

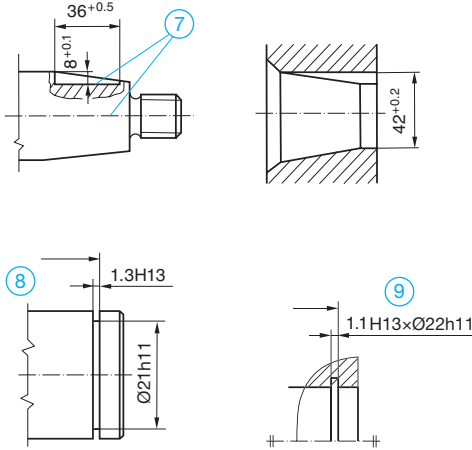
Metal technology symbols																																													
Directional valves			5/3-way valve with blocking centre position		Roller																																								
	Designation: Here 3/2-way valve 3 connections (1-3) 2 switching positions (a, b)		Directional throttle valve with 2 outer limit positions		Spring																																								
	2/2-way valve, normal position open		Directional throttle valve with neutral centre position		Pressurisation, hydraulic																																								
	2/2-way valve, normal position closed	Operating states of valves			Pressurisation, pneumatic																																								
	3/2-way valve, normal position closed		Normal position closed		Pressurisation, indirect Hydraulic																																								
	3/2-way valve, normal position open		Normal position open		Pressurisation, indirect Pneumatic																																								
		Actuation methods			Indirect actuation via pressure release																																								
	4/3-way valve, normal position open		Muscle power, general		Electromagnet and pilot directional valve																																								
	4/2-way valve		Pushbutton		Electromagnet																																								
	4/3-way valve with closed centre position		Lever		Electric motor																																								
	4/3-way valve with floating centre position		Pedal	Other devices																																									
	5/2-way valve		Plunger, pushbutton		Timing element, adjustable																																								
			Roller, operates only in one direction		Light																																								
Directional valves, short designation and connector labels				Cylinder																																									
Short designation		Connector label																																											
<p><i>Example designation</i></p> <p>3/2-way valve 2 switching positions 3 connections</p>		<table border="1"> <thead> <tr> <th>Connection</th> <th>Old standard</th> <th>for 2/2-way valve, manually operated</th> <th>for 3/2-way valve, pneum. operated</th> <th>for 5/2-way valve pneum. operated</th> </tr> </thead> <tbody> <tr> <td>Pressure supply.</td> <td>P</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>Working line</td> <td>A</td> <td>1</td> <td>2</td> <td>2</td> </tr> <tr> <td>Working line</td> <td>B</td> <td>-</td> <td>-</td> <td>4</td> </tr> <tr> <td>Venting</td> <td>R</td> <td>-</td> <td>3</td> <td>3</td> </tr> <tr> <td>Venting</td> <td>S</td> <td>-</td> <td>-</td> <td>5</td> </tr> <tr> <td>Control connection</td> <td>Y</td> <td>-</td> <td>12</td> <td>12</td> </tr> <tr> <td>Control connection</td> <td>Z</td> <td>-</td> <td>-</td> <td>14</td> </tr> </tbody> </table>				Connection	Old standard	for 2/2-way valve, manually operated	for 3/2-way valve, pneum. operated	for 5/2-way valve pneum. operated	Pressure supply.	P	1	1	1	Working line	A	1	2	2	Working line	B	-	-	4	Venting	R	-	3	3	Venting	S	-	-	5	Control connection	Y	-	12	12	Control connection	Z	-	-	14
Connection	Old standard	for 2/2-way valve, manually operated	for 3/2-way valve, pneum. operated	for 5/2-way valve pneum. operated																																									
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				Single-acting cylinder, return stroke through force																																									
				Single-acting cylinder, return stroke through spring																																									
				Double-acting cylinder with single piston rod																																									
				Double-acting cylinder with two-sided piston rod																																									
				Cylinder with adjustable damping on the piston side																																									
				Cylinder with double, adjustable damping																																									

Technical Documentation

Standardisation

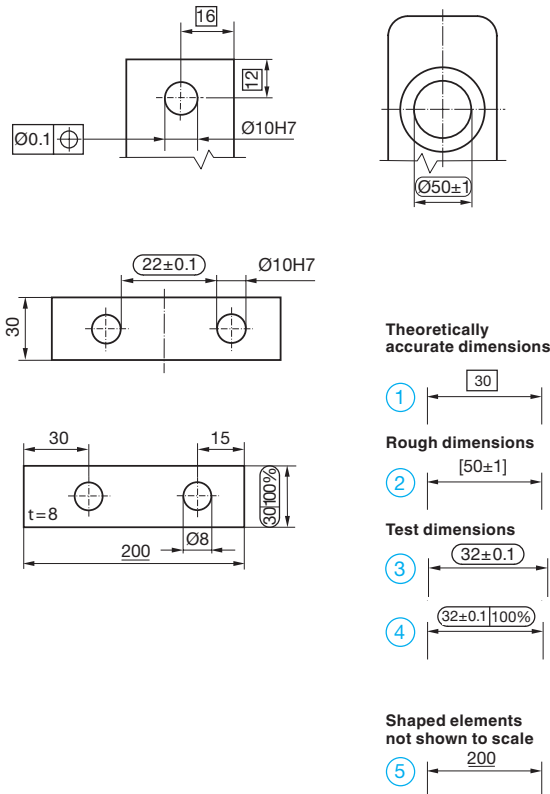
Technical drawing

Dimensioning of grooves and recesses



- ⑧ With peripheral grooves or recesses, the groove width and base diameter are dimensioned.
- ⑨ Grooves or recesses for retaining rings, locking rings etc. are dimensioned in simplified form by specifying width (fit) x groove base diameter (fit).

Special dimensions



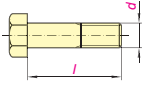
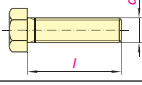
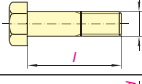
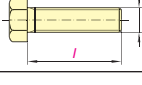
- ① Theoretically accurate dimensions are also indicated in tables and lists by a rectangular frame and without tolerances.
- ② If a drawing of the unmachined part is not prepared, the rough dimensions are shown in the production drawing in square brackets. The meaning of these brackets must be explained in the drawing title block.

Test dimensions are shown in frames with two semicircles. An explanation of the meaning and the test scope must be provided near the title block, for example

- ③ Dimensions are specially checked by the orderer (recipient) during the acceptance test or
- ④ Dimensions are 100% checked by the orderer (recipient) during the acceptance test. They are not checked randomly!
- ⑤ Shaped elements that are not shown to scale are indicated by *underlining* their dimensions.

Note:

Use of this marking is not permitted in CAD drawings.

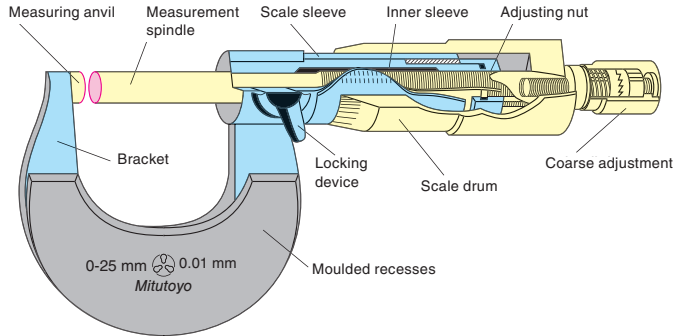
Machine elements											
Thread run-outs and thread undercuts										DIN 76-1	
Male thread						Female thread					
d	P	$x_{1 \max}$	$d_g \text{ h13}$	g	r	d	P	$e_{1 \min}$	$d_g \text{ H13}$	g	r
M1	0.25	0.6	0.6	0.9	0.12	M1	0.25	1.5	1.1	1.4	0.12
M2	0.4	1	1.3	1.4	0.2	M2	0.4	2.3	2.2	2.2	0.2
M3	0.5	1.25	2.2	1.75	0.2	M3	0.5	2.8	3.3	2.7	0.2
M4	0.7	1.75	2.9	2.45	0.4	M4	0.7	3.8	4.3	3.8	0.4
M5	0.8	2	3.7	2.8	0.4	M5	0.8	4.2	5.3	4.2	0.4
M6	1	2.5	4.4	3.5	0.6	M6	1	5.1	6.5	5.2	0.6
M8	1.25	3.2	6	4.4	0.6	M8	1.25	6.2	8.5	6.7	0.6
M10	1.5	3.8	7.7	5.2	0.8	M10	1.5	7.3	10.5	7.8	0.8
M12	1.75	4.3	9.4	6.1	1	M12	1.75	8.3	12.5	9.1	1
M16	2	5	13	7	1	M16	2	9.3	16.5	10.3	1
M20	2.5	6.3	16.4	8.7	1.2	M20	2.5	11.2	20.5	13	1.2
M24	3	7.5	19.6	10.5	1.6	M24	3	13.1	24.5	15.2	1.6
M30	3.5	9	25	12	1.6	M30	3.5	15.2	30.5	17.7	1.6
M36	4	10	30.3	14	2	M36	4	16.8	36.5	20	2
M42	4.5	11	35.6	16	2	M42	4.5	18.4	42.5	23	2
M48	5	12.5	41	17.5	2.5	M48	5	20.8	48.5	26	2.5
M56	5.5	14	48.3	19	3.2	M56	5.5	22.4	56.5	28	3.2
M64	6	15	55.7	21	3.2	M64	6	24	64.5	30	3.2
Identification of threads (examples)											
M30	Metric ISO thread, standard thread, nominal diameter 30 mm										
M 30x1	Metric ISO thread, fine thread, nominal diameter 30 mm, pitch 1 mm										
M 30 - LH	Metric ISO thread, standard thread, nominal diameter 30 mm, left-hand thread										
Tr 40x14 P7	Metric ISO trapezoidal thread, multiple starts, 40 mm nominal diameter, 14 mm pitch, 7 mm spacing, number of starts = pitch/spacing = 14/7 = 2 (two-start thread)										
Screws											
Screw types – overview											
Hexagon head screws											
DIN EN ISO 4014		Stem and regular thread	M1.6 – M64	Mechanical engineering, Tool building, Automobile construction							
DIN EN ISO 4017		Regular thread up to head	M1.6 – M64								
DIN EN ISO 8765		Stem and fine thread	M8x1 to M64x4								
DIN EN ISO 8676		Fine thread up to head	M8x1 to M64x4								

Measurement and testing technology

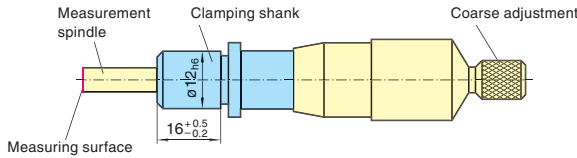
Basic principles of dimensional metrology and measuring instruments

Micrometers
DIN 863

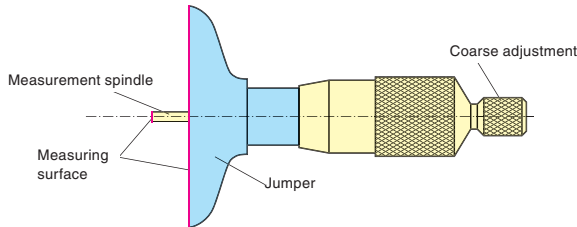
Micrometer gauge



Integrated micrometer

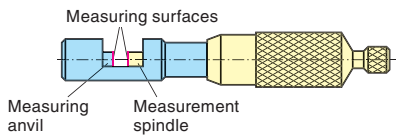


Depth micrometer



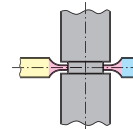
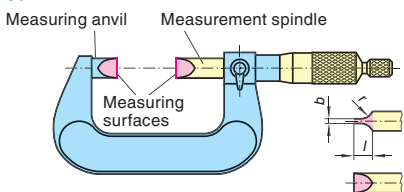
Special
designs of
micrometers

Micrometer with small clamp
Type D2



Measuring of wire thicknesses and ball diameters

External screw type micrometer with narrow measuring surfaces
Type D4

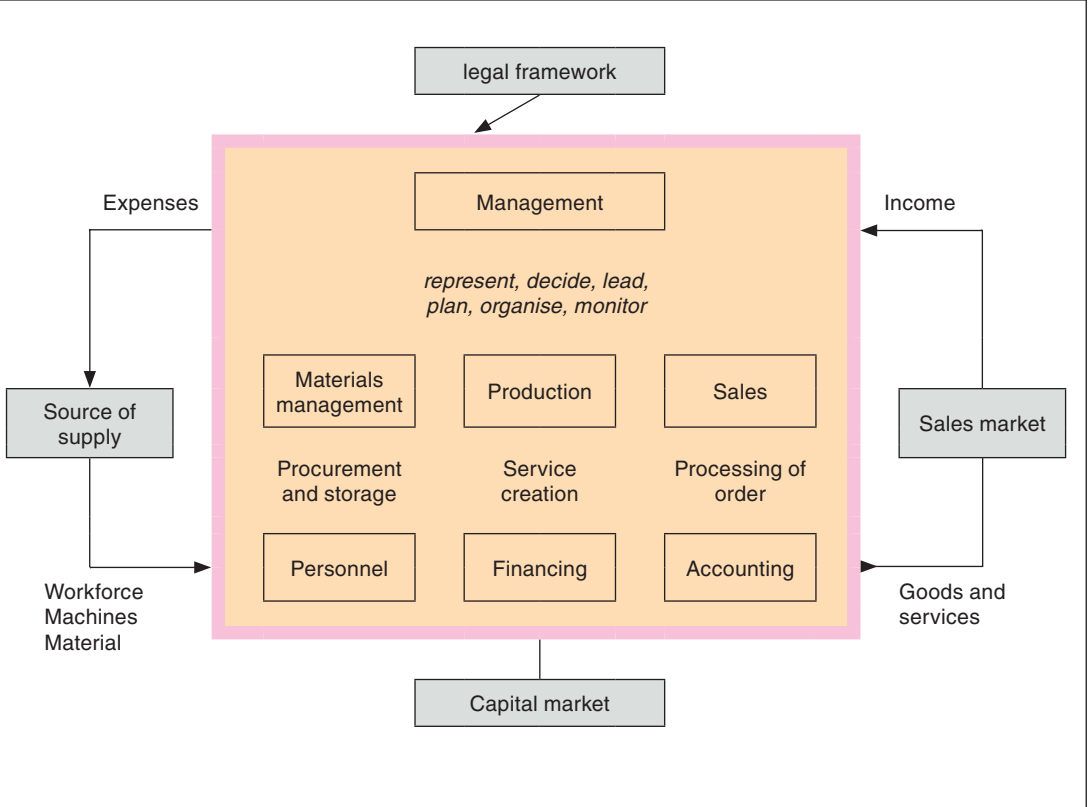


Measurements at narrow recesses
(e. g. for retaining rings)

Interdisciplinary skills

Enterprise and company

Model: Industrial enterprise



Environment and enterprise

Every company must be interested in operating in an environmentally-aware manner for purely *economic reasons*. On the one hand, this provides *competitive advantages* and on the other, it *reduces costs*. Companies that do not do this are taking considerable risks.

