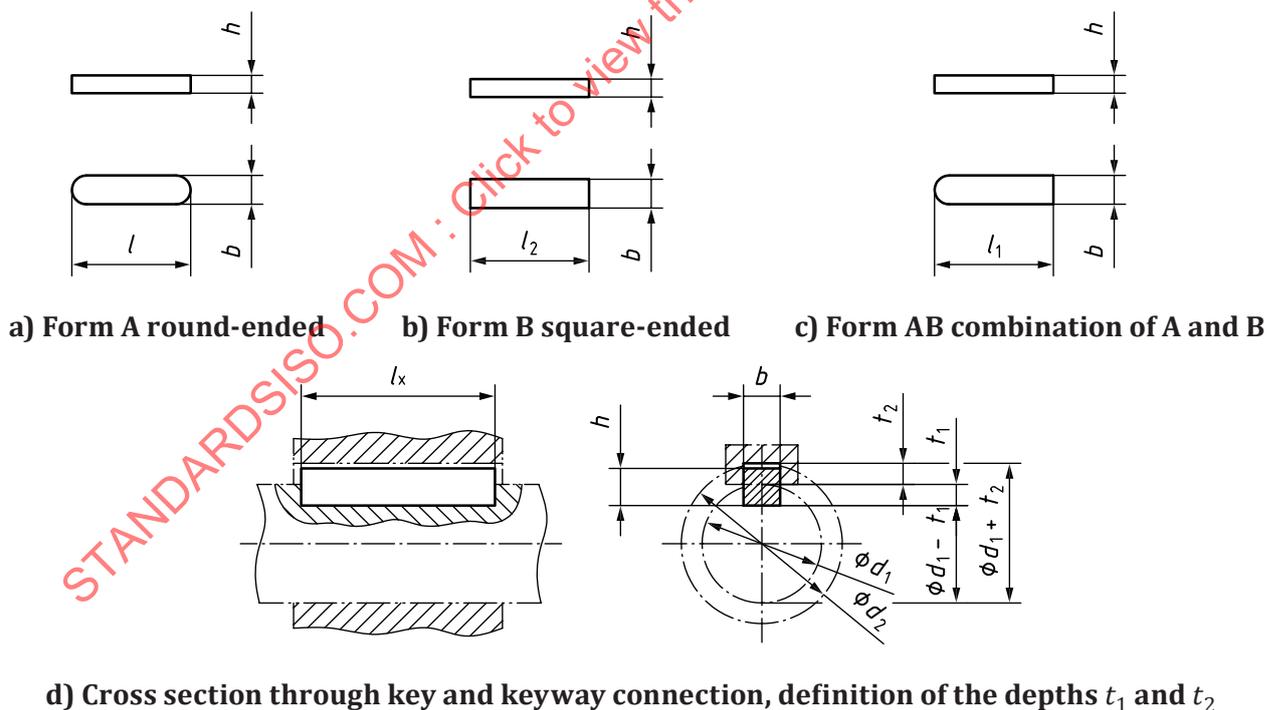
With ISO R773:1969 being withdrawn, there is currently no International Standard defining keys and keyways available. Since for Group B (see 7.3) and Group D (see 7.5), keys and keyways are the means to transfer torque from the actuator to the valve, information on design and dimensions is given in this annex.

#### B.2 Key and keyway forms

Forms for key and keyway shall fulfil the requirements given in Figure B.1 to Figure B.3.

Keys and keyways according to low patterns are not described in this annex.

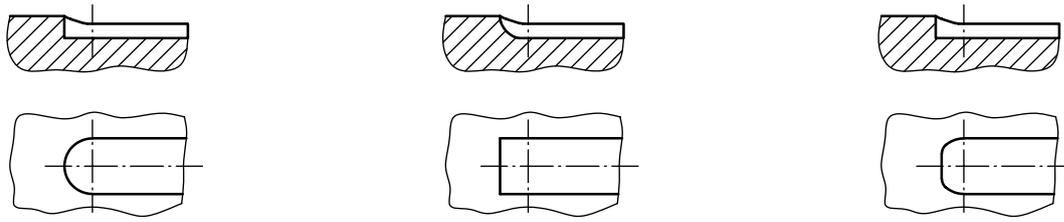
Bolts for retaining of keys, slants for disassembly of keys and holes for spiral pins are common with larger key sizes, but are not described in this annex.



NOTE 1 Length  $l_x$  according to form A, B or AB.

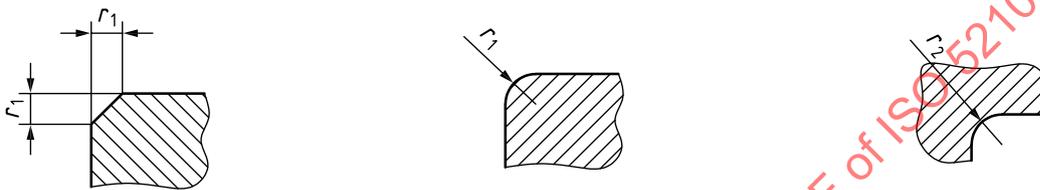
NOTE 2  $l_2 = l - 2\left(\frac{b}{2}\right)$  and  $l_1 = l - \left(\frac{b}{2}\right)$ .

Figure B.1 — Key forms



a) Keyway form N1 (groove by end mill)    b) Keyway form N2 (groove by disc milling cutter)    c) Keyway form N3 (according to specification by valve manufacturer)

Figure B.2 — Keyway forms for valve shafts



a) Chamfer (according to manufacturer of key)    b) Radius (according to manufacturer of key)    c) Radius at base of groove for shaft and hub

NOTE Chamfer and radius [Figures B.3 a) and b)] are chamfered/rounded (at all edges).

Figure B.3 — Chamfering/rounding for key/rounding at base of groove

### B.3 Dimensions and tolerances (cross section and design details)

The dimensions of the keys and keyways, as well as their tolerances, shall be in accordance with those given in [Tables B.1](#) and [B.2](#).