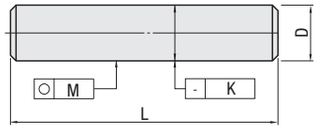
For **Pricing** and **Days to Ship**,Please Configure Online.

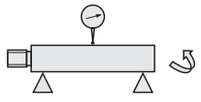
Shafts - Precision Standards -

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

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

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

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

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

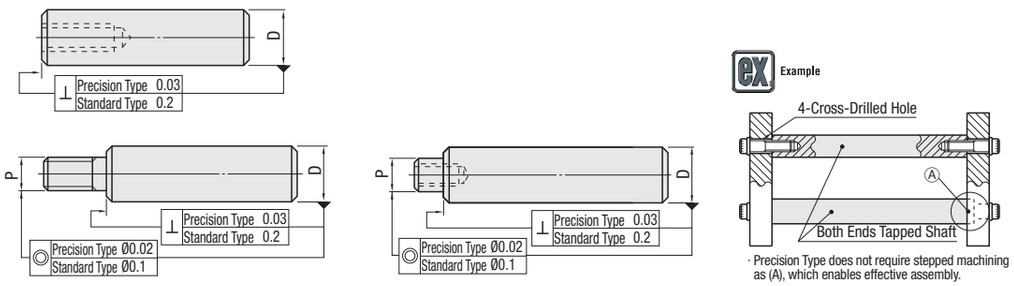
Dimension Over	Dimension or Less	Dimension Tolerance
3	6	±0.1
6	30	±0.2
30	120	±0.3
120	400	±0.5
400	1000	±0.8
1000	1500	±1.2

Straightness

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

Concentricity, Perpendicularity

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



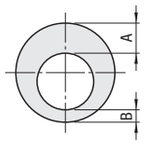
· Precision Type does not require stepped machining as (A), which enables effective assembly.

About Hollow Shaft Wall Thickness Deviations

Unit: mm

O.D. (D)	52100 Bearing Steel Wall Thickness Deviation Value	440C Stainless Steel 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		

The hollow shaft's interior surfaces are not plated.
The interior may 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).

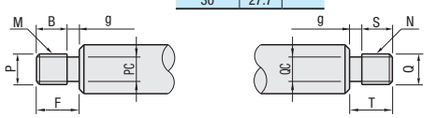
· For Coarse Threads

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
52100 Bearing Steel	g6, h5	Induction Hardened 52100 Bearing Steel 58HRC~ 440C Stainless Steel Equivalent 56HRC~	-
440C Stainless Steel			
52100 Bearing Steel			Hard Chrome Plating Plating Hardness: HV750 ~ Plating Thickness: 5μ or More
440C Stainless Steel			
52100 Bearing Steel	g6		Low Temp. Black Chrome Plating Plating Thickness: 1 ~ 2μ
440C Stainless Steel			
1045 Carbon Steel	f8	-	Hard Chrome Plating Plating Hardness: HV750 ~ Plating Thickness: 10μm or More
304 Stainless Steel			

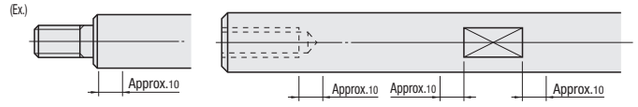
Effective Hardened Layer Depth of Shafts (hardened) with O.D. Tolerance g6, h5

O.D. (D)	Effective Hardened Depth 52100 Bearing Steel	440C Stainless Steel
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	

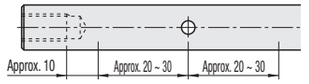
Notes on Hardened and Surface Treating

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 440C Stainless Steel 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"



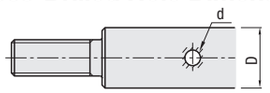
· For Shafts with Cross-Drilled Hole, annealing may lower hardness in the range of 20mm and 30mm around machined area for 52100 Bearing Steel and 440C Stainless Steel respectively.

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 or low temp. black chrome plating.
Hard chrome plating or low temp. black chrome plating will be removed from stepped, tapered and machined areas.
About Features of Low Temp. Black Chrome Plating, please see **P.112**
The hollow shaft's interior surfaces are not plated. The interior may rust.

Other plating finished shapes are:
· Threaded and tapped shafts
· 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

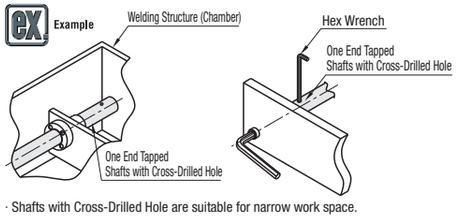


D	d
8	3
10	
12	
13	4
15	
16	

D	d
18	6
20	
25	7
30	

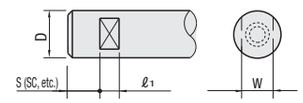
Cross-drilled hole areas may be out of O.D. tolerances due to annealing-induced deformation.
Hard chrome plating layers around machined area may be flaked by deburring. (//////Areas)
Orientation in relation to other features will be random.

Example



· 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 on the same plane.
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