INTERNATIONAL STANDARD

ISO 7789

Second edition
2007-10-01

Hydraulic fluid power — Two-, three- and four-port screw-in cartridge valves — Cavities

Transmissions hydrauliques — Distributeurs à cartouche à visser à deux, trois et quatre orifices — Logements

Reference number
ISO 7789:2007(E)

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 7789 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 5, *Control products and components*.

This second edition cancels and replaces the first edition (ISO 7789:1998), which has been technically revised. It also incorporates the Technical Corrigendum ISO 7789:1998/Cor.1:1999.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. Typical components found in such systems include hydraulic valves. These devices control flow direction, pressure or flow rate liquids in the enclosed circuit.

Hydraulic fluid power — Two-, three- and four-port screw-in cartridge valves — Cavities

1 Scope

This International Standard specifies the dimensions and provides other data relating to cavities in which two-, three- and four-port, screw-in cartridge valves are mounted in order to ensure interchangeability.

It is applicable to two-, three- and four-port screw-in cartridge valves generally used in industrial and mobile equipment.

2 Normative references

The following referenced documents are indispensable for the application 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 1101:2004, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 1219-1:2006, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphic symbols for conventional use and data-processing applications*

ISO 1302:2002, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 2768-1:1989, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 2768-2:1989, *General tolerances — Part 2: Geometrical tolerances for features without individual tolerance indications*

ISO 5598:—[1)], *Fluid power systems and components — Vocabulary*

ISO 5783:1995, *Hydraulic fluid power — Code for identification of valve mounting surfaces and cartridge valve cavities*

ISO 6149-1:2006, *Connections for hydraulic fluid power and general use — Ports and stud ends with ISO 261 metric threads and O-ring sealing — Part 1: Ports with truncated housing for O-ring seal*

ISO 16874:2004, *Hydraulic fluid power — Identification of manifold assemblies and their components*

1) To be published. (Revision of ISO 5598:1985)

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 5598 and the graphical symbols given in ISO 1219-1 apply.

4 Dimensions

4.1 The dimensions of cavities for hydraulic screw-in cartridge valves with two-, three- and four-ports shall be selected from the figures and tables specified in 4.2 to 4.10.

4.2 The dimensions of cavities for two-port valves (excluding pressure-relief valves) with 5 mm to 20,5 mm maximum port diameter are shown in Figure 1 and given in Table 1.

4.3 The dimensions of cavities for two-port pressure-relief valves with 5 mm to 20,5 mm maximum port diameter and with a flow direction from port 1 to port 2, are shown in Figure 2 and given in Table 3.

4.4 The dimensions of cavities for two-port pressure-relief valves with 6 mm to 20,5 mm maximum port diameter and with a flow direction from port 2 to port 1, are shown in Figure 3 and given in Table 5.

4.5 The dimensions of cavities for three-port valves with 6 mm to 20,5 mm maximum port diameter are shown in Figure 4 and given in Table 7.

4.6 The dimensions of cavities for four-port valves with 6 mm to 20,5 mm maximum port diameter are shown in Figure 5 and given in Table 9.

4.7 The dimensions of cavities for two-port valves (excluding pressure-relief valves) with 10,5 mm to 20,5 mm maximum main port diameter and one pilot port are shown in Figure 6 and given in Table 11.

4.8 The dimensions of cavities for two-port pressure-relief valves with 10,5 mm to 20,5 mm maximum main port diameter, one vent or pilot port and with a flow direction from port 1 to port 2 are shown in Figure 7 and given in Table 13.

4.9 The dimensions of cavities for two-port pressure-relief valves with 10,5 mm to 20,5 mm maximum main port diameter, one vent or pilot port and with a flow direction from port 2 to port 1 are shown in Figure 8 and given in Table 15.

4.10 The dimensions of cavities for three-port valves with 10,5 mm to 20,5 mm maximum main port diameter and one pilot port are shown in Figure 9 and given in Table 17.

5 Tolerances

Tolerances values for all dimensions and surface roughness are given in Figures 1 to 9 and in Tables 1, 3, 5, 7, 9, 11, 13, 15 and 17, in accordance with ISO 1101 and ISO 1302.

Tolerances for linear and angular dimensions shall be in accordance with the designation as described in ISO 2768-1.

Geometrical tolerances shall be in accordance with the designation as described in ISO 2768-2.

NOTE All figures in this International Standard indicate tolerance requirements using the ISO code “ISO 2768-mk” as described in ISO 2768-1 and ISO 2768-2.

6 Ports usage and identification

6.1 Interchangeability of cartridge valves in the cavities defined by this International Standard requires uniform identifications and functions of the valve ports. Symbols for the valve types intended for use in each cavity are shown in Tables 2, 4, 6, 8, 10, 12, 14, 16 and 18. Port usage and identification (1, 2, 3 and 4) are shown on the symbols.

6.2 The tabulated symbols illustrate general types of valves. Variations within each type shall conform to the port usage convention shown for that type.

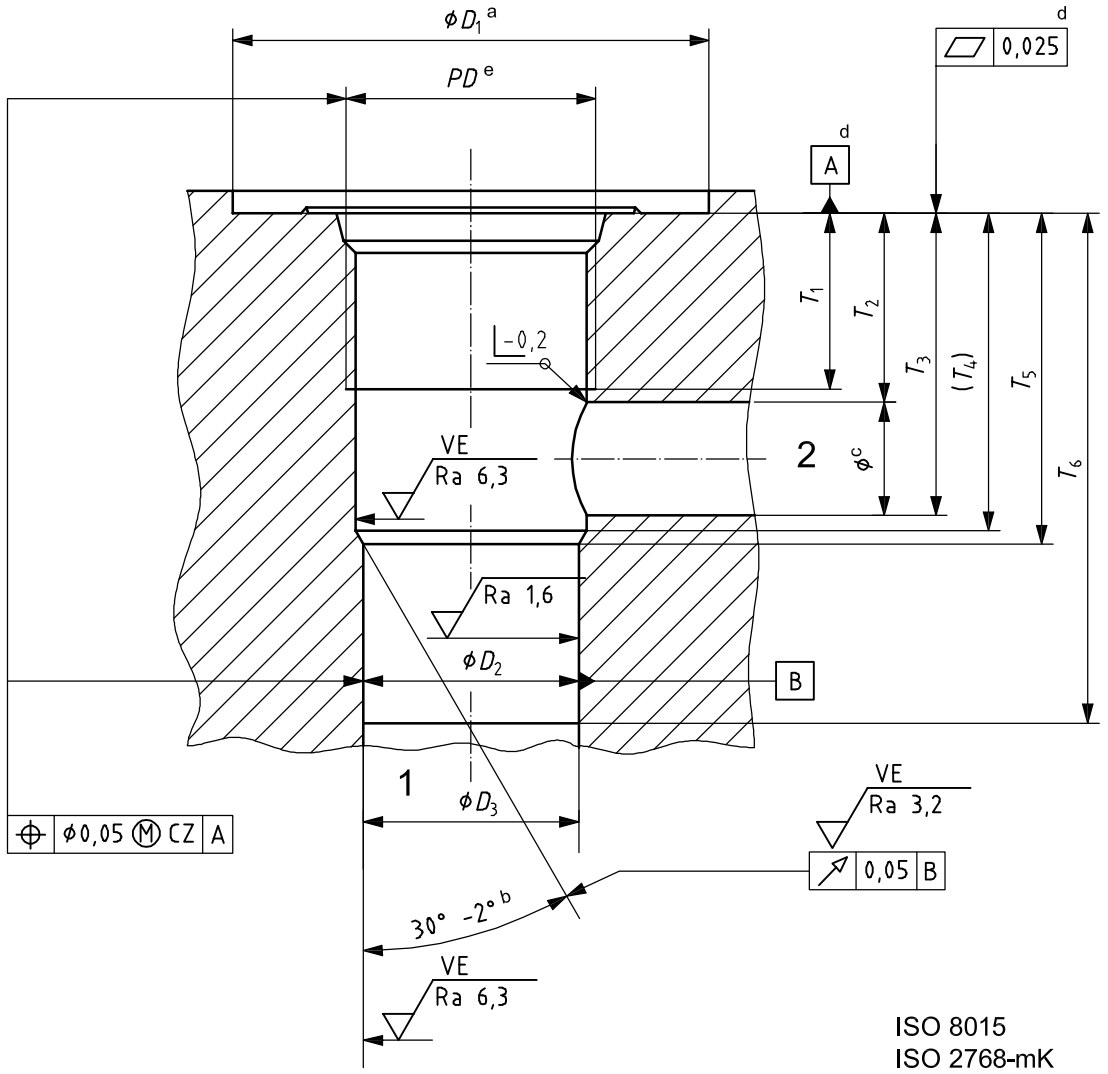
6.3 Some of the tabulated symbols are commonly combined with other graphic elements to represent a complete valve. For example, the four-port directional control valve shown in Table 10 normally includes operators such as solenoids or springs. Interchangeability of such complete valves requires that the combined symbols, including the added elements, be identical as to port connection in each operator condition.

6.4 The manifold identification shall be in accordance with ISO 16874.

7 **Identification statement** (Reference to this International Standard)

It is strongly recommended to manufacturers who choose to conform to this International Standard that the following statement be used in test reports, catalogues and sales literature:

“Cavity dimensions and port usage are in accordance with ISO 7789:2007, *Hydraulic fluid power — Two-, three- and four-port screw-in cartridge valves — Cavities*.”



Key

1, 2, ports

NOTE The same designations are used in Table 2.

PD (thread) pitch diameter

VE visual examination

a The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

b No burrs permitted in this area, the edge must be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

c Radial groove optional.

d Datum area inside ring nose.

e The port is in accordance with ISO 6149-1.

Figure 1 — Cavities for two-port valves (excluding pressure-relief valves) with 5 mm to 20,5 mm maximum port diameter

Table 1 — Dimensions for cavities for two-port valves (excluding pressure-relief valves) with 5 mm to 20,5 mm maximum port diameter

Dimensions in millimetres

Parameter		Dimension by codification [a]					
		18-01-0-07	20-01-0-07	22-01-0-07	27-01-0-07	33-01-0-07	42-01-0-07
Thread [b]		M18×1,5	M20×1,5	M22×1,5	M27×2	M33×2	M42×2
D_1 min.		32	38	42	48	58	74
D_2 H8		15	17	19	23	29	38
D_3		15	17	19	23	29	38
T_1 min.		14,5	14,5	15,5	19	19	19,5
T_2 min.		14,5	14,5	17	22	22	23
T_3 max.		19,5	20,5	27,5	35	38,5	43,5
(T_4)		20	21	28	35,5	39	44
T_5 $^{+0,4}_{0}$		21,3	22,3	29,3	37,2	40,7	45,7
T_6	T_6 min. [c]	29,5	30,5	38,5	46,5	50	56
	T_6 $^{+1}_{0}$ [d]	31	32	40	48	52	58

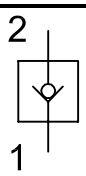
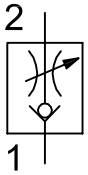
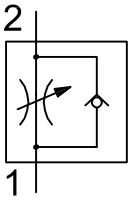
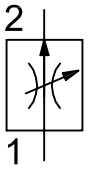
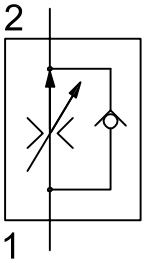
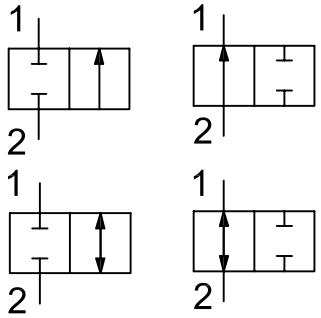
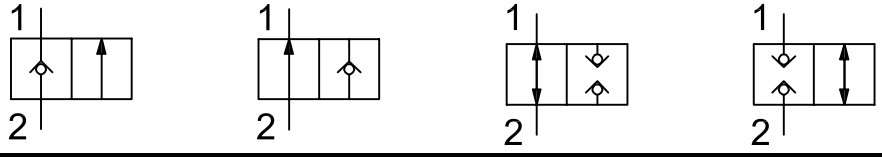
[a] Codification is in accordance with ISO 5783.

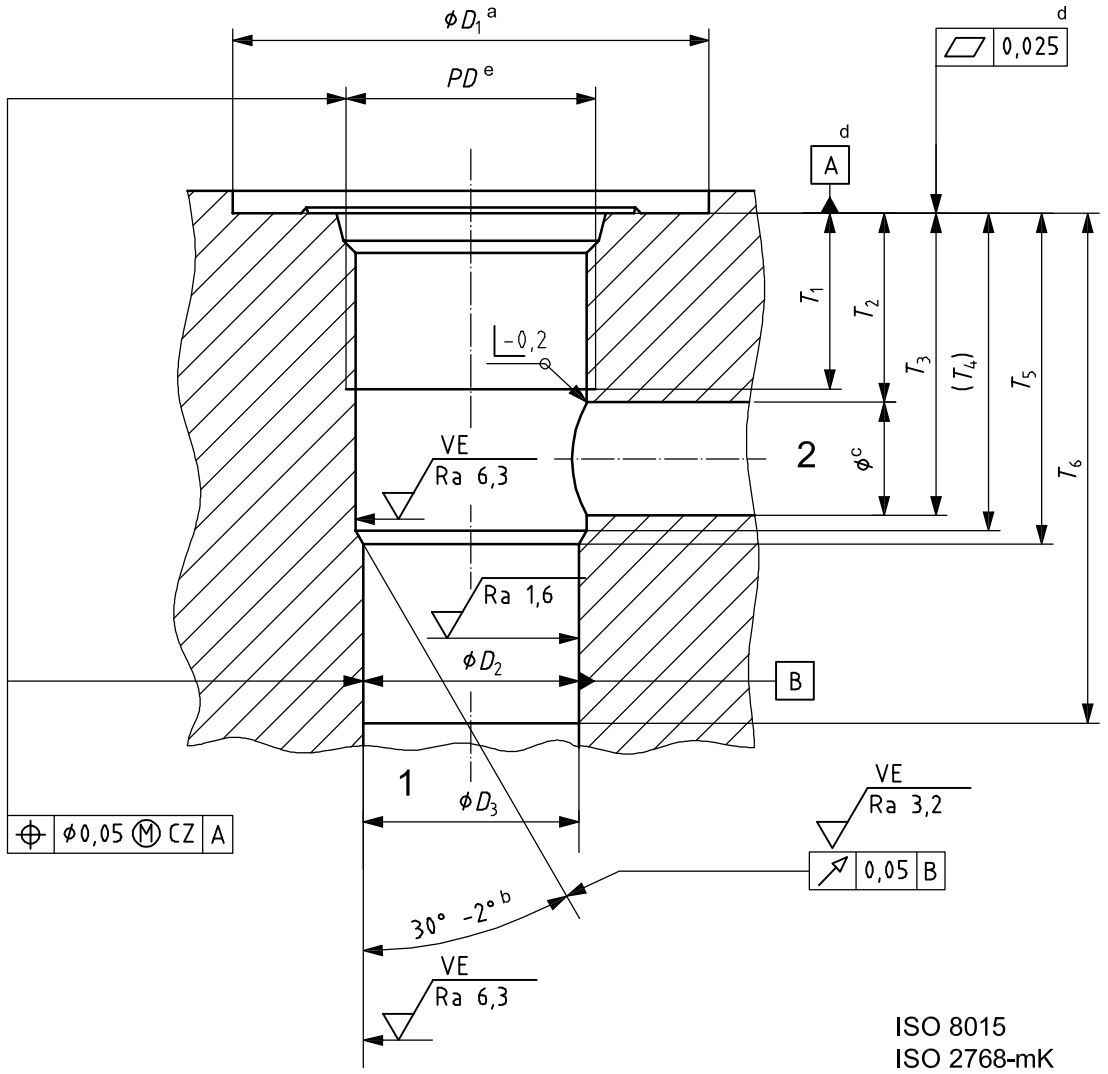
[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this International Standard).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_6. For some valve types, additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 2 — Symbols for valves entering the cavities shown in Figure 1

Description	Symbol	Description	Symbol
Non-return valve		Throttle non-return valve	
Flow-control valve with free-flow return check		Pressure-compensated flow-control valve	
Pressure-compensated flow control valve with free-flow return check		Two-port directional control valve	
Two-port directional control poppet (seat) valve			



Key

1, 2, ports

NOTE The same designations are used in Table 4.

PD (thread) pitch diameter

VE visual examination

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 2 — Cavities for two-port pressure-relief valves with 5 mm to 20,5 mm maximum port diameter and with a flow direction from port 1 to port 2

Table 3 — Dimensions for cavities for two-port pressure-relief valves with 5 mm to 20,5 mm maximum port diameter and with a flow direction from port 1 to port 2

Dimensions in millimetres

Parameter		Dimension by codification [a]					
		18-02-0-07	20-02-0-07	22-02-0-07	27-02-0-07	33-02-0-07	42-02-0-07
Thread [b]		M18×1,5	M20×1,5	M22×1,5	M27×2	M33×2	M42×2
D_1 min.		32	38	42	48	58	74
D_2 H8		13,5	15,5	17,5	21,5	27	36
D_3		13,5	15,5	17,5	21,5	27	36
T_1 min.		14,5	14,5	15,5	19	19	19,5
T_2 min.		14,5	14,5	17	22	22	23
T_3 max.		19,5	20,5	27,5	35	38,5	43,5
(T_4)		20	21	28	35,5	39	44
T_5 $^{+0,4}_{0}$		22,6	23,6	30,6	38,5	42,5	47,5
T_6	T_6 min. [c]	30,5	31,5	40	48	52	58
	T_6 $^{+1}_{0}$ [d]	32	33	41,5	49,5	54	60

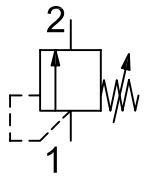
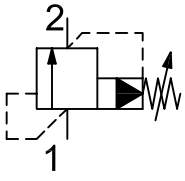
[a] Codification is in accordance with ISO 5783.

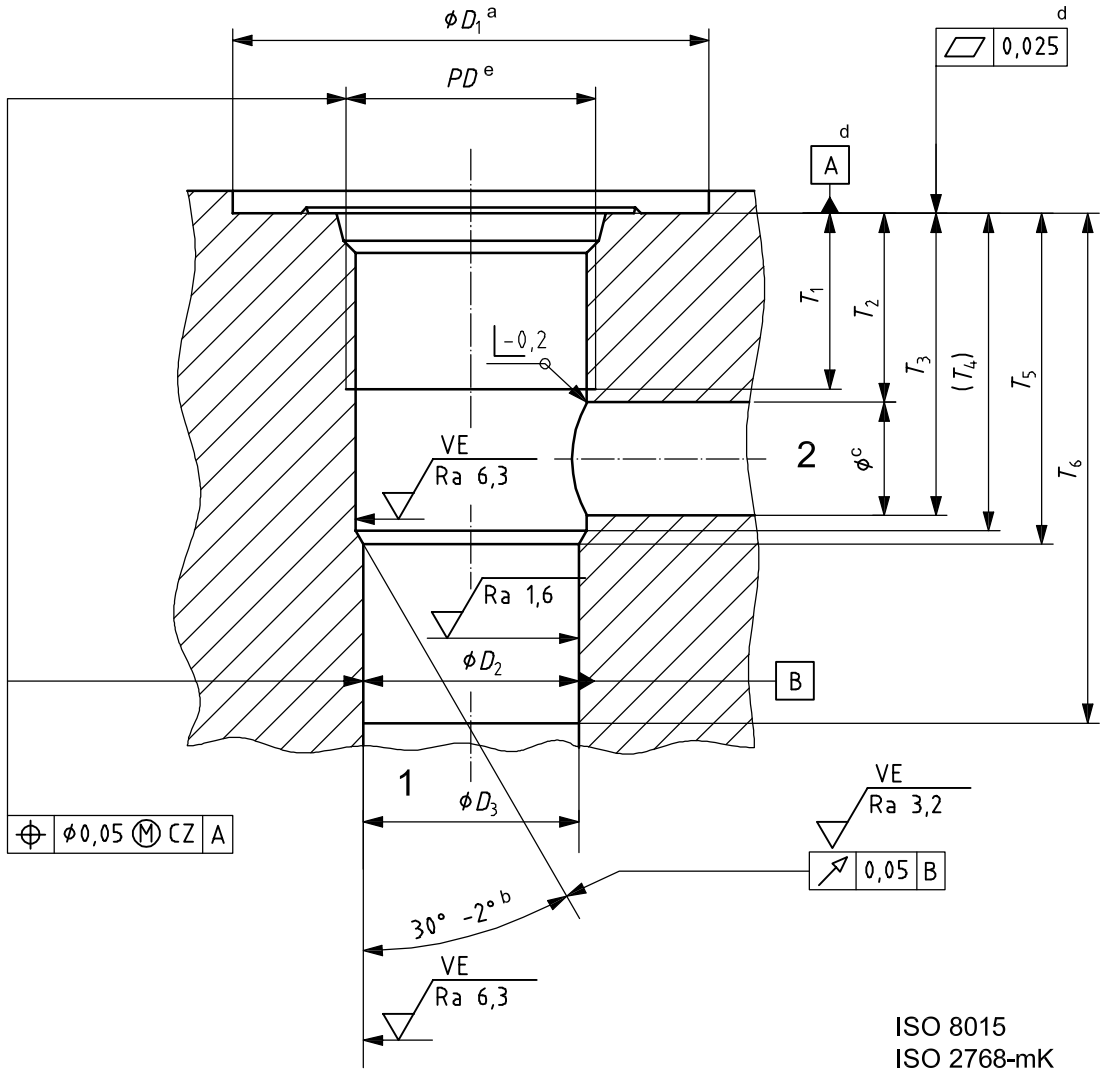
[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this International Standard).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_6. For some valve types, additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 4 — Symbol for valves entering the cavities shown in Figure 2

Description	Symbol
Pressure-relief valve, direct operated	
Pressure-relief valve, pilot operated	



Key

1, 2, ports

NOTE The same designations are used in Table 6.

PD (thread) pitch diameter

VE visual examination

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 3 — Cavities for two-port pressure-relief valves with 6 mm to 20,5 mm maximum port diameter and with a flow direction from port 2 to port 1

Table 5 — Dimensions for cavities for two-port pressure-relief valves with 6 mm to 20,5 mm maximum port diameter and with a flow direction from port 2 to port 1

Dimensions in millimetres

Parameter		Dimension by codification [a]				
		20-03-0-07	22-03-0-07	27-03-0-07	33-03-0-07	42-03-0-07
Thread [b]		M20×1,5	M22×1,5	M27×2	M33×2	M42×2
D_1 min.		38	42	48	58	74
D_2 H8		14	16	20	25	34
D_3		14	16	20	25	34
T_1 min.		14,5	15,5	19	19	19,5
T_2 min.		14,5	17	22	22	23
T_3 max.		20,5	27,5	35	38,5	43,5
(T_4)		21	28	35,5	39	44
$T_5\ ^{+0,4}_{0}$		24,9	31,9	39,8	44,2	49,2
T_6	T_6 min. [c]	33	41	49	53,5	59,5
	$T_6\ ^{+1}_{0}$ [d]	34,5	42,5	50,5	55,5	61,5

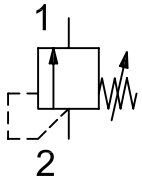
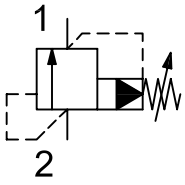
[a] Codification is in accordance with ISO 5783.

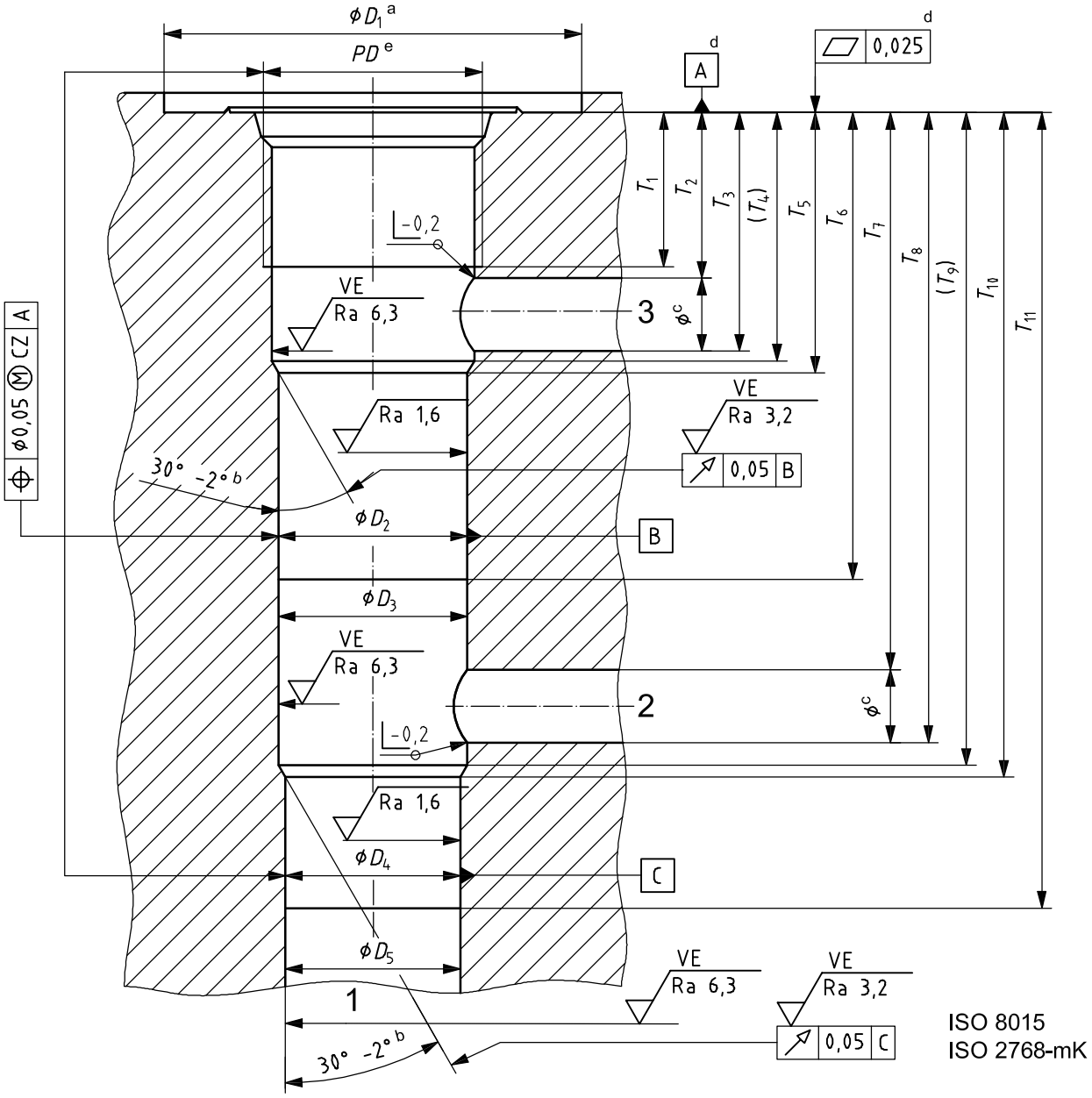
[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this document).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_6. For some valve types additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 6 — Symbol for valves entering the cavities shown in Figure 3

Description	Symbol
Pressure-relief valve, direct operated	
Pressure-relief valve, pilot operated	



Key

1, 2 and 3, ports

PD (thread) pitch diameter

VE visual examination

NOTE The same designations are used in Table 8.

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 4 — Cavities for three-port valves with 6 mm to 20,5 mm maximum port diameter

Table 7 — Dimensions for cavities for three-port valves with 6 mm to 20,5 mm maximum port diameter

Dimensions in millimetres

Parameter		Dimension by codification [a]				
		20-04-0-07	22-04-0-07	27-04-0-07	33-04-0-07	42-04-0-07
Thread [b]		M20×1,5	M22×1,5	M27×2	M33×2	M42×2
D_1 min.		38	42	48	58	74
D_2 H8		17	19	23	29	38
D_3		17	19	23	29	38
D_4 H8		15,5	17	21	27	36
D_5		15,5	17	21	27	36
T_1 min.		14,5	15,5	19	19	19,5
T_2 min.		14,5	17	22	22	23
T_3 max.		20,5	27,5	35	38,5	43,5
(T_4)		21	28	35,5	39	44
T_5 $^{+0,4}_{0}$		22,3	29,3	37,2	40,7	45,7
T_6 min.		30,3	37,3	45,2	48,7	53,7
T_7 min.		30,5	38,5	46,5	50	56
T_8 max.		36,5	49	59,5	66,5	76,5
(T_9)		37	49,5	60	67	77
T_{10} $^{+0,4}_{0}$		38,3	51,2	61,7	68,7	78,7
T_{11}	T_{11} min. [c]	46,5	60,5	71	78	89
	T_{11} $^{+1}_{0}$ [d]	48	62	72,5	80	91

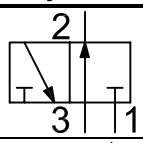
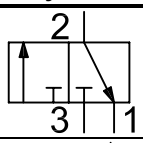
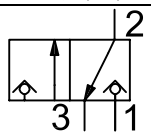
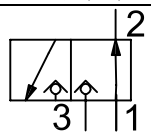
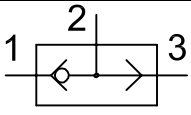
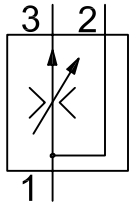
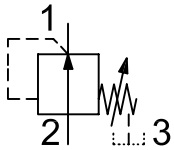
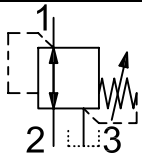
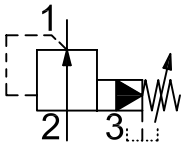
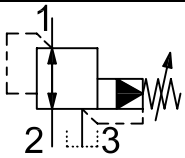
[a] Codification is in accordance with ISO 5783.

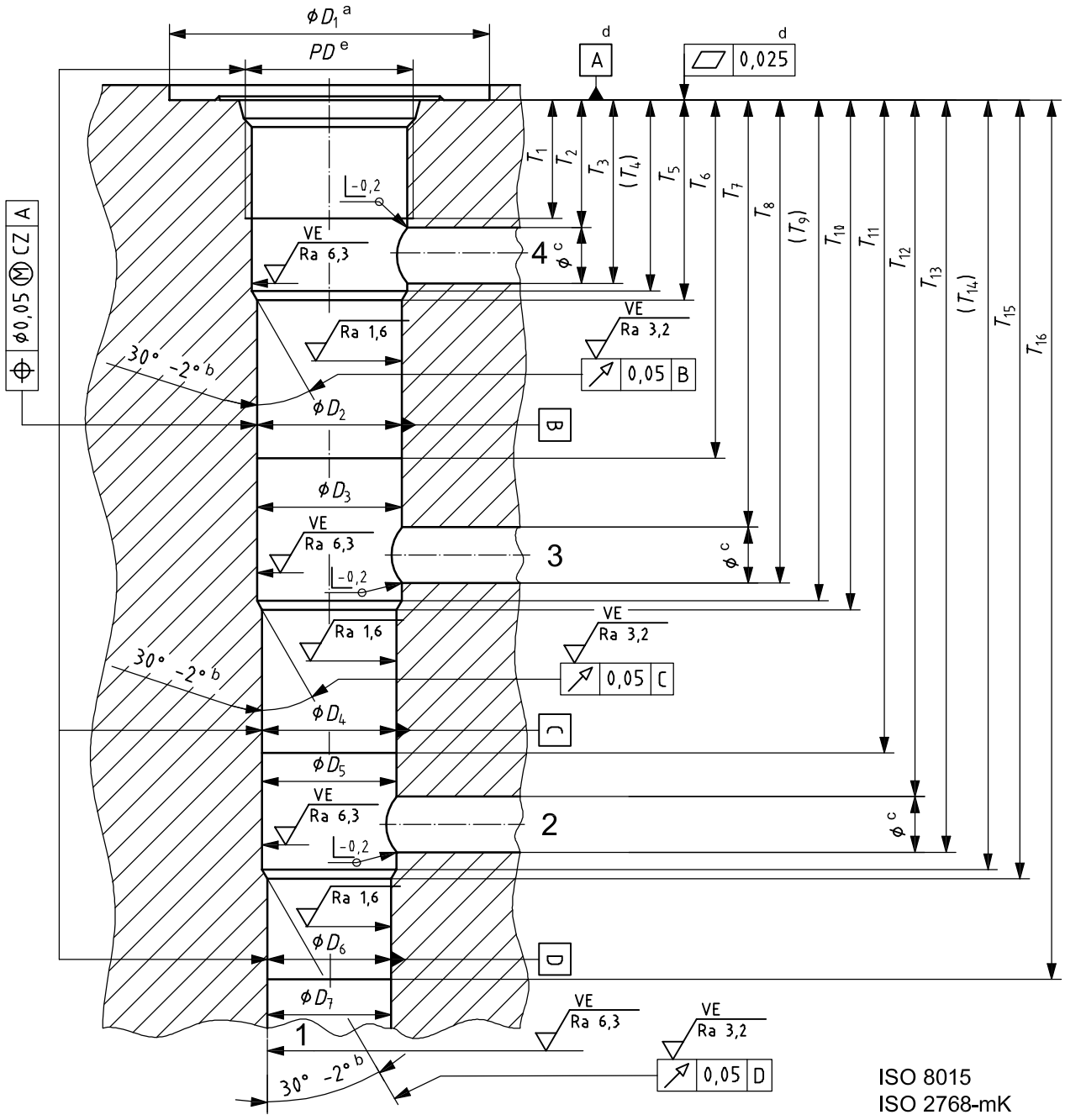
[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this International Standard).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_{11}. For some valve types, additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 8 — Symbols for valves entering the cavities shown in Figure 4

Description	Symbol	Description	Symbol
Three-port directional control valve		Three-port directional control valve	
Three-port directional control poppet (seat) valve		Three-port directional control poppet (seat) valve	
Shuttle valve		Three-port flow control valve	
Pressure-reducing valve, direct operated		Pressure-reducing valve with relief, direct operated	
Pressure-reducing valve, pilot operated		Pressure-reducing valve with relief, pilot operated	



Key

1, 2 and 3, ports

NOTE The same designations are used in Table 10.

PD (thread) pitch diameter

VE visual examination

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 5 — Cavities for four-port valves with 6 mm to 20,5 mm maximum port diameter

Table 9 — Dimensions for cavities for four-port valves with 6 mm to 20,5 mm maximum port diameter

Dimensions in millimetres

Parameter		Dimension by codification [a]				
		20-05-0-07	22-05-0-07	27-05-0-07	33-05-0-07	42-05-0-07
Thread [b]		M20×1,5	M22×1,5	M27×2	M33×2	M42×2
D_1 min.		38	42	48	58	74
D_2 H8		17	19	23	29	38
D_3		17	19	23	29	38
D_4 H8		15,5	17	21	27	36
D_5		15,5	17	21	27	36
D_6 H8		14	15	19	25	34
D_7		14	15	19	25	34
T_1 min.		14,5	15,5	19	19	19,5
T_2 min.		14,5	17	22	22	23
T_3 max.		20,5	27,5	35	38,5	43,5
(T_4)		21	28	35,5	39	44
$T_5\ ^{+0,4}_{0}$		22,3	29,3	37,2	40,7	45,7
T_6 min.		30,3	37,3	45,2	48,7	53,7
T_7 min.		30,5	38,5	46,5	50	56
T_8 max.		36,5	49	59,5	66,5	76,5
(T_9)		37	49,5	60	67	77
$T_{10}\ ^{+0,4}_{0}$		38,3	51,2	61,7	68,7	78,7
T_{11} min.		46,3	59,2	69,7	76,7	86,7
T_{12} min.		46,5	60,5	71	78	89
T_{13} max.		52,5	71	84	94,5	109,5
(T_{14})		53	71,5	84,5	95	110
$T_{15}\ ^{+0,4}_{0}$		54,3	73,2	86,2	96,7	111,7
T_{16}	T_{16} min [c]	62,5	82,5	95,5	106	122
	$T_{16}\ ^{+1}_{0}$ [d]	64	84	97	108	124

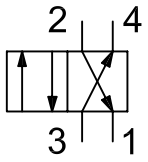
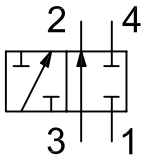
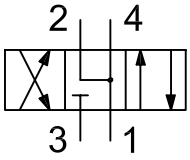
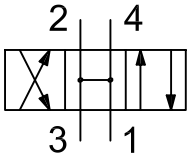
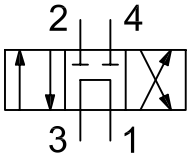
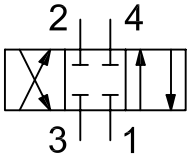
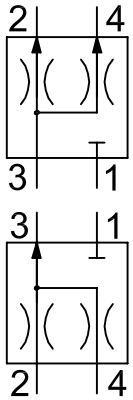
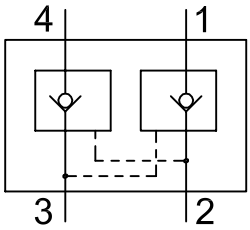
[a] Codification is in accordance with ISO 5783.

[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this International Standard).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_{16}. For some valve types, additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 10 — Symbols for valves entering the cavities shown in Figure 5

Description	Symbol	Description	Symbol
Four-port directional control valve		Diverter valve	
Four-port directional control valve Motor Spool		Four-port directional control valve Open centre spool	
Four-port directional control valve Tandem Spool		Four-port directional control valve Closed centre spool	
Divider-combiner valve		Pilot to open, non-return valve double	

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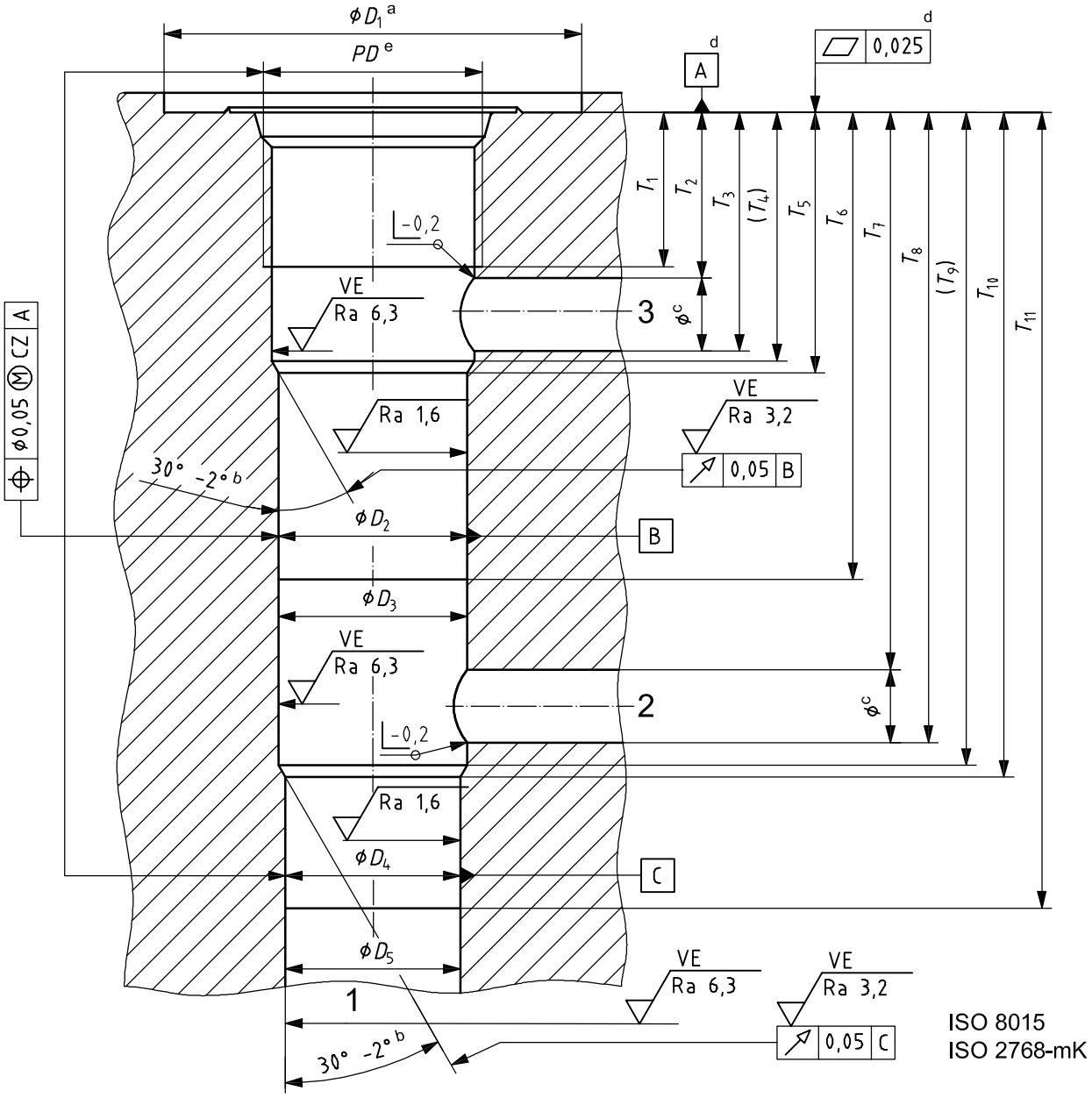


Key

1, 2 and 3, ports

PD (thread) pitch diameter

VE visual examination

NOTE The same designations are used in Table 12.

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 6 — Cavities for two-port valves (excluding pressure-relief valves) with 10,5 mm to 20,5 mm maximum main port diameter and one-pilot port

Table 11 — Dimensions for cavities for two-port valves (excluding pressure-relief valves) with 10,5 mm to 20,5 mm maximum main port diameter and one-pilot port

Dimensions in millimetres

Parameter		Dimension by codification [a]			
		22-06-0-07	27-06-0-07	33-06-0-07	42-06-0-07
Thread [b]		M22×1,5	M27×2	M33×2	M42×2
D_1 min.		42	48	58	74
D_2 H8		19	23	29	38
D_3		19	23	29	38
D_4 H8		17	21	27	36
D_5		17	21	27	36
T_1 min.		15,5	19	19	19,5
T_2 min.		17	21,5	21	21,5
T_3 max.		21,5	26	25,5	26
(T_4)		22	26,5	26	26,5
T_5 $^{+0,4}_{0}$		23,3	28,2	27,7	28,2
T_6 min.		31,3	36,2	35,7	36,2
T_7 min.		32,5	37,5	37	38,5
T_8 max.		43	50,5	53,5	59
(T_9)		43,5	51	54	59,5
T_{10} $^{+0,4}_{0}$		45,2	52,7	55,7	61,2
T_{11}	T_{11} min. [c]	54,5	62	65	71,5
	T_{11} $^{+1}_{0}$ [d]	56	63,5	67	73,5

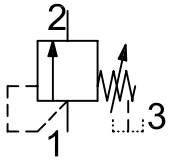
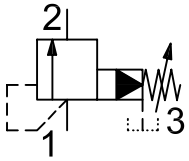
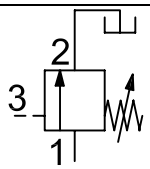
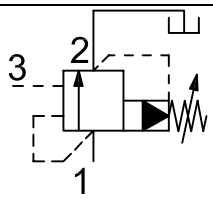
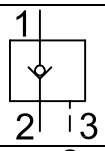
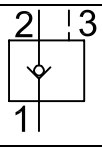
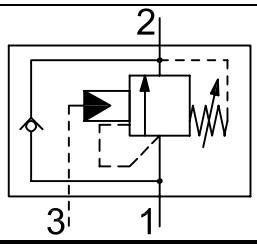
[a] Codification is in accordance with ISO 5783.

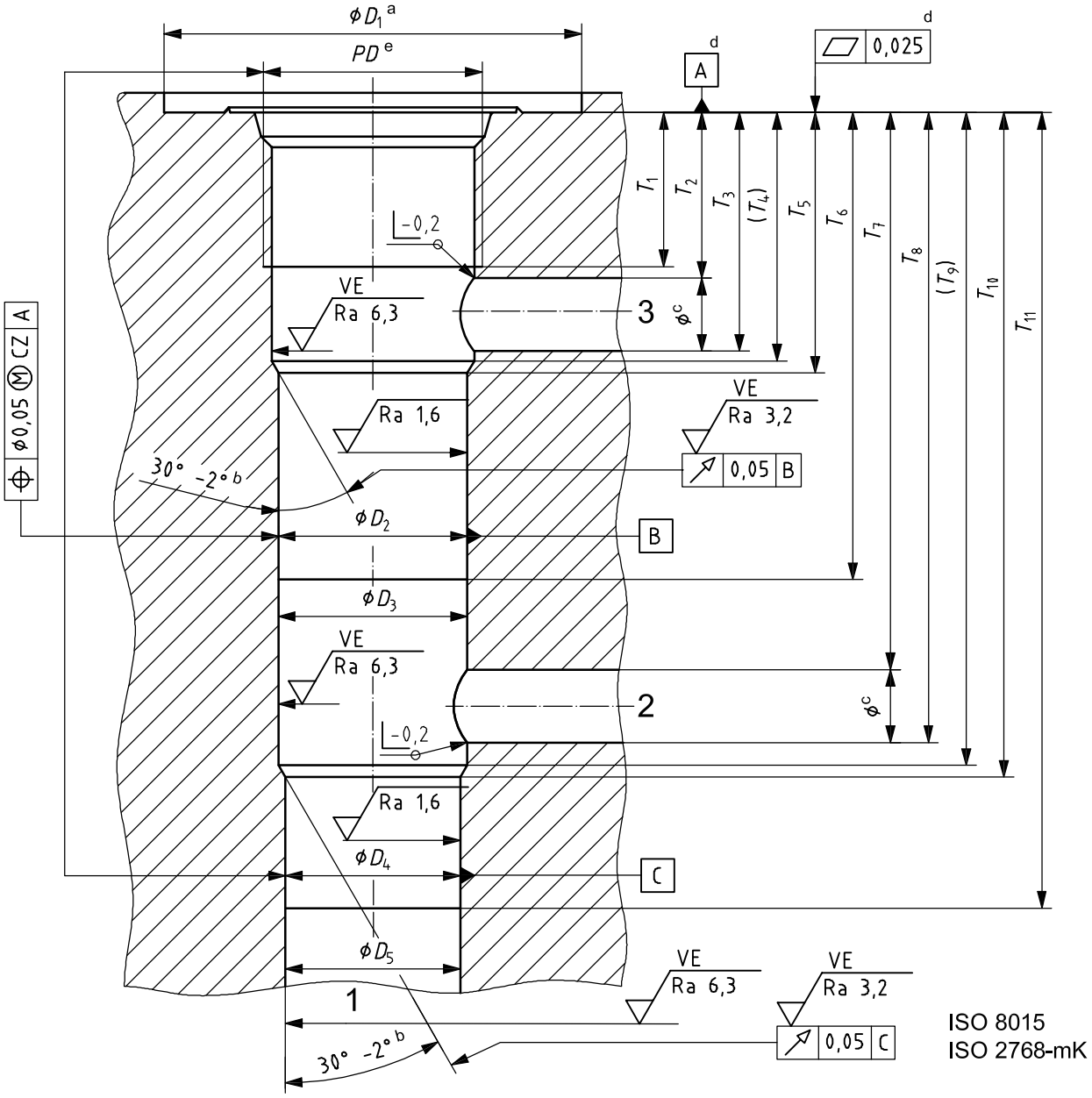
[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this International Standard).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_{11}. For some valve types, additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 12 — Symbols for valves entering the cavities shown in Figure 6

Description	Symbol	Description	Symbol
Sequence valve, direct operated		Sequence valve, pilot operated	
Accumulator unloading valve, direct operated		Accumulator unloading valve, pilot operated	
Pilot to open, non-return valve		Pilot to close, non-return valve	
Counter balance valve			



Key

1, 2 and 3, ports

NOTE The same designations are used in Table 14.

PD (thread) pitch diameter

VE visual examination

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 7 — Cavities for two-port pressure-relief valves with 10,5 mm to 20,5 mm maximum main port diameter, one vent or pilot port and with a flow direction from port 1 to port 2

Table 13 — Dimensions for cavities for two-port pressure-relief valves with 10,5 mm to 20,5 mm maximum main port diameter, one vent or pilot port and with a flow direction from port 1 to port 2

Dimensions in millimetres

Parameter		Dimension by codification [a]			
		22-07-0-07	27-07-0-07	33-07-0-07	42-07-0-07
Thread [b]		M22×1,5	M27×2	M33×2	M42×2
D_1 min.		42	48	58	74
D_2 H8		19	23	29	38
D_3		19	23	29	38
D_4 H8		15,5	19,5	25	34
D_5		15,5	19,5	25	34
T_1 min.		15,5	19	19	19,5
T_2 min.		17	21,5	21	21,5
T_3 max.		21,5	26	25,5	26
(T_4)		22	26,5	26	26,5
$T_5\ ^{+0,4}_{0}$		23,3	28,2	27,7	28,2
T_6 min.		31,3	36,2	35,7	36,2
T_7 min.		32,5	37,5	37	38,5
T_8 max.		43	50,5	53,5	59
(T_9)		43,5	51	54	59,5
$T_{10}\ ^{+0,4}_{0}$		46,5	54	57,5	63
T_{11}	T_{11} min. [c]	56	63,5	67	73,5
	$T_{11}\ ^{+1}_{0}$ [d]	57,5	65	69	75,5

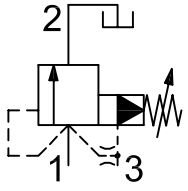
[a] Codification is in accordance with ISO 5783.

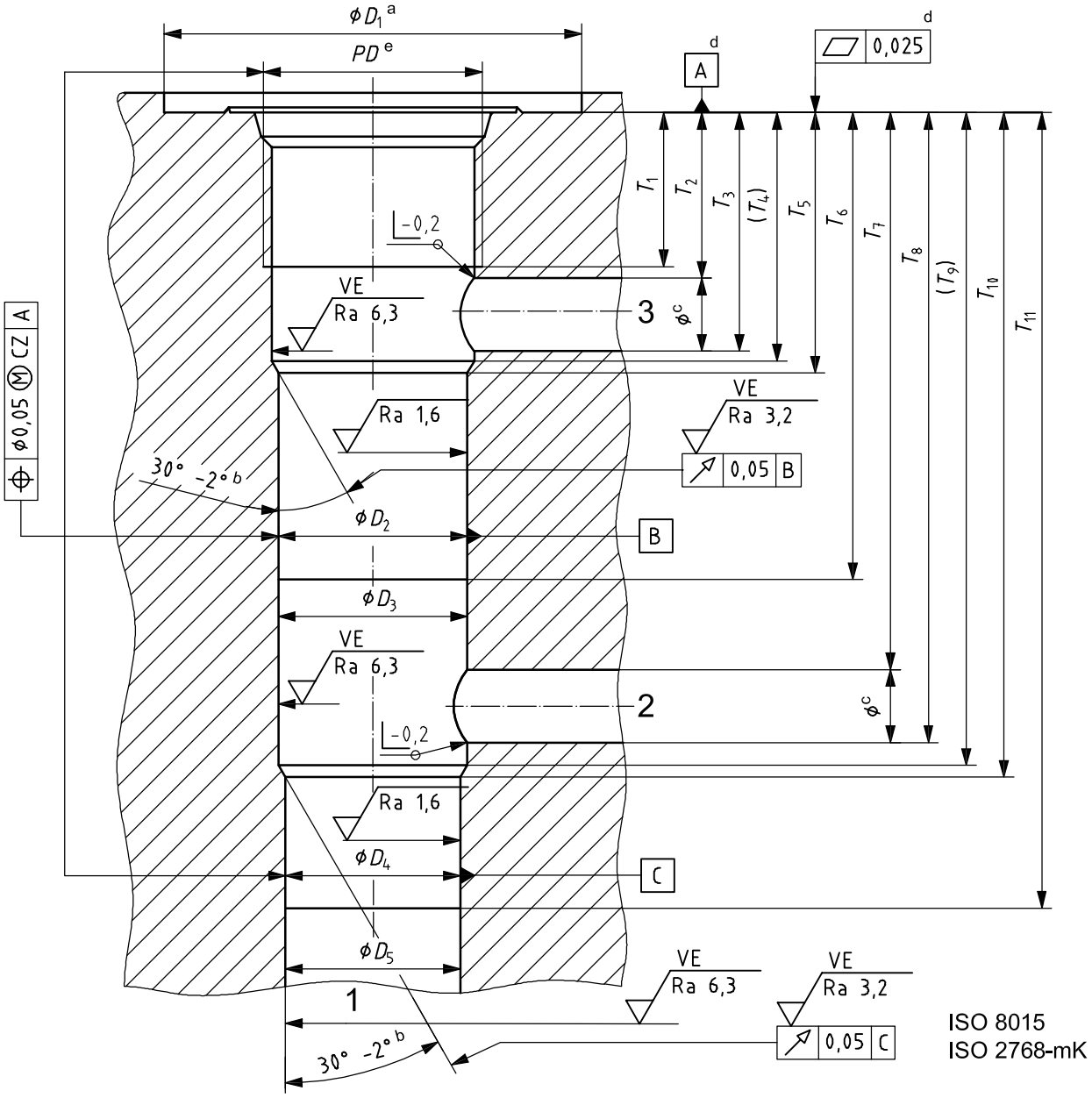
[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this document).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_{11}. For some valve types, additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 14 — Symbol for valves entering the cavities shown in Figure 7

Description	Symbol
Pressure-relief valve with ventable or pilot port, pilot operated	



Key

1, 2 and 3, ports

PD (thread) pitch diameter

VE visual examination

NOTE The same designations are used in Table 16.

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 8 — Cavities for two-port pressure-relief valves with 10,5 mm to 20,5 mm maximum main port diameter, one vent or pilot port and with a flow direction from port 2 to port 1

Table 15 — Dimensions for cavities for two-port pressure-relief valves with 10,5 mm to 20,5 mm maximum main port diameter, one vent or pilot port and with a flow direction from port 2 to port 1

Dimensions in millimetres

Parameter		Dimension by codification [a]			
		22-08-0-07	27-08-0-07	33-08-0-07	42-08-0-07
Thread [b]		M22×1,5	M27×2	M33×2	M42×2
D_1 min.		42	48	58	74
D_2 H8		19	23	29	38
D_3		19	23	29	38
D_4 H8		14	18	23	32
D_5		14	18	23	32
T_1 min.		15,5	19	19	19,5
T_2 min.		17	21,5	21	21,5
T_3 max.		21,5	26	25,5	26
(T_4)		22	26,5	26	26,5
T_5 $^{+0,4}_{0}$		23,3	28,2	27,7	28,2
T_6 min.		31,3	36,2	35,7	36,2
T_7 min.		32,5	37,5	37	38,5
T_8 max.		43	50,5	53,5	59
(T_9)		43,5	51	54	59,5
T_{10} $^{+0,4}_{0}$		47,8	55,3	59,2	64,7
T_{11}	T_{11} min. [c]	57	64,5	68,5	75
	T_{11} $^{+1}_{0}$ [d]	58,5	66	70,5	77

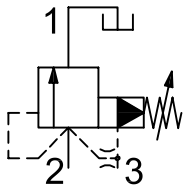
[a] Codification is in accordance with ISO 5783.

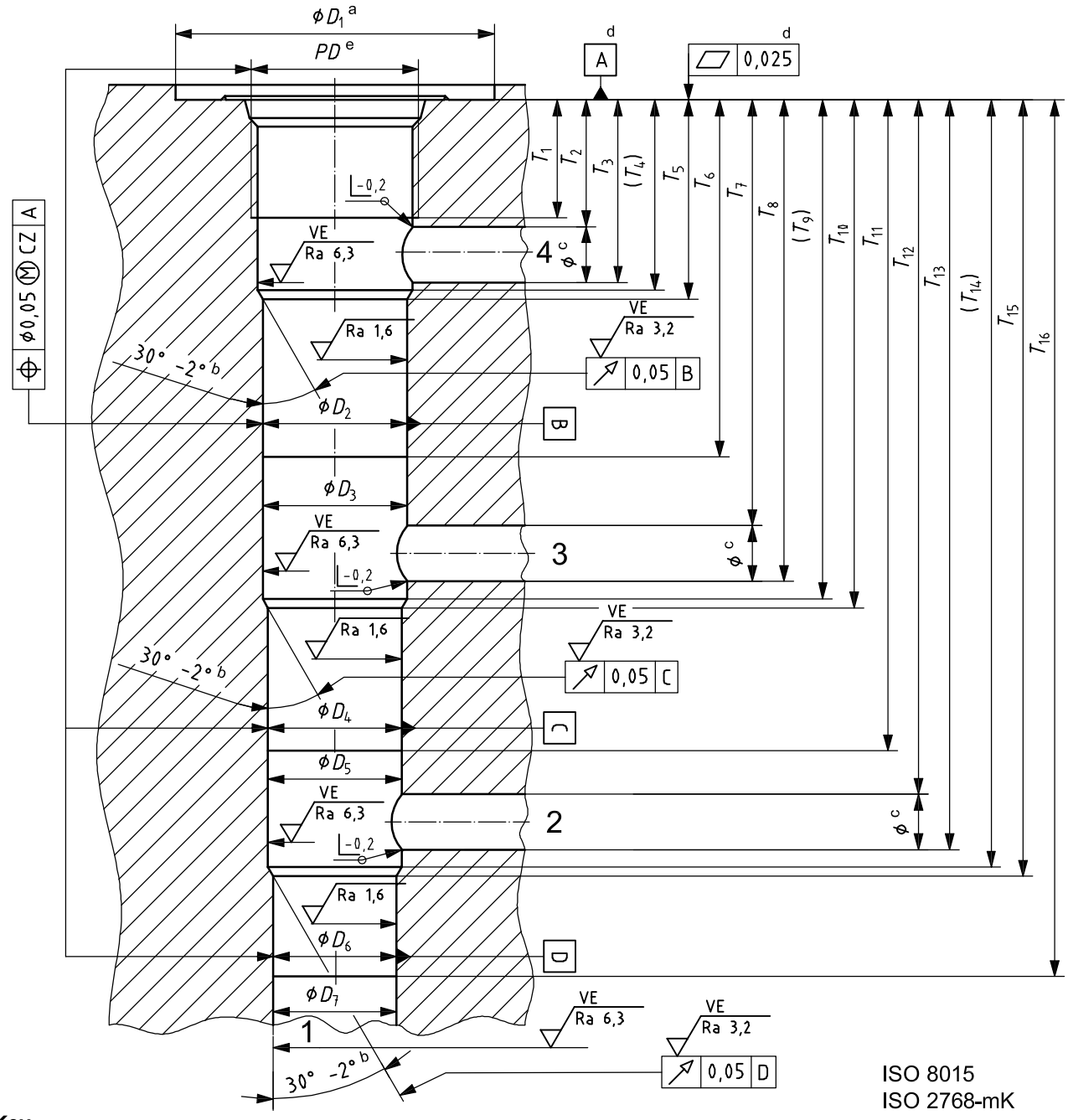
[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this document).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_{11}. For some valve types additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 16 — Symbol for valves entering the cavities shown in Figure 8

Description	Symbol
Pressure-relief valve with ventable or pilot port, pilot operated	



Key

1, 2, 3 and 4 ports

NOTE The same designations are used in Table 18.

PD (thread) pitch diameter

VE visual examination

[a] The dimensions given are the minimum space required for a screw-in cartridge valve with an allowance for using an axially fitting tool, such as a box spanner, to tighten the cartridge; if it is necessary to use a flat spanner, then adequate clearance should be provided.

This is also the minimum recommended distance between centres of two similarly sized cavities.

Connectors on electrically operated valves may exceed this space dimension and allowance shall be made for fitting and removing any such connectors.

[b] No burrs permitted in this area; the edge shall be rounded.

The cavity geometry is normally produced with an appropriate multi-diameter form tool. Sharp edges should be avoided by rounding to a radius of 0,1 mm to 0,2 mm.

[c] Radial groove optional.

[d] Datum area inside ring nose.

[e] The port is in accordance with ISO 6149-1.

Figure 9 — Cavities for three-port valves with 10,5 mm to 20,5 mm maximum main port diameter and one-pilot port

Table 17 — Dimensions for cavities for three-port valves with 10,5 mm to 20,5 mm maximum main port diameter and one-pilot port

Dimensions in millimetres

Parameter		Dimension by codification [a]			
		22-09-0-07	27-09-0-07	33-09-0-07	42-09-0-07
Thread [b]		M22×1,5	M27×2	M33×2	M42×2
D_1 min.		42	48	58	74
D_2 H8		19	23	29	38
D_3		19	23	29	38
D_4 H8		17	21	27	36
D_5		17	21	27	36
D_6 H8		15	19	25	34
D_7		15	19	25	34
T_1 min.		15,5	19	19	19,5
T_2 min.		17	21,5	21	21,5
T_3 max.		21,5	26	25,5	26
(T_4)		22	26,5	26	26,5
T_5 $^{+0,4}_{0}$		23,3	28,2	27,7	28,2
T_6 min.		31,3	36,2	35,7	36,2
T_7 min.		32,5	37,5	37	38,5
T_8 max.		43	50,5	53,5	59
(T_9)		43,5	51	54	59,5
T_{10} $^{+0,4}_{0}$		45,2	52,7	55,7	61,2
T_{11} min.		53,2	60,7	63,7	69,2
T_{12} min.		54,5	62	65	71,5
T_{13} max.		65	75	81,5	92
(T_{14})		65,5	75,5	82	92,5
T_{15} $^{+0,4}_{0}$		67,2	77,2	83,7	94,2
T_{16}	T_{16} min. [c]	76,5	86,5	93	104,5
	T_{16} $^{+1}_{0}$ [d]	78	88	95	106,5

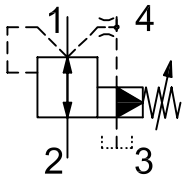
[a] Codification is in accordance with ISO 5783.

[b] The port is in accordance with ISO 6149-1 (relevant for dimensions and tolerances not specified in this International Standard).

[c] This dimension is the minimum finished length required for the sealing diameter on the cartridge.

[d] Suggested pre-machining depth to obtain appropriate diameter tolerance for T_{16}. For some valve types, additional pilot drill dimensions may be specified by the valve manufacturer to provide clearance for an extension to the valve and/or to allow for minimum fluid flow path in this area.

Table 18 — Symbol for valves entering the cavities shown in Figure 9

Description	Symbol
Pressure-reducing valve with relief, with remote control	

Bibliography

[1] ISO 129-1, *Technical drawings — Indication of dimensions and tolerances — Part 1: General principles*

[2] ISO 286-1, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*

[3] ISO 8015, *Technical drawings — Fundamental tolerancing principle*

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