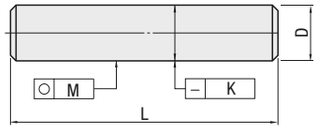
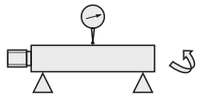
Shafts - Precision Standards

Accuracy Standards

Circularity, Straightness, L Dimension Accuracy



Straightness Measurement Method



Shaft ends are supported on V-blocks and turned 360 degrees to measure shaft runout using a dial indicator. 1/2 of measured runout is defined as the straightness.

O.D. g6, h5 Shafts (Hardened)

D Section Circularity Unit: mm

D Over	D or Less	Circularity M
2	13	0.004
13	20	0.005
20	40	0.006
40	50	0.007

L, Y Dimension Tolerances Unit: mm

Dimension Over	Dimension or Less	Dimension Tolerance
2	6	±0.1
6	30	±0.2
30	120	±0.3
120	400	±0.5
400	1000	±0.8
1000	1500	±1.2

Straightness Unit: mm

D	L	Straightness K
3, 4	N/A	(L/100)x0.05 or Less
5	N/A	(L/100)x0.03 or Less
6~50	100 or Less	0.01 or Less
	Over 100	(L/100)x0.01 or Less

O.D. f8 Shafts (Not Hardened)

D Section Circularity Unit: mm

D Over	D or Less	Circularity M
5	10	0.011
10	18	0.014
18	30	0.017
30	50	0.020

L, Y Dimension Tolerances Unit: mm

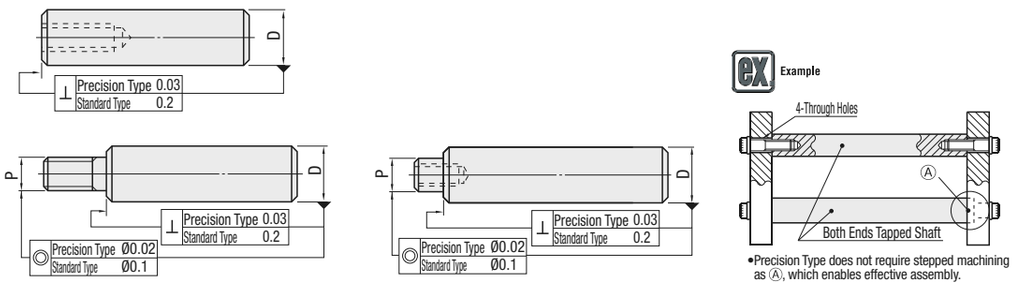
Dimension Over	Dimension or Less	Dimension Tolerance
3	6	±0.1
6	30	±0.2
30	120	±0.3
120	400	±0.5
400	1000	±0.8
1000	1500	±1.2

Straightness Unit: mm

Condition L	Straightness K
L≤100	0.025 or Less
L>100	(L/100)x0.025 or Less

Concentricity, Perpendicularity

Features of Precision Shafts: Perpendicularity is ⊥ 0.03 , Concentricity (Threaded and Stepped) is ◎ Ø0.02.



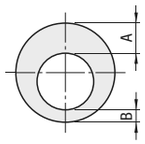
•Precision Type does not require stepped machining as Ⓐ, which enables effective assembly.

About Hollow Shaft Wall Thickness Deviations

Unit: mm

O.D. (D)	EN 1.3505 Equiv. Wall Thickness Deviation Value	EN 1.4125 Equiv. Wall Thickness Deviation Value
6	0.3 or Less	-
8	0.4 or Less	1.5 or Less
10		4.0 or Less
12		
13		
16		
20		
25	0.6 or Less	
30	1.0 or Less	
35		-
40	1.5 or Less	
50		

Hollow shaft interior surfaces are not plated, which causes rust.



Deviation Value = A-B

Thread Undercut Dimensions (PC, QC) (Reference Values)

O.D. Tolerance g6, h5 Shafts (Hardened), O.D. Tolerance f8 Shafts (Plated)

When specifying Shafts with thread undercuts or adding thread undercut alterations (PC, QC), PC and QC dimensions are as the table below. When B(S) is specified, undercut width (g) is F-B (T-S).
Refer to the table below for the dimensions of PC and QC when combined with Fine Thread alterations (PMC, PMS, QMC, QMS, MMC, MMS, NMC, and NMS).

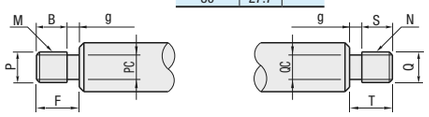
•For Coarse Threads

P(=M) Q(=N)	PC QC	F-B (T-S)
6	4.4	2
8	6.0	3
10	7.7	
12	9.4	4
16	13.0	
20	16.4	5
24	19.6	
30	25.0	

•When combined with Fine Thread Alterations

PMC, MMC QMC, NMC	PC QC	F-B (T-S)
6	4.8	2.0
8	6.4	
10	8.4	
12	10.4	
15	13.4	
17	15.4	
20	18.4	
25	22.7	3.0
30	27.7	

PMS, MMS QMS, NMS	PC QC	F-B (T-S)
10	8.0	3.0
12	9.7	
14	11.7	
18	15.7	



Shaft Material, Hardness, Surface Treatment

M Material	O.D. Tolerance	H Hardness	S Surface Treatment
EN 1.3505 Equiv.	g6, h5	Induction Hardening EN 1.3505 Equiv. 58HRC~ EN 1.4125 Equiv. 56HRC~	-
EN 1.4125 Equiv.			
EN 1.3505 Equiv.			Hard Chrome Plating Plating Hardness HV750 ~ Plating Thickness: 5μ or More
EN 1.4125 Equiv.			
EN 1.3505 Equiv.	g6		LTBC Plating Plating Thickness: 1 ~ 2μ
EN 1.4125 Equiv.			
EN 1.1191 Equiv.	f8	-	Hard Chrome Plating Plating Hardness HV750 ~ Plating Thickness 10μ or More
EN 1.4301 Equiv.			

Effective Hardened Layer Depth of Shafts (hardened) with O.D. Tolerance g6, h5

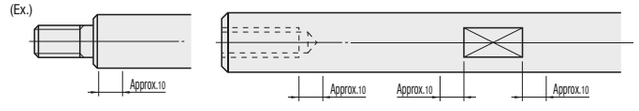
Unit: mm

O.D. (D)	Effective Hardened Depth EN 1.3505 Equiv.	Effective Hardened Depth EN 1.4125 Equiv.
3	0.5 or More	0.5 or More
4		
5		
6~10		
12, 13	0.7 or More	0.5 or More
15~20		0.7 or More
25~50	1.0 or More	

Notes on Hardening and Surface Treating

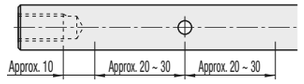
Reduced Hardness around Machined Areas

Machining is applied after base materials are case hardened.
In the example below, annealing caused by machining may result in reduced hardness of the machined area + 10mm fore and aft.



Annealing caused by machining may lower hardness of following areas:
- All threaded shafts
- All stepped shafts
- Tapped Holes: when M≥D/2, RC threads, two tapped holes on ends, hard chrome plated EN 1.4125 Equiv. products
- Retaining ring grooves, keyway, tapers, hex socket holes, wrench flats, tapped pilot, set screw grooves
- Keyway, Flats, 90-deg. Flats, V-grooves
- Shaft Ends Configurable Type (G, H shape), Hollow Shafts (Lateral Hole on One Side)

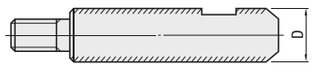
(Note) Excluding "Full Length Hardness Guaranteed Type"



•For Shafts with Cross-Drilled Hole, annealing may lower hardness in the range of 20mm and 30mm around machined area for EN 1.3505 Equiv. and EN 1.4125 Equiv. respectively.

Surface Treatment Plating Layers

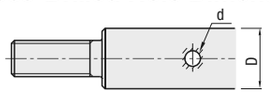
Machining is applied after base materials are surface treated.
In the example below, only ▨ D area is treated with hard chrome plating/low temp. black chrome plating.
Hard chrome plating, low temp. black chrome plating will not remain on cut-ends, stepped. tapered, and altered sections.
For Features of LTBC Plating, see P.128.
Hollow shaft interior surfaces are not plated, which causes rust.



Other plating finished shapes are:
- Threaded, Stepped and Tapped
- Retaining ring grooves, keyway, tapers, hex socket holes, wrench flats, set screw grooves
- Keyway, Flats, 90-deg. Flats, V-grooves

Surface Treatment Fully Plated Shafts will have the plating on the entire shaft except centering holes and tapped sections.

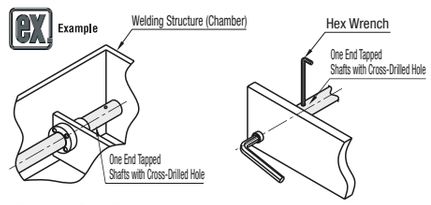
Cross-Drilled Hole Dimension Details



Cross-drilled hole areas may be out of O.D. tolerances due to annealing-induced deformation.
Hard chrome plating layers around machined area may be flaked by deburring. (▨ Areas)
Orientation in relation to other features will be random.

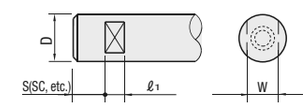
D	d
8	3
10	
12	
13	4
15	
16	

D	d
18	6
20	
25	7
30	



•Shafts with Cross-Drilled Hole are suitable for narrow work space.

Shafts: Detailed Wrench Flats Dimensions



S(SC, etc.) =1mm Increment
S (SC, etc.) +ℓ1≤L
S(SC etc.) =0 or S(SC etc.) ≥1
Cannot be machined coplanar.
Orientation in relation to other features will be random.

D	W	ℓ1
6	5	8
8	7	
10	8	
12	10	10
13	11	
15	13	
16	14	

D	W	ℓ1
18	16	10
20	17	
25	22	
30	27	15
35	30	
40	36	20
50	41	

⊗Not applicable to D=3, 4, 5