Precision steel shafts

The Advantages

- Induction hardened and ground
- Solid or tubular shafts
- Available in various tolerances
- Available in heat-treated steel, corrosion-resistant steel or hard chromium plated steel
- Cut to customer specified lengths
- With chamfers to protect the Linear Bushing seal
- Completed per customer design
- As a guidance shaft for Linear Bushings
- As rollers, pistons and axles

Precision steel shafts

Overview

Measurements

Shaft Ø d	Part numbers Solid shafts					
	Heat-treated steel		X46Cr13		X90CrMoV18	
[mm]	h6	h7	h6	h7	h6	h7
3	R1000 003 00				R1000 003 20	
4	R1000 004 00	R1000 004 01	R1000 004 30	R1000 004 31		
5	R1000 005 00	R1000 005 01	R1000 005 30	R1000 005 31		
6	R1000 006 00	R1000 006 01	R1000 006 30	R1000 006 31		
8	R1000 008 00	R1000 008 01	R1000 008 30	R1000 008 31		
10	R1000 010 00	R1000 010 01	R1000 010 30	R1000 010 31		
12	R1000 012 00	R1000 012 01	R1000 012 30	R1000 012 31	R1000 012 20	R1000 012 21
14	R1000 014 00	R1000 014 01	R1000 014 30	R1000 014 31		
15	R1000 015 00	R1000 015 01				
16	R1000 016 00	R1000 016 01	R1000 016 30	R1000 016 31	R1000 016 20	R1000 016 21
18	R1000 018 00	R1000 018 01				
20	R1000 020 00	R1000 020 01	R1000 020 30	R1000 020 31	R1000 020 20	R1000 020 21
22	R1000 022 00	R1000 022 01				
24	R1000 024 00	R1000 024 01				
25	R1000 025 00	R1000 025 01	R1000 025 30	R1000 025 31	R1000 025 20	R1000 025 21
30	R1000 030 00	R1000 030 01	R1000 030 30	R1000 030 31	R1000 030 20	R1000 030 21
32	R1000 032 00	R1000 032 01				
35	R1000 035 00	R1000 035 01				
38	R1000 038 00	R1000 038 01				
40	R1000 040 00	R1000 040 01	R1000 040 30	R1000 040 31	R1000 040 20	R1000 040 21
45	R1000 045 00	R1000 045 01				
50	R1000 050 00	R1000 050 01	R1000 050 30	R1000 050 31	R1000 050 20	R1000 050 21
55	R1000 055 00	R1000 055 01				
60	R1000 060 00	R1000 060 01	R1000 060 30	R1000 060 31	R1000 060 20	R1000 060 21
70	R1000 070 00	R1000 070 01				
80	R1000 080 00	R1000 080 01	R1000 080 30	R1000 080 31	R1000 080 20	R1000 080 21
100	R1000 100 00	R1000 100 01				
110	R1000 110 00	R1000 110 01				

Shaft Ø d	Part numbers				
	Solid Shaft		Tubular shaft		
	Hard chromium plating		Heat-treated steel		Hard chromium plating
[mm]	h6	h7	h6	h7	h7
3					
4					
5					
6					
8			R1001 008 10		
10			R1001 010 10		
12	R1000 012 60	R1000 012 61	R1001 012 10	R1001 012 11	
14					
15					
16	R1000 016 60	R1000 016 61	R1001 016 10		
18					
20	R1000 020 60	R1000 020 61	R1001 020 10	R1001 020 11	
22					
24					
25	R1000 025 60	R1000 025 61	R1001 025 10	R1001 025 11	R1001 025 41
30	R1000 030 60	R1000 030 61	R1001 030 10	R1001 030 11	R1001 030 41
32					
35					
38					
40	R1000 040 60	R1000 040 61	R1001 040 10	R1001 040 11	R1001 040 41
45					
50	R1000 050 60	R1000 050 61	R1001 050 10	R1001 050 11	R1001 050 41
55					
60	R1000 060 60	R1000 060 61	R1001 060 10	R1001 060 11	R1001 060 41
70					
80	R1000 080 60	R1000 080 61	R1001 080 10	R1001 080 11	R1001 080 41
100			R1001 100 10	R1001 100 11	
110					

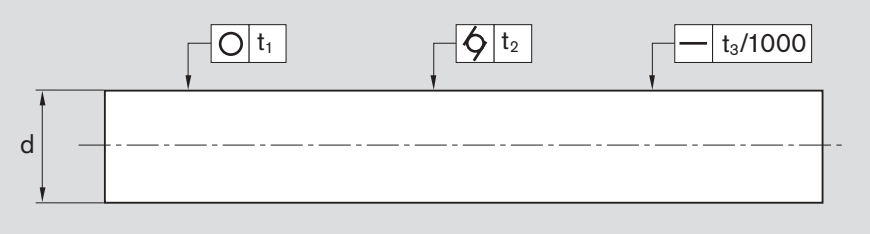
Precision steel shafts

Technical Data

Dimensional accuracy and tolerance zones

The diameters of Precision Steel Shafts are accurate to within the tolerance zones h6 and h7. Details on the dimensional accuracy of the shafts are compiled in the tables on the right. The tolerance for the diameter of soft-annealed shaft sections may go slightly beyond the tolerance zones quoted.

By request: Precision Steel Shafts may also be supplied in tolerance zone h5 (standard diameters 30 to 80 only). For special diameter tolerances,please consult us.



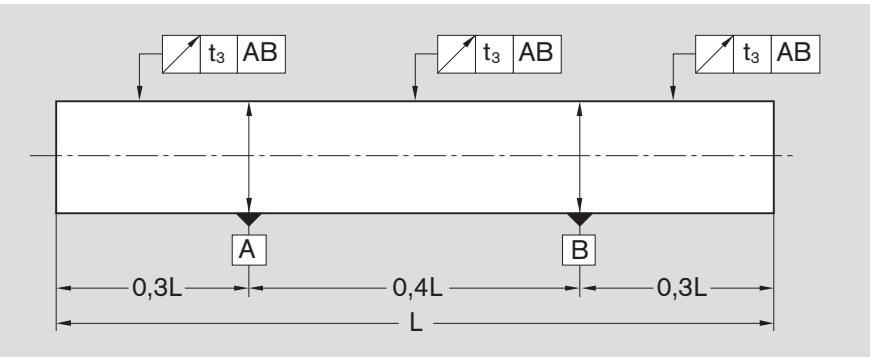
Nominal diameter d [mm]	over	1	3	6	10	18	30	50	80
	to	3	6	10	18	30	50	80	120
Diameter tolerance [µm]	h6	0	0	0	0	0	0	0	0
		−6	−8	−9	−11	−13	−16	−19	−22
	h7	0	0	0	0	0	0	0	0
		−10	−12	−15	−18	−21	−25	−30	−35
Roundness t_1 [µm]	h6	3	4	4	5	6	7	8	10
	h7	4	5	6	8	9	11	13	15
Taper t_2 [1] [µm]	h6	4	5	6	8	9	11	13	15
	h7	6	8	9	11	13	16	19	22
Straightness t_3 [2] [µm/m]		150	150	120	100	100	100	100	100
Surface roughness (Ra) [3] [µm]		0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32

[1] Dial gauge reading during straightness measurement. For lengths of less than 1 m the lowest possible value is 40 µm. This corresponds to a straightness tolerance of 20 µm.

[2] Applies to shafts made of heat-treatable or anti-friction bearing steel only.
Please contact us for surface finish and surface roughness (R_a) tolerances for hard chrome plated and corrosion-resistant steel shafts.

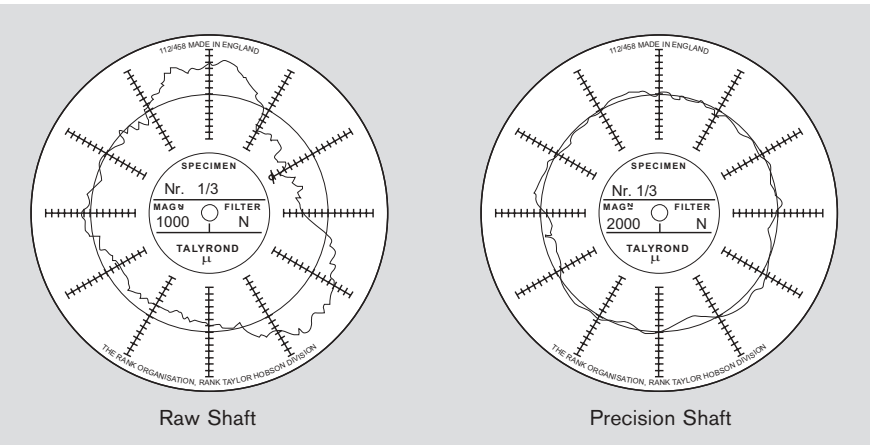
Measurement of straightness per ISO 13012

Measurements are performed at points equidistant between the support points and the overhanging ends of the shaft. The measured values are half the gage measurement when the shaft is rotated by 360°.



Measurement of roundness

The drawing shows the roundness of a raw shaft in comparision to a precision steel shaft.

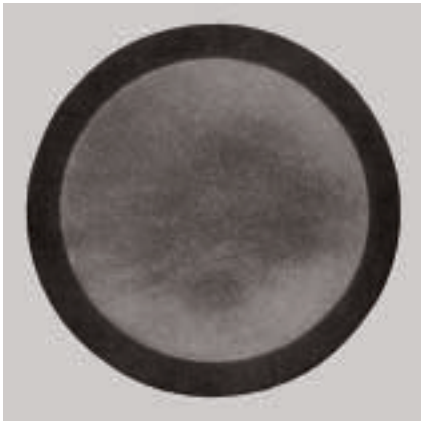


Raw Shaft

Precision Shaft

Shaft hardness

The surface of the shaft is induction-hardened to a depth of at least 0.4 up to 3.2 mm. depending on the shaft diameter. Surface hardness and depth of hardness are extremely uniform. both in the axial and in the circumferential direction. This is the reason for the excellent dimensional consistency and the long service life of Precision Steel Shafts.
The photographs opposite show a longitudinal and a transverse section through a hardened and ground Precision Steel Shaft.
The hardened surface zone has been made visible by caustic etching.



Shaft Ø d [mm]	over	1	3	10	18	30	50	80
	to	3	10	18	30	50	80	120
Hardness depth[1] [mm]	min.	0.4	0.4	0.6	0.9	1.5	2.2	3.2

[1] Please contact us to obtain the depth of hardness for corrosion-resistant steel shafts.

Minimum hardness
Solid and tubular shafts → HRC 60

Corrosion-resistant
steel shafts to → HRC 54
ISO 683-17/ EN 10088

The graphic shows the micro-structure in the surface zone of a shaft cross section (magnification approx. 10x). The hardened outer layer of martensite and the smooth transition to the tough inner core structure are clearly visible.

Induction hardened surface zone
Structure: Martensite
hardness ≥ HRC 60 (Rockwell C)

Transitional structure:
Martensite
Troostite
Pearlite

Core structure:
Pearlite and ferrite

Precision steel shafts

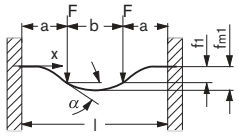
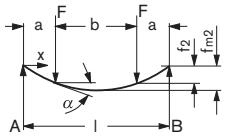
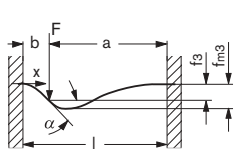
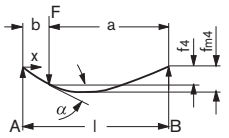
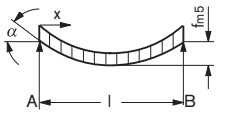
Technical Data

Shaft deflection

When steel shafts are used as linear motion guideways for linear bushings it is important that the shaft deflection occurring ander load is kept within certain limits, as otherwise the proper functioning and the service life of the assembly could be impaired[1)].

To facilitate the determination of shaft deflection by calculation, we have compiled the most common load cases together with the associated deflection equations in the table below.

The equations for calculation of the inclination of the shaft in the linear bushing (tan a) can also be taken from this table.

Case No.	Loading conditions	Deflection equation	Shaft inclination in linear bushings
1		$f_1 = \frac{F \cdot a^3}{6 \cdot E \cdot J} \cdot \left(2 - \frac{3 \cdot a}{l}\right)$ $f_{m1} = \frac{F \cdot a^2}{24 \cdot E \cdot J} \cdot (3l - 4a)$	$\tan \alpha_{(x=a)} = \frac{F \cdot a^2 \cdot b}{2 \cdot E \cdot J \cdot l}$
2		$f_2 = \frac{F \cdot l^3}{2 \cdot E \cdot J} \cdot \frac{a^2}{l^2} \cdot \left(1 - \frac{4}{3} \cdot \frac{a}{l}\right)$ $f_{m2} = \frac{F \cdot l^3}{8 \cdot E \cdot J} \cdot \frac{a}{l} \cdot \left(1 - \frac{4}{3} \cdot \frac{a^2}{l^2}\right)$	$\tan \alpha_{(x=a)} = \frac{F \cdot a \cdot b}{2 \cdot E \cdot J}$
3		$f_3 = \frac{F \cdot l^3}{3 \cdot E \cdot J} \cdot \frac{a^3 \cdot b^3}{l^3 \cdot l^3}$ $f_{m3} = \frac{2 \cdot F \cdot l^3}{3 \cdot E \cdot J} \cdot \frac{a^3}{l^3} \cdot \frac{b^2}{l^2} \cdot \left(\frac{l}{l + 2a}\right)^2$	$\tan \alpha_{(x=b)} = \frac{F \cdot a^2 \cdot b^2}{2 \cdot E \cdot J \cdot l^2} \cdot \left(1 - \frac{2 \cdot b}{l}\right)$
4		$f_4 = \frac{F \cdot l^3}{3 \cdot E \cdot J} \cdot \frac{a^2 \cdot b^2}{l^2 \cdot l^2}$ $f_{m4} = f_4 \cdot \frac{l + b}{3 \cdot b} \cdot \sqrt{\frac{l + b}{3 \cdot a}}$	$\tan \alpha_{(x=b)} = \frac{F \cdot a}{6 \cdot E \cdot J \cdot l} \cdot (3b^2 - l^2 + a^2)$
5		$f_5 = \frac{5 \cdot F \cdot l^3}{384 \cdot E \cdot J}$	$\tan \alpha_{(x=0)} = \frac{F \cdot l^2}{24 \cdot E \cdot J}$

[1)] There will be no loss of load-carrying capacity or service life in Super Linear Bushings a, h and H provided the shaft deflection does not exceed 30' (tan 30' = 0.0087).

The table gives the values for the maximum permissible shaft inclination ($\tan a_{max}$) for each size of Standard Linear Bushing.
At $\tan a = \tan a_{max}$ the permissible static load capacity is approx. 0.4 C_0.

Shaft Ø d [mm]	$\tan \alpha_{max}$
5	$12.3 \cdot 10^{-4}$
8	$10.0 \cdot 10^{-4}$
12	$10.1 \cdot 10^{-4}$
16	$8.5 \cdot 10^{-4}$
20	$8.5 \cdot 10^{-4}$
25	$7.2 \cdot 10^{-4}$

Shaft Ø d [mm]	$\tan \alpha_{max}$
30	$6.4 \cdot 10^{-4}$
40	$7.3 \cdot 10^{-4}$
50	$6.3 \cdot 10^{-4}$
60	$5.7 \cdot 10^{-4}$
80	$5.7 \cdot 10^{-4}$

Values for E x J and mass for steel shafts

Solid Shafts		
Ø d [mm]	E x J [N x mm²]	Mass [kg/m]
3	$8.35 \cdot 10^5$	0.06
4	$2.64 \cdot 10^6$	0.10
5	$6.44 \cdot 10^6$	0.15
8	$4.22 \cdot 10^7$	0.39
10	$1.03 \cdot 10^8$	0.61
12	$2.14 \cdot 10^8$	0.88
14	$3.96 \cdot 10^8$	1.20
16	$6.76 \cdot 10^8$	1.57
20	$1.65 \cdot 10^9$	2.45
25	$4.03 \cdot 10^9$	3.83
30	$8.35 \cdot 10^9$	5.51
40	$2.64 \cdot 10^{10}$	9.80
50	$6.44 \cdot 10^{10}$	15.32
60	$1.34 \cdot 10^{11}$	22.05
80	$4.22 \cdot 10^{11}$	39.21

Tubular shafts			
Shaft diameter		E x J	Mass
outer [mm]	Inner [mm]	[N x mm²]	[kg/m]
8	3	$4.14 \cdot 10^7$	0.34
10	4	$1.00 \cdot 10^8$	0.51
12	3.4	$2.12 \cdot 10^8$	0.81
16	8	$6.33 \cdot 10^8$	1.18
20	14	$1.25 \cdot 10^9$	1.25
25	14	$3.63 \cdot 10^9$	2.63
30	19	$7.01 \cdot 10^9$	3.30
40	26.5	$2.13 \cdot 10^{10}$	5.50
50	29.6	$5.65 \cdot 10^{10}$	9.95
60	36.5	$1.15 \cdot 10^{11}$	13.89
80	57.4	$3.10 \cdot 10^{11}$	19.02

Calculation values: Modulus of elasticity = $2.1 \cdot 10^5$ N/mm²
Seals = 7.8 g/cm³

Precision steel shafts

Technical Data

Mill-cut lengths

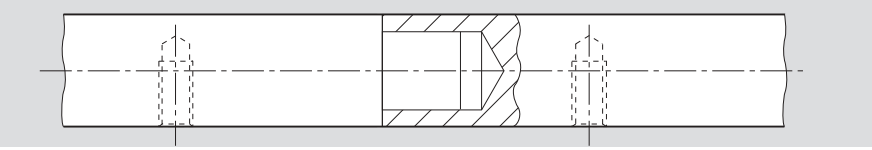
Type of shafts	Diameter [mm]	Mill-cut length[1] [m]
Solid Shafts[2]	3	0.4
	4 to 8	3.6
	ab 10	6.1
Tubular shafts	8 and 10	1
	16	2
	20	5.7
	12 and up to 25	6.1
Corrosion-resistant steel shafts	3	0.4
	4 to 10	3.6
	up to 12	6.1

[1] The first 50 mm at each end of mill-cut lengths may deviate slightly from the nominal diameter.

[2] Solid shafts of lenghts up to 8 m and Ø 20 and over are available upon request.

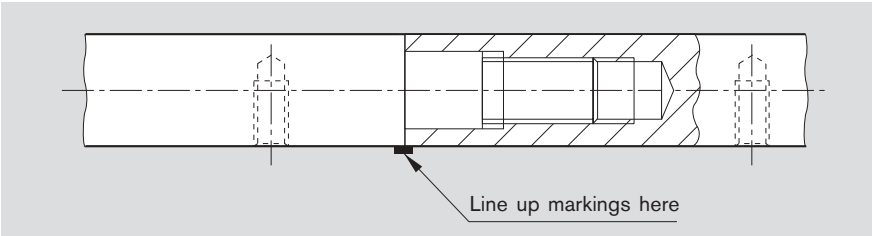
Composite shafts Plug-and-socket joints

We can supply composite shafts for applications requiring a shaft longer than the mill-cut lengths available. The shaft sections are joined together by a spigot-and-recess arrangement, one section having a locating plug and the other a mating hole (see figure below). The joined shaft must rest on a full-length, continuous support rail or must at least be supported at regular intervals with one of the supports located at the joint between the shaft sections (see "Shaft Support Rails").



Shafts with threaded joints (does not apply to corrosion-resistant steel shafts)

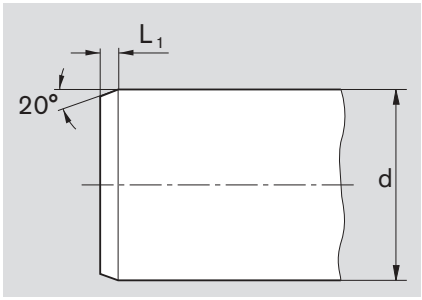
At the customer's request, the plug can be threaded and the mating hole tapped (see figure below). Line-up markings are then provided at the ends of the mating shaft sections to facilitate vertical alignment of the radial holes for attachment of the coupled shaft assembly to the shaft support rail.
All machining and marking operations are carried out on the shaft sections after they have been hardened and groand. Since it will not be possible to re-grind the finished joint, extreme care is taken in the machining of the centering arrangement to ensure precision mating of the shaft sections.



Shaft Machining

Chamfers

Steel shafts intended for use as linear motion guideways for Linear Bushings must be chamfered at the ends to prevent damage to the ball retainers or wipers when the linear bushing is being pushed onto the shaft.
The figure and the table give the dimensions of the chamfers required. Linear bushings with seals must not be pushed over sharp edges in the shaft (e.g. retaining ring grooves), as this would damage the seal lips.



Shaft Ø d	[mm]	3	4	5	8	10	12	14	16	20	25	30	40	50	60	80
Length of Chamfer L_1	[mm]	1	1	1.5	1.5	1.5	2	2	2	2	2	2	3	3	3	3

Machining

Hardened and gound steel shafts in mill-cut lengths are always in stock. These can be cut to any desired length and machined to have any of the following characteristics:

- Reduced diameter ends
- Male or female threads
- Countersinks
- Radial or axial holes
- Recesses
- or other specialily machined features.

Annealing of machined sections

Machined shafts may have to be annealed due to the hardened outer zone (slight measurement change possible)

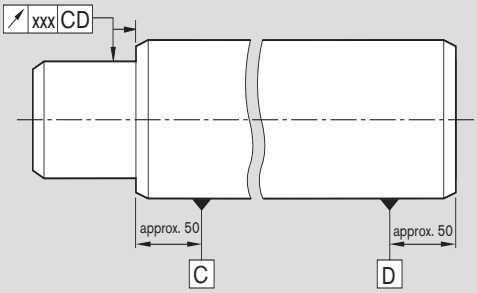
Length tolerances for cut-to-size shafts

Dimensions [mm]	
Length	Tolerance
to 400	±0.5
over 400 to 1000	±0.8
over 1000 to 2000	±1.2
over 2000 to 4000	±2.0
over 4000 to 6000	±3.0
over 6000 to 8000	±3.5

Steel shafts with closer length tolerance can also be supplied at a surcharge.

Round and flat run of the reduced diameter end

Customers can request a trial to accomplish these values as shown.
Values xxx < 0.02 upon request.



Precision steel shafts

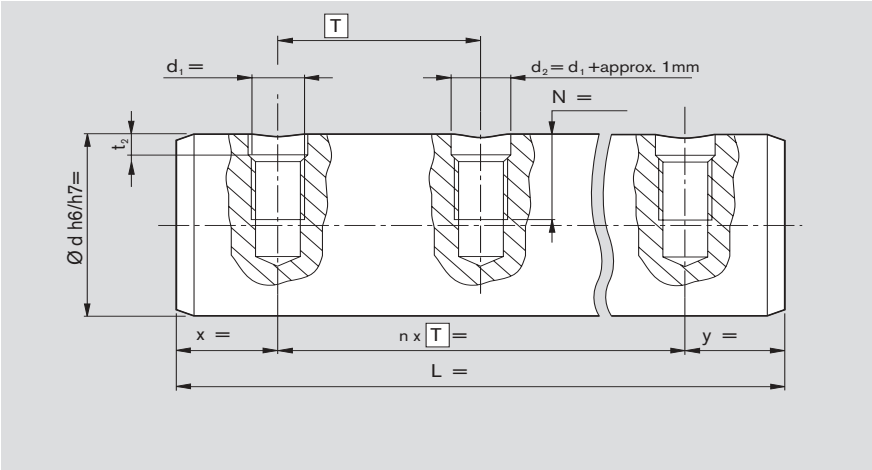
Shaft Machining

Advantages
- Many processing options
- Shorter delivery times
- Lower cost

Ordering
- Inquiries with customer design or template
- Registered dimensions and tolerances
- Avoid oversizing
- Machining on one or both sides

Shafts with radial holes, drilled or drilled and tapped

Shafts that have to be supported require radial holes for attachment of the shaft supports. The radial holes are drilled into the steel shafts after hardening and grinding.
The diameter, depth and spacing of the holes depend on the diameter of the shaft. Refer to the table in the sections "Shaft Support Rails for Standard and Super Linear Bushings" and "Shaft Support Rails for Radial Linear Bushings" for standard dimensions.



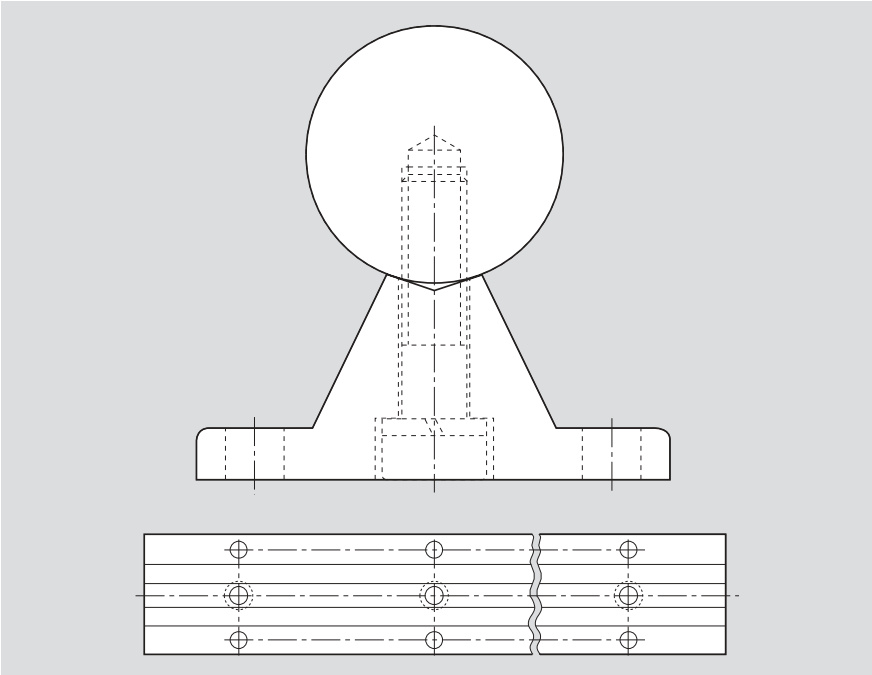
Recommended values for boring of clearing holes in the hardened surface zone

Dimensions [mm]		
Ø d	d_1	t_2
12	M4	2.5
16	M5	2.5
20	M6	3.0
25	M8	3.0
30	M10	3.5
40	M10	4.0
40	M12	4.5

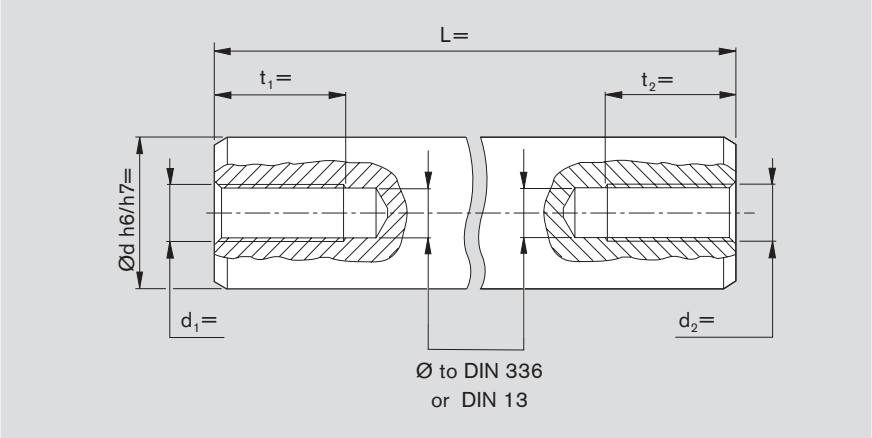
Dimensions [mm]		
Ø d	d_1	t_2
50	M12	4.0
50	M14	4.5
50	M16	5.0
60	M14	5.5
60	M20	6.5
80	M16	5.5
80	M24	6.5

Values for corrosion-resistant steel shafts upon request.

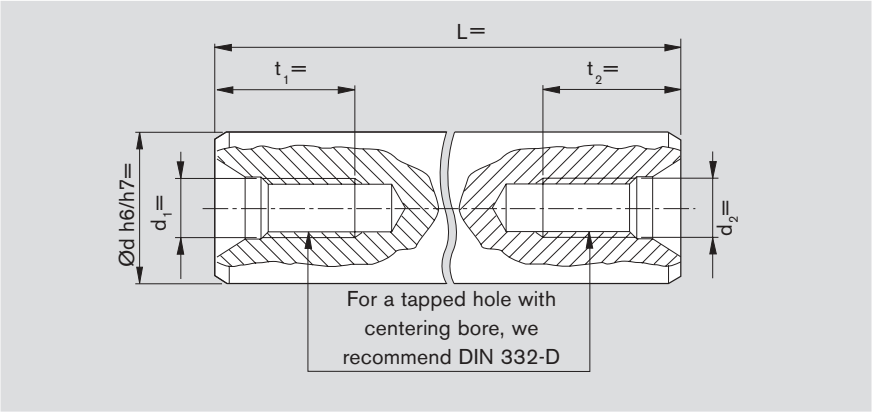
For matching Shaft Support Rails, see the related chapter.



Shaft ends with tapped hole



Shaft ends with tapped hole and centering bore to DIN 332-D



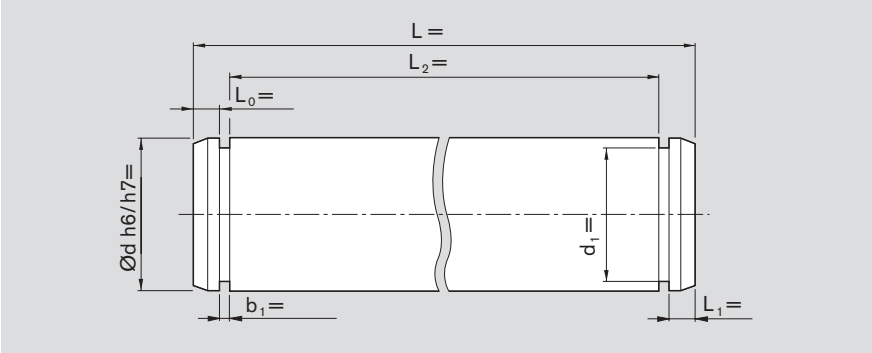
Recommended dimension for shaft ends with tapped hole and centering bore.

Shaft Ød [mm]	Thread d_1/d_2	Depth t_1/t_2 [mm]
8	M4	10
10	M4	10
12	M5	12.5
14	M5	12.5
16	M6	16
20	M8	19
25	M10	22
30	M12	28
40	M12	28
50	M16	36
60	M20	42
80	M24	50

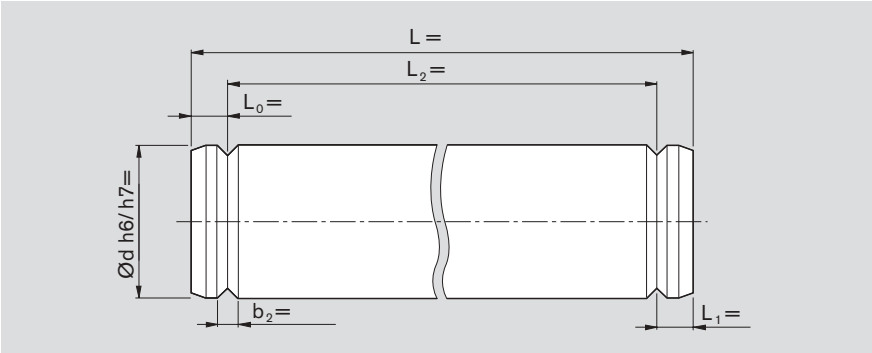
Precision steel shafts

Shaft Machining

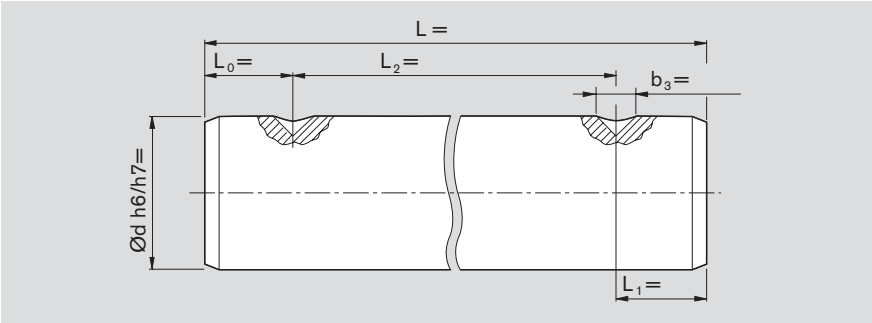
Shaft ends for retaining ring groove to DIN 471



Shaft ends with 90° cutout



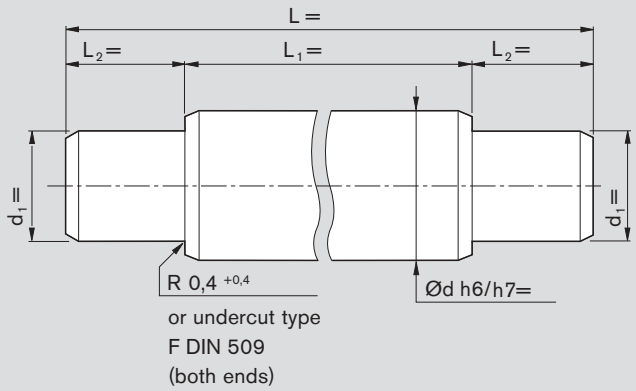
Shaft ends with 90° countersink



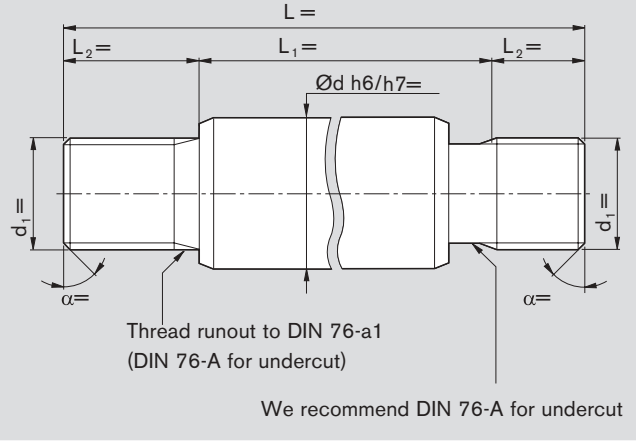
Dimensional recommendation for shaft ends for retaining ring, 90° shaft ends, 90° countersink:

Ød	Dimension [mm] b_1 +0.1	d_1	b_2	b_3	Retaining ring DIN 471 - Dimension [mm]	Part number
4	0.5	3.8 -0.04	–	–	4x0.4	R3410 765 00
5	0.7	4.8 -0.04	2	3	5x0.6	R3410 742 00
8	0.9	7.6 -0.06	2	4	8x0.8	R3410 737 00
10	1.1	9.6 -0.11	2	5	10x1	R3410 745 00
12	1.1	11.5 -0.11	2.5	5	12x1	R3410 712 00
14	1.1	13.4 -0.11	2.5	5	14x1	R3410 747 00
16	1.1	15.2 -0.11	3	5	16x1	R3410 713 00
20	1.3	19 -0.13	3	5	20x1.2	R3410 735 00
25	1.3	23.9 -0.21	4	6	25x1.2	R3410 750 00
30	1.6	28.6 -0.21	4	6	30x1.5	R3410 724 00
40	1.85	37.5 -0.25	5	8	40x1.75	R3410 726 00
50	2.15	47 -0.25	5	8	50x2	R3410 727 00
60	2.15	57 -0.3	6	8	60x2	R3410 764 00
80	2.65	76.5 -0.3	6	10	80x2.5	–

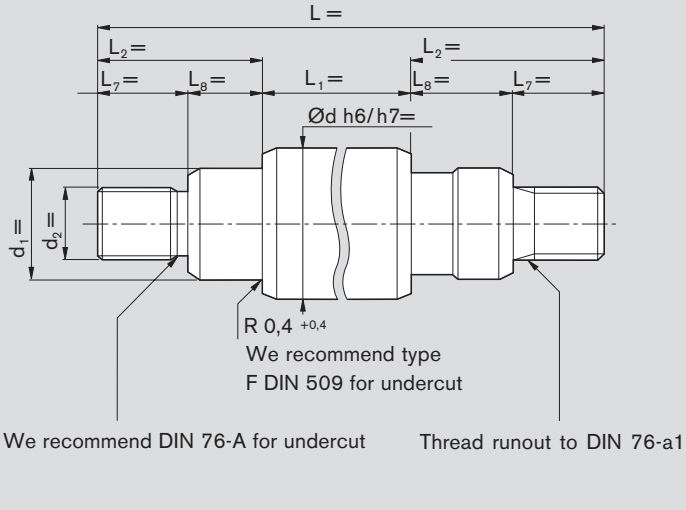
Shaft ends with spigot both ends



Shaft ends with threaded spigot (both ends)



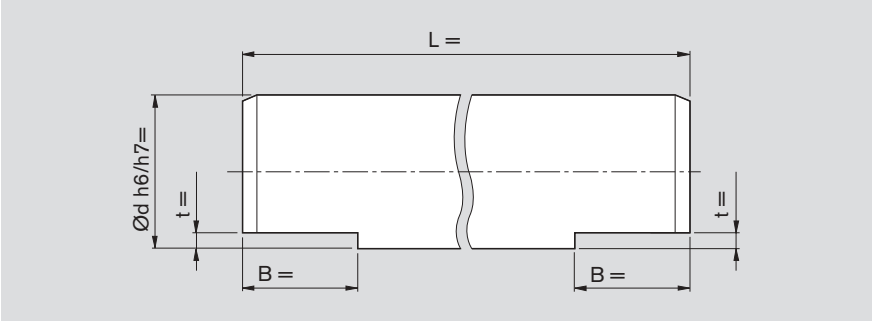
Shaft ends with spigot and threaded spigot (both ends)



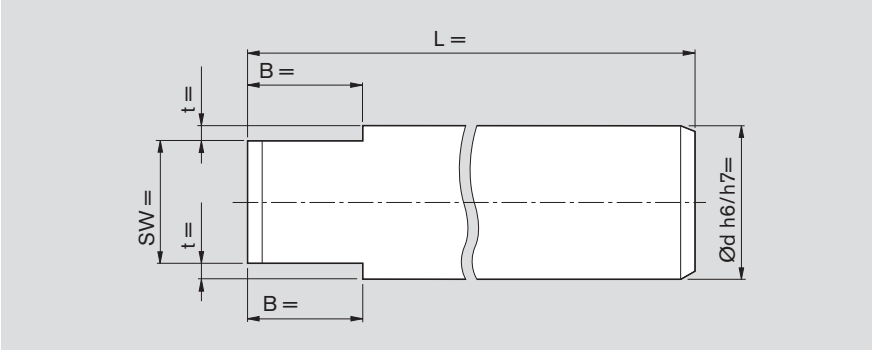
Precision steel shafts

Shaft Machining

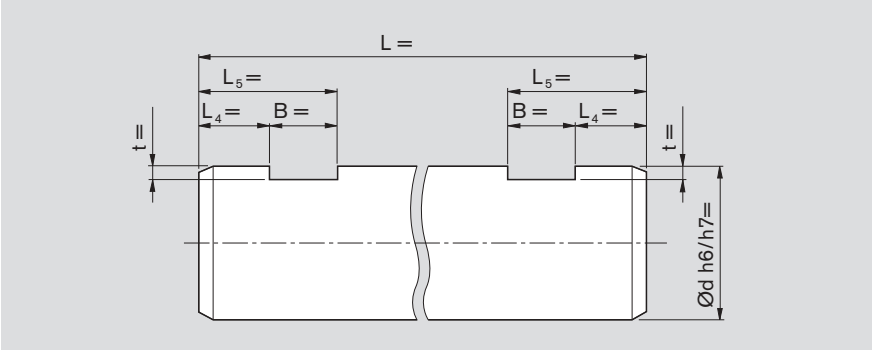
Shaft ends with single flat (both ends)



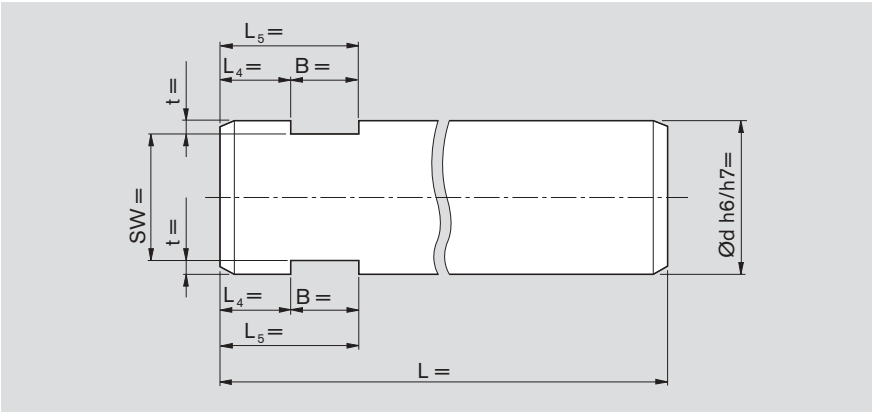
Shaft ends with outer flats (one end)



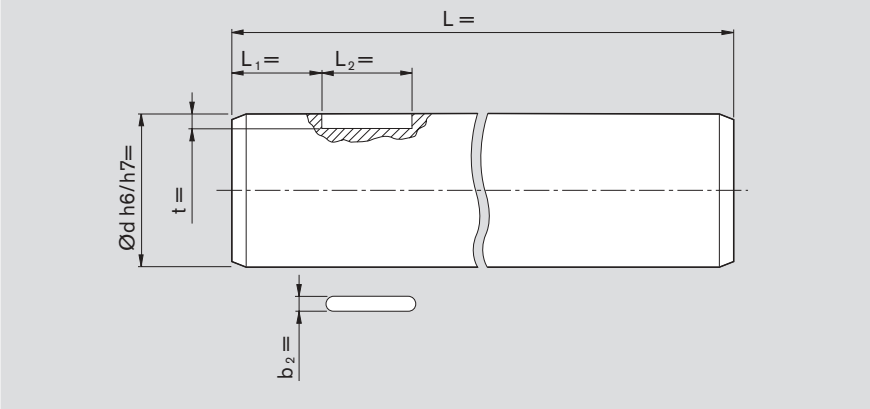
Shaft ends with grooves (both ends)



Shaft ends with inner flats (one end)



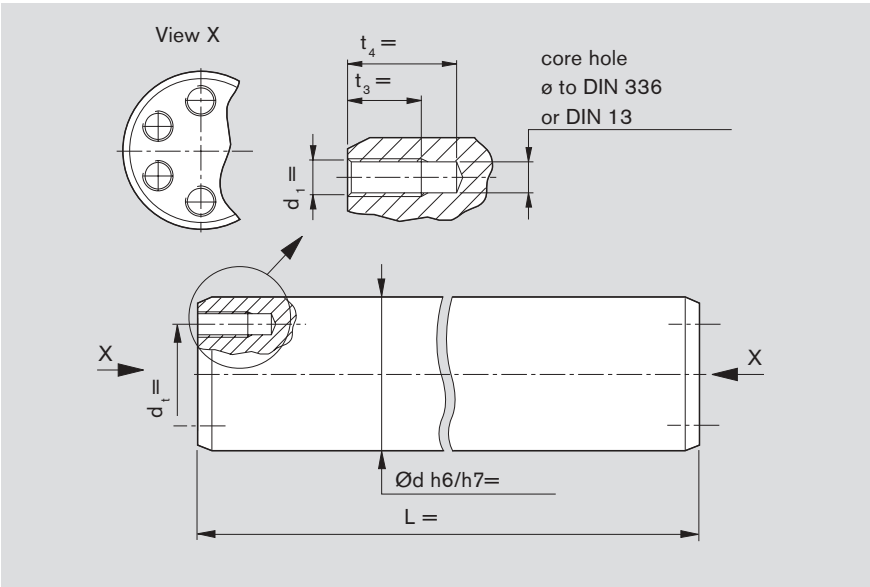
Spring groove to DIN 6885-1



Dimensional recommendation:

Dimensions [mm]		
Ød	b_2 P9	t
8	2	1.2 +0.1
10	3	1.8 +0.1
12	4	2.5 +0.1
14	5	3 +0.1
16	5	3 +0.1
20	6	3.5 +0.1
25	8	4 +0.2
30	8	4 +0.2
40	12	5 +0.2
50	14	5.5 +0.2
60	18	7 +0.2
80	22	9 +0.2

Shaft ends with holes tapped to pitch circle (both ends)



Precision steel shafts

Ordering data

Solid shafts made of heat-treated steel

When a shaft forms an integral part of an anti-friction bearing system, the materials used have to satisfy exacting requirements.
Rexroth offers the optimum shaft material for each diameter range. The materials we use have a much higher carbon content compared to frequently used mass-produced steels, which has a very positive influence on the achievable surface hardness and provides better resistance to aging.
The exceptionally uniform surface hardness and hardening depth of Rexroth shafts, combined with an excellent degree of purity, homogeneous microstructure and defined grain sizes, ensure particularly long service life ander rolling loads.

Available diameters [mm]
3, 4, 5, 6, 8, 10, 12, 14, 15, 16, 18, 20, 22, 24, 25, 30, 32, 35, 38, 40, 45, 50, 55, 60, 70, 80, 100, 110

Ø d [mm]	Lengths [m]
3	0.4
4 - 8	3.6
10 - 110	6.1

Solid shafts from 20 mm in diameter and up to 8 m in length are available upon request. Greater overall lengths are composed of sections joined end-to-end. Linear Bushing can roll over joints without any problems.

Materials	Hardness
Cf 53, Cf 60, Ck 67	min. 60 HRC

Part numbers	
Tolerance h6	R1000 xxx 00
Tolerance h7	R1000 xxx 01

xxx = Diameter in mm

Ordering example:
Solid Shaft Ø 25 h7 out of heat-treated steel.
Length: 460 mm
Part number:
R1000 025 01, 460 mm

Corrosion-resistant solid steel shafts to ISO 683-17 / EN 10088

The correct choice for applications requiring high corrosion resistance in a clean environment, e.g. in the food industry, semiconductor manufacturing and medical engineering.
X 90 CrMoV 18 differs from X 46 Cr 13 in that it is additionally resistant to lactic acid.

Materials	Available diameters [mm]
X 46 Cr 13	4, 5, 6, 8, 10, 12, 14, 16, 20, 25, 30, 40, 50, 60, 80
X 90 CrMoV 18	3, 12, 16, 20, 25, 30, 40, 50, 60, 80

Ø d [mm]	Lengths [m]
3	0.4
4-10	3.6
12-80	6.1

Greater overall lengths are composed of sections joined end-to-end. Linear Bushing can roll over joints without any problems.

Materials	Hardness
X 46 Cr 13	min. 54 HRC
X 90 CrMoV 18	min. 55 HRC

Part numbers X 46 Cr 13	
Tolerance h6	R1000 0xx 30
Tolerance h7	R1000 0xx 31

Part numbers X 90 CrMoV 18	
Tolerance h6	R1000 0xx 20
Tolerance h7	R1000 0xx 21

xx = Diameter in mm

Ordering example:
Solid shaft Ø 16 h6 our of corrosion-resistant steel X 46 Cr 13.
Length: 350 mm
Part number:
R1000 016 30, 350 mm

Solid steel shafts with hard-chromium plating

Optimum anti-corrosion protection for applications in chemically aggressive environments.

Available diameter [mm]
12, 16, 20, 25, 30, 40, 50, 60, 80

Ø d [mm]	Lengths [m]
12	5.5
16, 20	6.5
25 - 80	7

Greater overall lengths are composed of sections joined end-to-end. Rexroth Linear Bushings can roll over joints without any problems.

Materials	Hardness
Cf 53, Cf 60, Ck 67	min. 60 HRC (approx. 700 HV)
Chrome plating (Thickness approx. 10 µm)	approx. 1000 HV

Part numbers	
Tolerance h6	R1000 0xx 60
Tolerance h7	R1000 0xx 61

xx = Diameter in mm

Ordering example:
Solidshaft Ø 30
Hard chromium plating h7,
Length 480 mm
Part number: R1000 030 61, 480 mm

Heat-treated tubular steel shafts

Tubular shafts are conductive and can transport liquids and gasses. Tubular shafts are also often used for weight reduction. The material is smoothly rolled. The interior diameters are rough.

Available diameter [mm]	
outer	inner (approx.)
8	3
10	4
12	3.4
16	8
20	14
25	14
30	19
40	26.5
50	29.6
60	36.5
80	57.4
100	65

Ø d [mm]	Lengths max. [m]
8. 10	1
16	2
20	5.7
12 and 25 - 100	6.1

Materials	Hardness
Ck 60	min. 60 HRC

Part numbers	
Tolerance h6	R1001 xxx 10
Tolerance h7	R1001 xxx 11

xxx = Outer diameter in mm

Ordering example:
Tubular shaft Ø 80 h7.
Length 3600 mm
Part number:
R1001 080 11. 3600 mm

Tubular shafts, hard chromium plating

The outer diameter of tubular shafts are hard-chromium plated.

Available diameter [mm]	
outer	inner
25	14
30	19
40	26.5
50	29.6
60	36.5
80	57.4

Length : max 6.1 m

Materials	Hardness
Ck 60	min. 60 HRC (approx. 700 HV)
Chrome plating (Thickness approx.10 µm)	approx. 1000 HV

Part numbers	
Tolerance h7	R1001 0xx 41

xx = Outer diameter mm

Ordering example:
Tubular shaft Ø 40. Hard chromium plating h7. Length 2000 mm
Part number:
R1001 040 41, 2000 mm