SLIDE SHAFT

SLIDE SHAFT

The NB slide shaft is used with bearings such as a slide bush in order to obtain highly accurate linear motion. When used in combination with a slide bush, the shaft performs as the inner race of the bearing system. The quality and accuracy of the shaft directly affect the performance of the slide bush. NB slide shaft is manufactured with an emphasis on quality and accuracy to ensure stable functionality under many operating conditions. Superior performance is guaranteed for both rotational motion and combined rotation and linear motion.

ADVANTAGES

Advanced Machining Technology:

NB will perform a wide variety of highly accurate machining processes to provide custom shafting from relatively simple machining, such as tapping and shaft stepping to the more demanding high-speed rotating shafts and spindles. NB can also perform special grinding and bore machining requirements.

Excellent Wear Resistance:

High wear resistant carbon-chromium bearing steel (SUJ2) and Martensite stainless steel (equivalent to SUS440C) materials are most commonly used. These materials are annealed and tempered to achieve a reliably uniform hardened layer in both the circumferential and axial directions. A cross-sectional photograph illustrating the hardened layer depth of the NB slide shaft is shown below.

Surface Roughness:

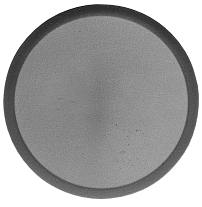
Precision grinding results in a surface roughness of less than 0.4 Ra.

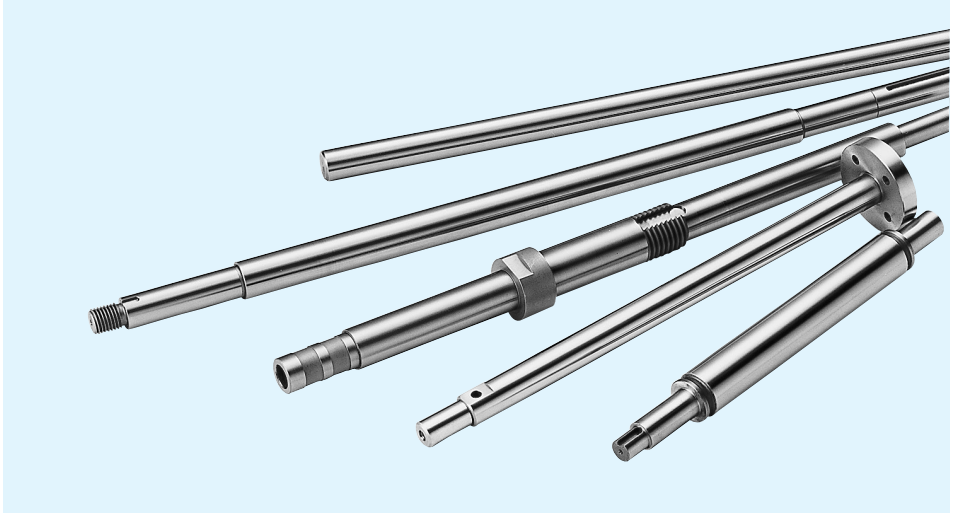
Wide Selection of Shaft Types:

SN type
SNS type
SNT type
Tapped shaft type (SNB/SNSB type)
SNW/SNWS(Inch type)
SNW-PD/SNWS-PD(Inch type pre-drilled shaft)

Special requirements:

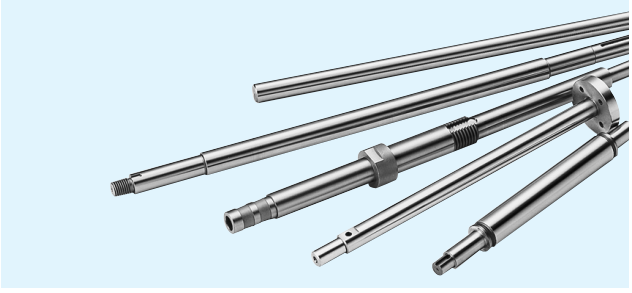
NB will provide slide shafts meeting special requirements (including special shapes and materials).





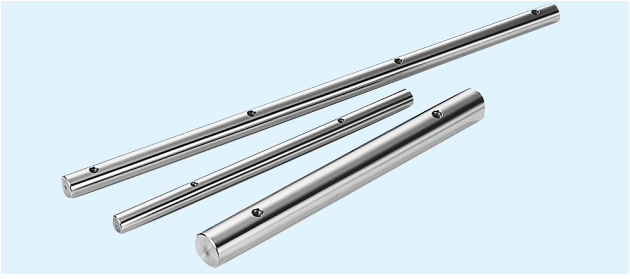
TYPES

SN/SNS/SNT Type (NB Shaft)



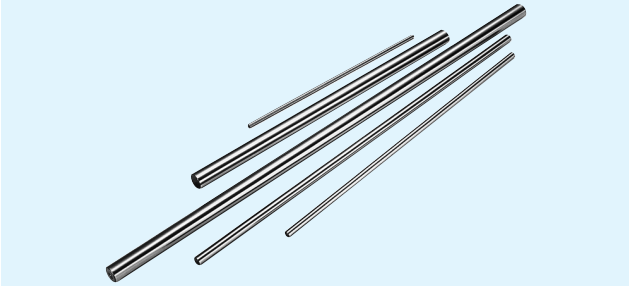
P.G-6,7,8

SNB/SNSB (NB Center-Lined Tapped Shaft)



P.G-9

SNW/SNWS Type



P.G-10,11

NB's SN/SNS slide shaft is a high-precision, straight, machined shaft series that may be used with a slide bush or as material in other applications.

Table G-1 SN/SNS Specifications

type	SN Type	SNS Type	SNT Type
material	SUJ-2	equivalent to SUS440C	SUJ-2
outer diameter tolerance	g6 or to be specified		
hardness	60HRC or more	56HRC or more	60HRC or more
surface roughness	less than 0.4Ra		
page	page G-6	page G-7	page G-8

The SNT pipe shaft may be used to reduce weight without reducing the material's rigidity. It may also be used for channeling electrical wires, hydraulic, or pneumatic sources.

Table G-2 SNB/SNSB Specifications

type	SNB type	SNSB type
material	SUJ-2	equivalent to SUS440C
outer diameter tolerance	g6 or to be specified	
hardness	60 HRC or more	56 HRC or more
surface roughness	less than 0.4Ra	
page	page G-9	

The SNW series are inch dimension shafts with the same quality level as SN/SNS type.

PD (center-lined tapped hole) type is available for relatively long shafts.

PD type can be used with WA shaft support rail (page E-46) for better performance.

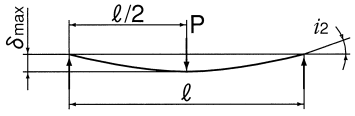
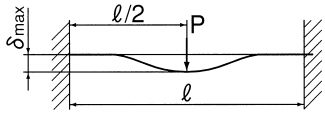
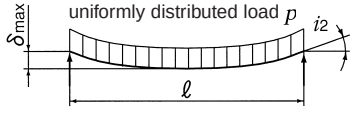
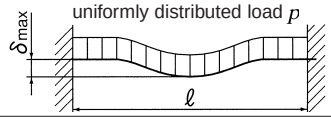
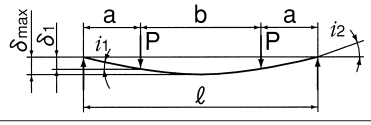
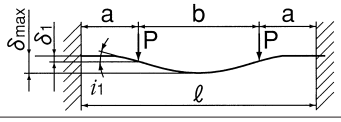
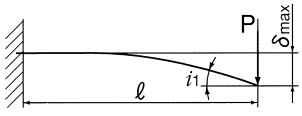
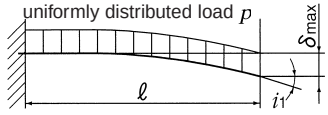
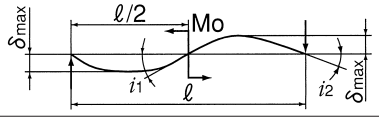
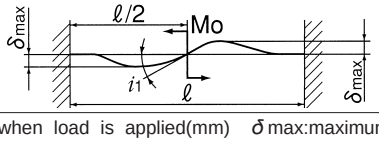
SNW/SNWS type

SNW-PD/SNWS-PD type

CALCULATION OF DEFLECTION AND DEFLECTION ANGLE

The following formulas can be used to obtain the deflection and its angle of a linear slide shaft. Some typical conditions are listed in Table G-3.

Table G-3 Formulas for Calculating Deflection and Deflection Angle

	support method	specification	formula for deflection	formula for deflection angle
1	support - support		$\delta_{max}=\frac{P\ell^3}{48EI}=P\ell^3C$	$i_1=0$ $i_2=\frac{P\ell^2}{16EI}=3P\ell^2C$
2	fixed - fixed		$\delta_{max}=\frac{P\ell^3}{192EI}=\frac{1}{4}P\ell^3C$	$i_1=0$ $i_2=0$
3	support - support		$\delta_{max}=\frac{5p\ell^4}{384EI}=\frac{5}{8}p\ell^4C$	$i_2=\frac{p\ell^3}{24EI}=2p\ell^3C$
4	fixed - fixed		$\delta_{max}=\frac{p\ell^4}{384EI}=\frac{1}{8}p\ell^4C$	$i_2=0$
5	support - support		$\delta_1=\frac{Pa^3}{6EI}\left(2+\frac{3b}{a}\right)=8Pa^3\left(2+\frac{3b}{a}\right)C$ $\delta_{max}=\frac{Pa^3}{24EI}\left(\frac{3\ell^2}{a^2}-4\right)=2Pa^3\left(\frac{3\ell^2}{a^2}-4\right)C$	$i_1=\frac{Pab}{2EI}=24PabC$ $i_2=\frac{Pa(a+b)}{2EI}=24Pa(a+b)C$
6	fixed - fixed		$\delta_1=\frac{Pa^3}{6EI}\left(2-\frac{3a}{\ell}\right)=8Pa^3\left(2-\frac{3a}{\ell}\right)C$ $\delta_{max}=\frac{Pa^3}{24EI}\left(2+\frac{3b}{a}\right)=2Pa^3\left(2+\frac{3b}{a}\right)C$	$i_1=\frac{Pa^2b}{2EI\ell}=\frac{24Pa^2bC}{\ell}$ $i_2=0$
7	fixed - fixed		$\delta_{max}=\frac{P\ell^3}{3EI}=16P\ell^3C$	$i_1=\frac{P\ell^2}{2EI}=24P\ell^2C$ $i_2=0$
8	fixed - fixed		$\delta_{max}=\frac{p\ell^4}{8EI}=6p\ell^4C$	$i_1=\frac{p\ell^3}{6EI}=8p\ell^3C$ $i_2=0$
9	support - support		$\delta_{max}=\frac{\sqrt{3}M_0\ell^2}{216EI}=\frac{2\sqrt{3}}{9}M_0\ell^2C$	$i_1=\frac{M_0\ell}{12EI}=4M_0\ell C$ $i_2=\frac{M_0\ell}{24EI}=2M_0\ell C$
10	fixed - fixed		$\delta_{max}=\frac{M_0\ell^2}{216EI}=\frac{2}{9}M_0\ell^2C$	$i_1=\frac{M_0\ell}{16EI}=3M_0\ell C$ $i_2=0$

δ_1:deflection when load is applied(mm) δmax:maximum deflection(mm) i_1:deflection angle when load is applied(rad) i_2:deflection angle at the support(rad) Mo:moment(N·mm) P:concentrated load(N) p:uniformly distributed load(N/mm) a,b:loading point distance ℓ:span(mm) I:geometrical moment of inertia(mm^4) E:modulus of direct elasticity 2.06×10^5(N/mm^2) C:1/48EI($1/N\cdot mm^2$)

The Geometrical moment of inertia (I) is obtained using the following formula:

● For solid shaft

$$I = \frac{\pi D^4}{64}$$

● For hollow shaft

$$I = \frac{\pi}{64}(D^4 - d^4)$$

I : geometrical moment of inertia (mm^4) D : outer dia. (mm)
d : inner dia. (mm)

The values of the geometrical moment of inertia and C (=1/48 I) for NB slide shafts are listed in Table G-4 and G-5.

Calculation Examples:

1. Calculate the maximum deformation of a shaft with an outer diameter of 30 mm and a span of 500 mm when a concentrated load of 980 N is applied at the mid-point of the shaft (neglecting the weight of the shaft).

① support-support :

From the given conditions, P is 980 N and ℓ is 500 mm

From Table G-4, C for an outer diameter of 30 mm is 2.54 x 10^{-12} (1/N mm^2).

Substituting these values into the corresponding formula in Table G-3,

$\delta max = P\ell^3 C = 0.31$ mm.

② fixed-fixed :

Substituting the values into the corresponding formula given in Table G-3,

$$\delta max = \frac{1}{4} P\ell^3 C = 0.08 \text{ (mm)}$$

2. Calculate the maximum deformation of a shaft with an outer diameter of 60 mm, an inner diameter of 32 mm, and a span of 2000 mm due to its own weight.

From Table G-5, C for an outer diameter of 60 mm is

C = 1.73x10^{-13} (1/N mm^2)

The mass per unit length of a shaft with an outer diameter of 60 mm and an inner diameter of 32 mm is 15.9 kg/m. Therefore, a uniformly distributed load of 0.156 N/mm is applied. Substituting these values into the most appropriate formula for your application given in Table G-3.

$$\delta max = \frac{5}{8} p\ell^4 C = 0.27 \text{ (mm)}.$$

Table G-4 Geometrical moment of inertia and C for NB Slide Shafts

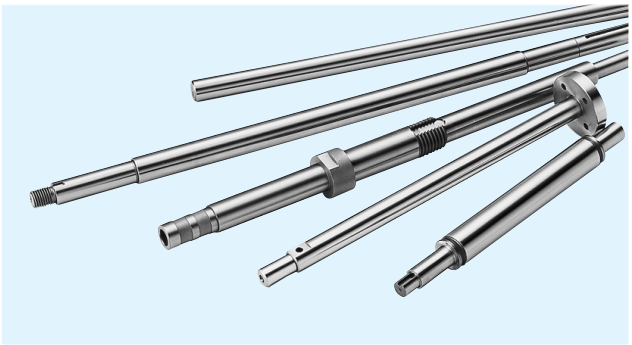
outer diameter D(mm)	Geometrical moment of inertia I(mm^4)	C=1/48EI (1/Nmm^2)
3	3.98	2.54×10^{-8}
4	1.26×10	8.03×10^{-9}
5	3.07×10	3.29×10^{-9}
6	6.36×10	1.59×10^{-9}
8	2.01×10^2	5.03×10^{-10}
10	4.91×10^2	2.06×10^{-10}
12	1.02×10^3	9.91×10^{-11}
13	1.40×10^3	7.22×10^{-11}
15	2.49×10^3	4.06×10^{-11}
16	3.22×10^3	3.14×10^{-11}
20	7.85×10^3	1.29×10^{-11}
25	1.92×10^4	5.27×10^{-12}
30	3.98×10^4	2.54×10^{-12}
35	7.37×10^4	1.37×10^{-12}
40	1.26×10^5	8.03×10^{-13}
50	3.07×10^5	3.29×10^{-13}
60	6.36×10^5	1.59×10^{-13}
80	2.01×10^6	5.03×10^{-14}
100	4.91×10^6	2.06×10^{-14}
120	1.02×10^7	9.91×10^{-15}
150	2.49×10^7	4.06×10^{-15}

Table G-5 Geometrical moment of inertia and C for NB Pipe Shafts

outer diameter D(mm)	inner diameter d(mm)	Geometrical moment of inertia I(mm^4)	C=1/48EI (1/Nmm^2)
6	2	6.28×10	1.61×10^{-9}
8	3	1.97×10^2	5.13×10^{-10}
10	4	4.78×10^2	2.11×10^{-10}
12	5	9.87×10^2	1.02×10^{-10}
13	6	1.34×10^3	7.55×10^{-11}
16	8	3.02×10^3	3.36×10^{-11}
20	10	7.36×10^3	1.37×10^{-11}
25	15	1.67×10^4	6.06×10^{-12}
30	16	3.65×10^4	2.77×10^{-12}
35	19	6.73×10^4	1.50×10^{-12}
40	20	1.18×10^5	8.57×10^{-13}
50	26	2.84×10^5	3.56×10^{-13}
60	32	5.85×10^5	1.73×10^{-13}
80	48	1.75×10^6	5.78×10^{-14}
100	60	4.27×10^6	2.37×10^{-14}

SN TYPE

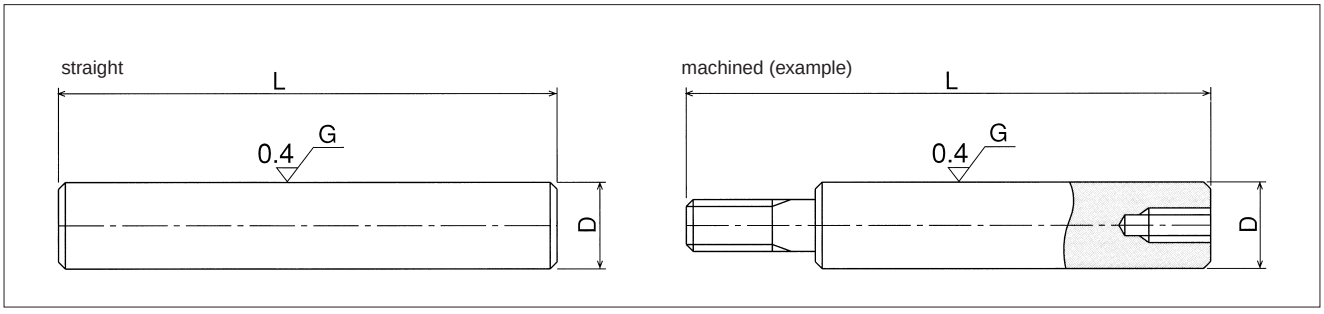
− NB Shaft −



part number structure example

SN **20** **h5** × **576**

- SN type
- outer diameter (D)
- outer diameter tolerance g6 when blank
- length (L)

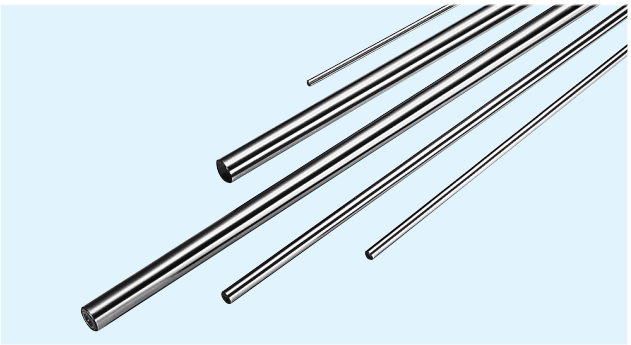


part number	outer diameter D mm	tolerance g6* μm	length L mm	mass kg/m
SN 3	3	−2/−8	50◀▶400	0.06
SN 4	4	− 4 −12	100◀▶500	0.10
SN 5	5		100◀▶700	0.16
SN 6	6		100◀▶1000	0.23
SN 8	8	− 5 −14	200◀▶1500	0.40
SN 10	10		200◀▶2000	0.62
SN 12	12	− 6 −17	200◀▶3000	0.89
SN 13	13		200◀▶3000	1.04
SN 15	15		300◀▶4000	1.39
SN 16	16		300◀▶4000	1.58
SN 20	20	− 7 −20	300◀▶5000	2.47
SN 25	25		300◀▶6000	3.85
SN 30	30		300◀▶6000	5.55
SN 35	35	− 9 −25	400◀▶6000	7.55
SN 40	40		400◀▶6000	9.87
SN 50	50		500◀▶6000	15.4
SN 60	60	−10 −29	600◀▶6000	22.2
SN 80	80		800◀▶6000	39.5
SN100	100	−12 −34	1000◀▶6000	61.7
SN120	120		1500◀▶4500	88.8
SN150	150	−14/−39	1500◀▶4500	139

material: high-carbon chromium bearing steel(SUJ2) hardness: HV697 (60HRC) or more
Tolerances other than *g6 are available upon request.

SNS TYPE

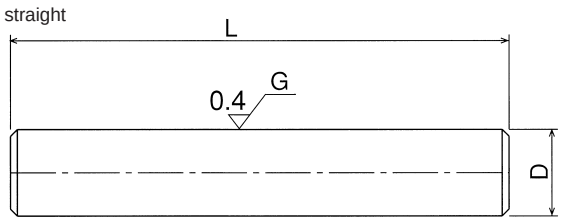
− NB Stainless Steel Shaft −

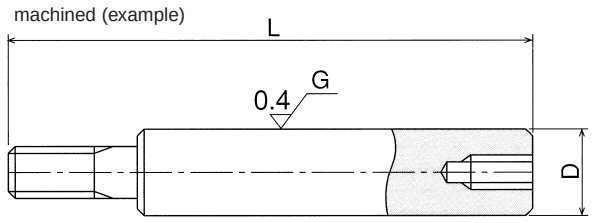


part number structure example

SNS | 20 | h5 × | 576

- SNS: SNS type
- 20: outer diameter (D)
- h5: outer diameter tolerance g6 when blank
- 576: length (L)





part number	outer diameter D mm	outer diameter tolerance g6* μm	length L mm	mass kg/m
SNS 3	3	−2/−8	50◀▶300	0.06
SNS 4	4	−4/−12	100◀▶400	0.10
SNS 5	5	−4/−12	100◀▶500	0.16
SNS 6	6	−4/−12	100◀▶600	0.22
SNS 8	8	−5/−14	200◀▶1000	0.39
SNS 10	10	−5/−14	200◀▶1500	0.61
SNS 12	12	−6/−17	200◀▶2500	0.88
SNS 13	13	−6/−17	200◀▶3000	1.03
SNS 16	16	−6/−17	300◀▶4000	1.56
SNS 20	20	−7/−20	300◀▶5000	2.43
SNS 25	25	−7/−20	300◀▶6000	3.80
SNS 30	30	−7/−20	300◀▶6000	5.48
SNS 35	35	−9/−25	400◀▶6000	7.23
SNS 40	40	−9/−25	400◀▶6000	9.44
SNS 50	50	−9/−25	500◀▶6000	15.2
SNS 60	60	−10/−29	600◀▶6000	21.9
SNS 80	80	−10/−29	800◀▶6000	39.0
SNS100	100	−12/−34	1000◀▶6000	60.9

material: Martensite stainless steel (equivalent to SUS440C)
hardness: HV613 (56HRC) or more
The length of hardening is up to 4500mm for shafts with diameter over 80mm.
Tolerances other than *g6 are available upon request.

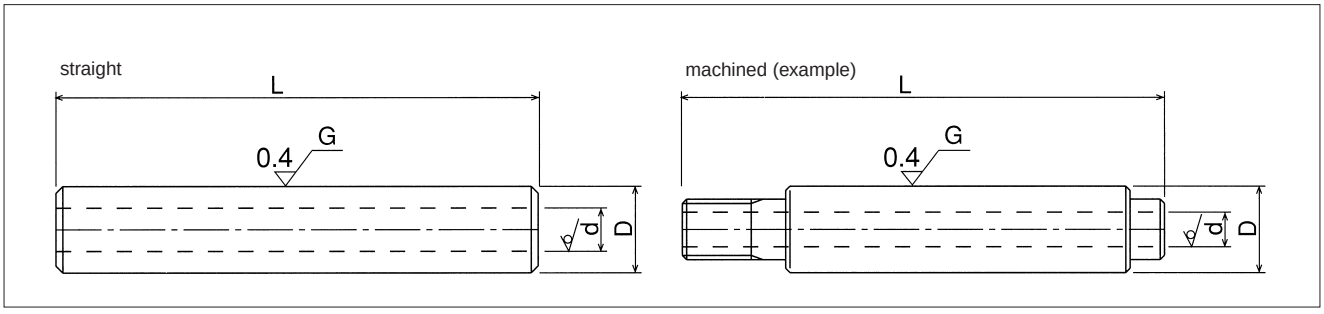
SNT TYPE

− NB Pipe Shaft −

part number structure example

SNT | 25 | h5 × | 576

- SNT type
- outer diameter (D)
- outer diameter tolerance g6 when blank
- length (L)



part number	outer diameter D mm	outer diameter tolerance *g6 μm	inner diameter d mm	length L mm	mass kg/m
SNT 6	6	−4/−12	2	100◀——▶400	0.20
SNT 8	8	− 5	3	200◀——▶600	0.34
SNT 10	10	−14	4	200◀——▶1000	0.52
SNT 12	12	− 6	5	200◀——▶1500	0.73
SNT 13	13	−17	6	200◀——▶1500	0.82
SNT 16	16		8	300◀——▶2500	1.18
SNT 20	20	− 7	10	300◀——▶4000	1.85
SNT 25	25	−20	15	300◀——▶4000	2.46
SNT 30	30		16	300◀——▶4500	3.97
SNT 35	35	− 9	19	400◀——▶4500	5.32
SNT 40	40	−25	20	400◀——▶4500	7.39
SNT 50	50		26	500◀——▶4500	11.3
SNT 60	60	−10	32	600◀——▶4500	15.9
SNT 80	80	−29	48	800◀——▶4500	25.3
SNT100	100	−12/−34	60	1000◀——▶4500	39.5

material: high-carbon chromium bearing steel (SUJ2) hardness: HV697 (60HRC) or more

Tolerances other than *g6 are available upon request.

NB CENTER-LINED TAPPED SHAFT

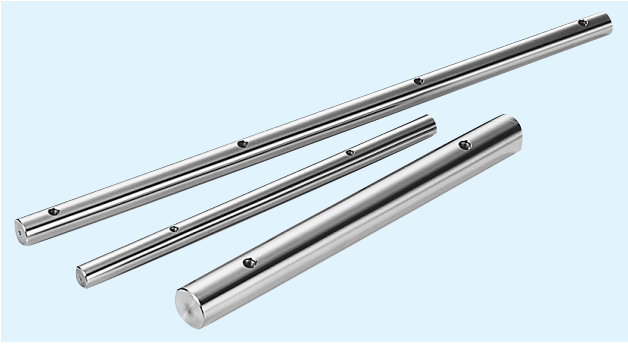
A larger diameter shaft can overcome problems in maintaining precision functionality when a high or unbalanced load is applied. The application of the center-lined tapped shaft together with the SA type support base is ideal in such cases (see SA dimensional table on pages E-32 and E-33). The center-lined tapped shaft is standardized to simplify selection.

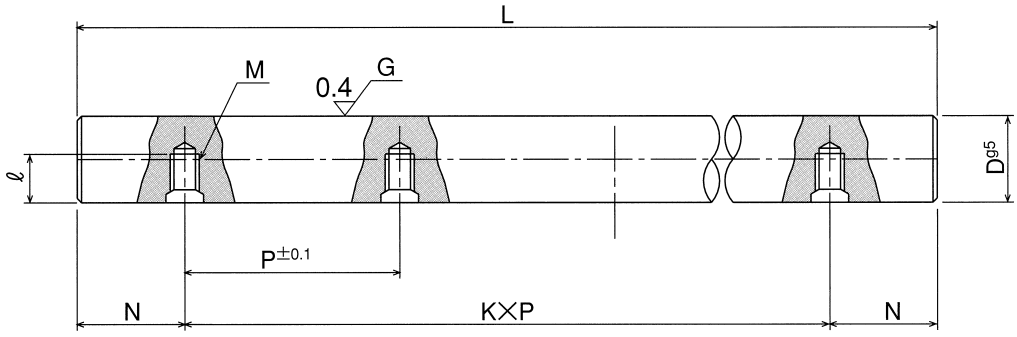
part number structure example

SNSB **25** × **576**

- SNSB: material
- 25: outer diameter (D)
- 576: length (L)

material	
SNB	SUJ2
SNSB	equivalent to SUS440C





N: $\frac{L-K\times P}{2}$

K: number of pitches

NB Center-Lined Tapped Shaft

part number	outer diameter D mm	tolerance g6* μm	pitch P mm	bolt size M	tap depth ℓ mm	maximum length Lmax mm
SNB10	10	−5/−14	100	M 4	4.5	1,500
SNB12	12	−6/−17	100	M 4	5.5	1,800
SNB13	13		100	M 4	6	2,000
SNB16	16		150	M 5	7	2,000
SNB20	20	−7/−20	150	M 6	9	3,000
SNB25	25		200	M 6	12	4,000
SNB30	30		200	M 8	15	4,500
SNB35	35	−9/−25	200	M 8	15	5,000
SNB40	40		300	M 8	18	6,000
SNB50	50		300	M10	22	6,000

material: high-carbon chromium bearing steel (SUJ2)
hardness: HV697 (60HRC) or more
*g6 is standard tolerance for the outer diameter.

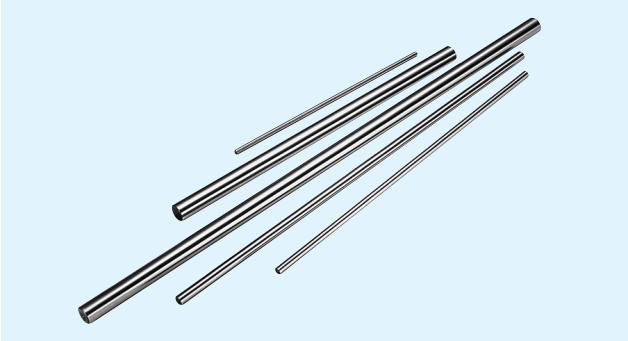
NB Center-Lined Stainless Tapped Shaft

part number	outer diameter D mm	tolerance g6* μm	pitch P mm	bolt size M	tap depth ℓ mm	maximum length Lmax mm
SNSB16	16	−6/−17	150	M 5	7	2,000
SNSB20	20	−7/−20	150	M 6	9	3,000
SNSB25	25		200	M 6	12	4,000
SNSB30	30		200	M 8	15	4,500
SNSB35	35	−9/−25	200	M 8	15	5,000
SNSB40	40		300	M 8	18	6,000
SNSB50	50		300	M10	22	6,000

material: Martensite stainless steel (equivalent to SUS440C)
hardness: HV613 (56HRC) or more
*g6 is standard tolerance for the outer diameter.

SNW TYPE

− NB Inch Shaft −

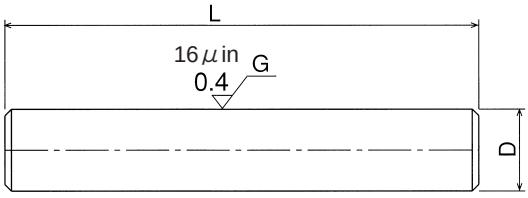


part number structure example

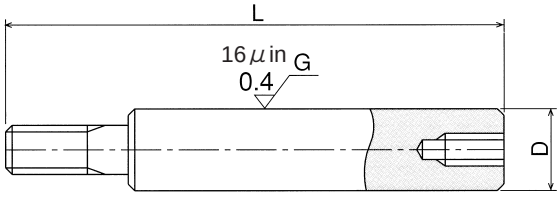
SNW | 24 | h5 × 4000 mm

- SNW type
- size
- outer diameter tolerance g6 when blank
- length (L)

straight



machined (example)



part number	outer diameter D inch / mm	tolerance g6* inch/μm	length L inch / mm	mass ℓ bs/inch kg/m
SNW 4	1/4 6.350	−.0002 −.0006	3.94 100 ◀▶ 39.37 1000	0.014 0.25
SNW 6	3/8 9.525	−5 −14	7.84 200 ◀▶ 59.06 1500	0.031 0.56
SNW 8	1/2 12.700	−.0002 −.0007	7.84 200 ◀▶ 118.11 3000	0.056 0.99
SNW10	5/8 15.875	−6 −17	7.84 200 ◀▶ 157.48 4000	0.086 1.55
SNW12	3/4 19.050	−.0003 −.0008	11.81 300 ◀▶ 157.48 4000	0.125 2.24
SNW16	1 25.400	−7 −20	11.81 300 ◀▶ 157.48 4000	0.222 3.98
SNW20	1-1/4 31.750	−.0004 −.0010	11.81 300 ◀▶ 157.48 4000	0.420 6.22
SNW24	1-1/2 38.100	−9 −25	15.75 400 ◀▶ 157.48 4000	0.500 8.95
SNW32	2 50.800	−.0004 −.0011 −10 −29	19.69 500 ◀▶ 157.48 4000	0.890 15.91
SNW40	2-1/2 63.500		23.62 600 ◀▶ 157.48 4000	1.391 25.00
SNW48	3 78.200		23.62 600 ◀▶ 157.48 4000	2.003 37.92
SNW64	4 101.600	−.0005/−.0013 −12/−34	39.37 1000 ◀▶ 157.48 4000	3.560 64.02

material：high-carbon chromium bearing steel（SUJ2）
hardness：HV 697（60HRC） or more
Tolerances other than *g6 are available upon request.
Longer lengths are also available.

1kg ≒ 2.205ℓ bs

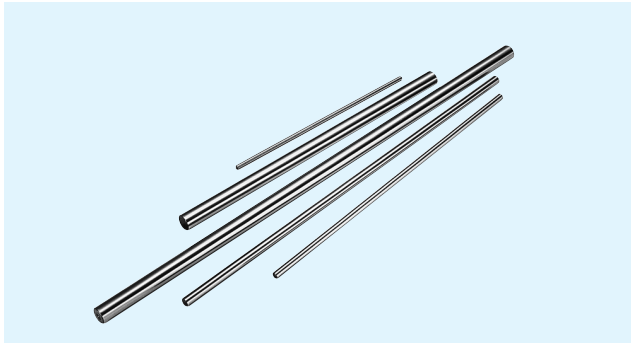
SNWS TYPE

− NB Inch Stainless Steel Shaft −

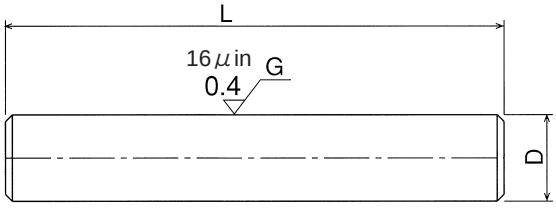
part number structure example

SNWS | 24 | h5 × 4000 mm

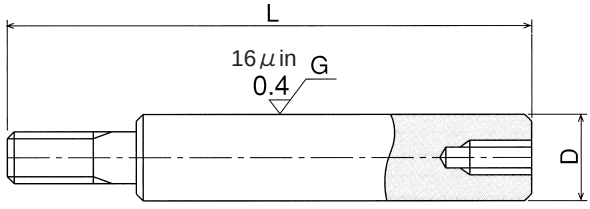
- SNWS: SNWS type
- 24: size
- h5: outer diameter tolerance g6 when blank
- 4000 mm: length (L)



straight



machined (example)



part number	outer diameter D inch / mm	outer diameter tolerance g6* inch/μm	length L inch / mm	mass ℓ bs/inch kg/m
SNWS 4	1/4 6.350	−.0002 −.0006	3.94 100 ◀——▶ 23.62 600	0.014 0.25
SNWS 6	3/8 9.525	−5 −14	7.84 200 ◀——▶ 39.37 1000	0.031 0.55
SNWS 8	1/2 12.700	−.0002 −.0007	7.84 200 ◀——▶ 98.43 2500	0.056 0.98
SNWS10	5/8 15.875	−6 −17	7.84 200 ◀——▶ 118.11 3000	0.086 1.54
SNWS12	3/4 19.050	−.0003 −.0008	11.81 300 ◀——▶ 157.48 4000	0.125 2.22
SNWS16	1 25.400	−7 −20	11.81 300 ◀——▶ 157.48 4000	0.222 3.95
SNWS20	1-1/4 31.750	−.0004 −.0010	11.81 300 ◀——▶ 157.48 4000	0.420 6.16
SNWS24	1-1/2 38.100	−9 −25	15.75 400 ◀——▶ 157.48 4000	0.500 8.88
SNWS32	2 50.800	−.0004/−.0011 −10/−29	19.69 500 ◀——▶ 157.48 4000	0.890 15.78

material：Martensite stainless steel（equivalent to SUS440C）

hardness：HV 613（56HRC） or more

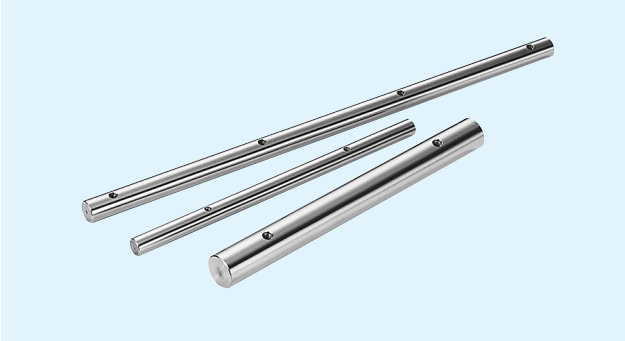
Tolerances other than *g6 are available upon request.

Longer lengths are also available.

1kg ≒ 2.205ℓ bs

SNW-PD

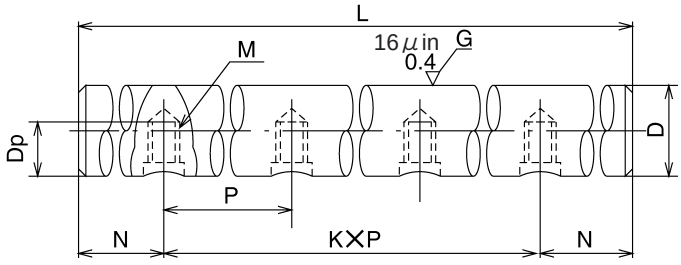
− NB Inch Pre-Drilled Shaft −



part number structure example

SNW | 20 | h5 × 72 inch- PD

- SNW type
- size
- outer diameter tolerance g6 when blank
- length (L)
- pre-drilled shaft



$N = \frac{L - K \times P}{2}$

K : number of pitches

part number	outer diameter D inch mm	outer diameter tolerance g6* inch/μm	pitch P inch/mm	bolt size M	tapped hole depth Dp inch/mm	maximum length L inch/mm
SNW 8-PD	1/2 12.700	−.0002 −.0007 −6 −17	4 101.6	#6-32	0.280 7.1	72 1,828.8
SNW10-PD	5/8 15.875			8-32	0.350 8.9	
SNW12-PD	3/4 19.050	−.0003 −.0008 −7 −20	6 152.4	10-32	0.400 10.2	
SNW16-PD	1 25.400			1/4-20	0.500 12.7	
SNW20-PD	1-1/4 31.750	−.0004 −.0010 −9 −25		5/16-18	0.650 16.5	
SNW24-PD	1-1/2 38.100			3/8-16	0.700 17.8	
SNW32-PD	2 50.800	−.0004/−.0011 −10/−29	8 203.2	1/2-13	0.850 21.6	

material : high-carbon chromium beering steel（SUJ2）.

hardness : HV 697（60HRC） or more

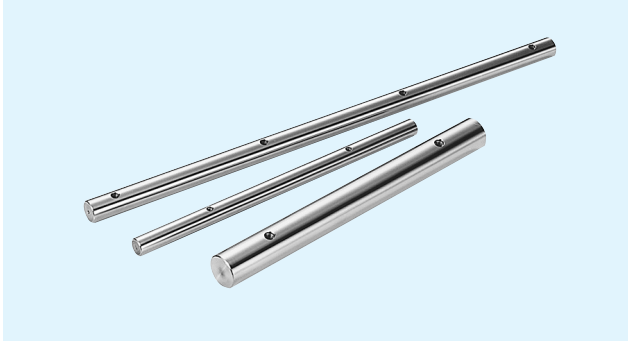
Tolerances other than *g6 are available upon request.

Longer lengths are also available.

1kg ≒ 2.205ℓbs

SNWS-PD

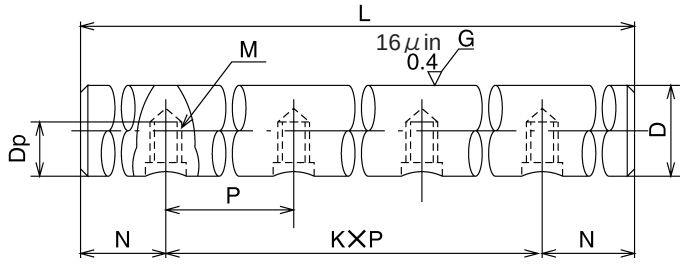
– NB Inch Pre-Drilled Stainless Steel Shaft –



part number structure example

SNWS 24 h5 × 72 inch- PD

- SNWS type
- size
- outer diameter tolerance g6 when blank
- length (L)
- pre-drilled shaft



$N = \frac{L-K\times P}{2}$

K : number of pitches

part number	outer diameter D inch mm	outer diameter tolerance g6* inch/μm	pitch P inch/mm	bolt size M	tapped hole depth Dp inch/mm	maximum length L inch/mm
SNWS12-PD	3/4 19,050	−.0003 −.0008 −7 −20	6 152.4	#10−32	0.400 10.2	72 1,828.8
SNWS16-PD	1 25,400			1/4−20	0.500 12.7	
SNWS20-PD	1−1/4 31,750	−.0004 −.0010 −9 −25		5/16−18	0.650 16.5	
SNWS24-PD	1−1/2 38,100		8 203.2	3/8−16	0.700 17.8	
SNWS32-PD	2 50,800	−.0004/−.0011 −10/−29		1/2−13	0.850 21.6	

material : Martensite stainless steel (equivalent to SUS440C)

hardness : HV613 (56HRC) or more

Tolerances other than *g6 are available upon request.

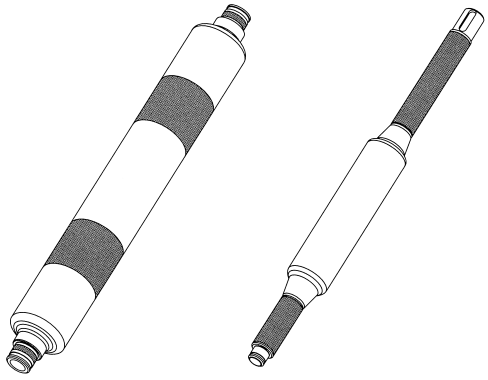
Longer lengths are also available.

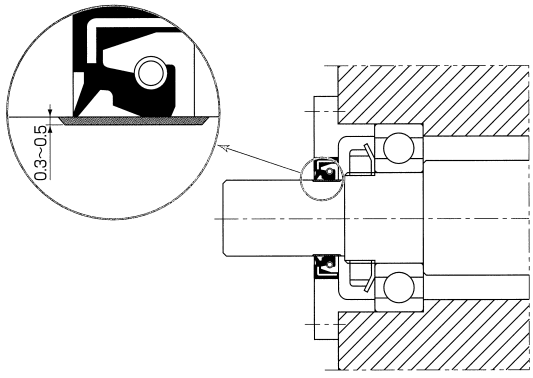
THERMAL-SPRAYING CERAMIC-COATING SPECIFICATION

ADVANTAGES:

Parts that require wear and corrosion resistance may be thermal-sprayed with a ceramic material per NB's ceramic-coating specifications. Material so treated may be used in a wide variety of applications. The pores in the coated layer result in good lubrication characteristics and can be sealed to achieve high corrosion resistance.

APPLICATION EXAMPLES:





Application of a ceramic coating to oil-sealing parts, rollers, and shafts results in good lubrication and high wear/corrosion resistance characteristics.

Note: Ceramic coated surface cannot be used as the inner race for a slide bush.

REFERENCE:

Standard Coated Materials

High-carbon chromium bearing steel (SUJ2)	Martensite stainless steel (equivalent to SUS440C)
Chrome molybdenum steel (SCM415, 435)	Austenite stainless steel (SUS303, 304)
Carbon steel for machinery (S45C)	Steel alloy for tools (SKS3, SK4)

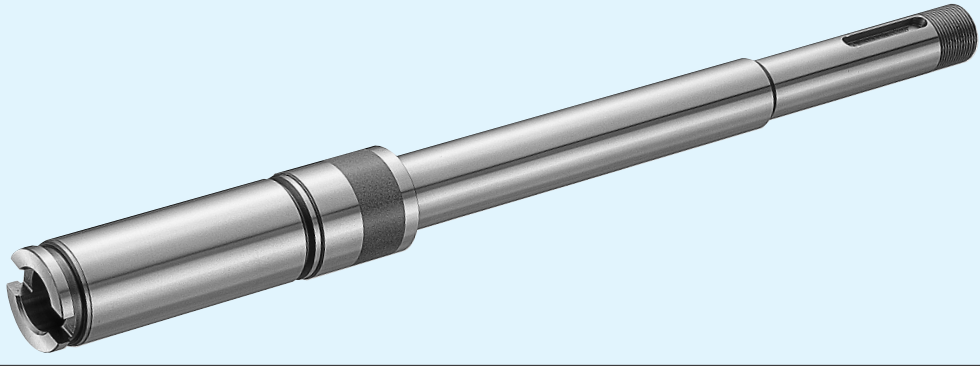
Proper heat treatment is done on your request. Thermal-spraying ceramic-coating is also available to be applied to other materials.

Standard Ceramic for Melt-Spray

main component	specific gravity	hardness	characteristics
TiO_2 titanium dioxide	4.7	60HRC	max. temp. 540℃ color: black wear resistant fine coating fine surface finish

thermal-spraying layer thickness : 0.3-0.5mm
Other types of ceramic materials can be thermal-sprayed. Contact NB for more information.

Example of Ceramic Coating



SPECIAL REQUIREMENTS

MACHINING EXAMPLE

NB can fabricate shafts to fit specific customer requirements.

Machining/Grinding:

Shafts can be machined or ground up to a diameter of 400mm and a length of 6000mm.

Internal Surface Grinding:

The straight/tapered portion of the inner spindle can be ground.

Deep Hole Machining:

Non-standard holes can be machined using a gun drill and BT machining methods. (Ref. to Table G-6.)

Screw Machining:

Triangular and trapezoidal screws can be handled.

Compatible Parts:

Special nuts compatible with a given shaft may be machined. The inner surface and outer diameter of the tapered portion can be ground.

Material and Heat Treatment:

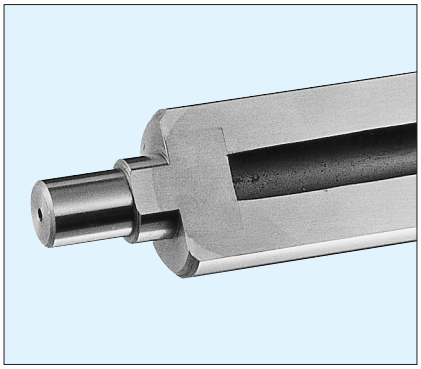
Non-NB material and non-NB shape parts can be heat treated. Please specify the heat treatment method and hardness.

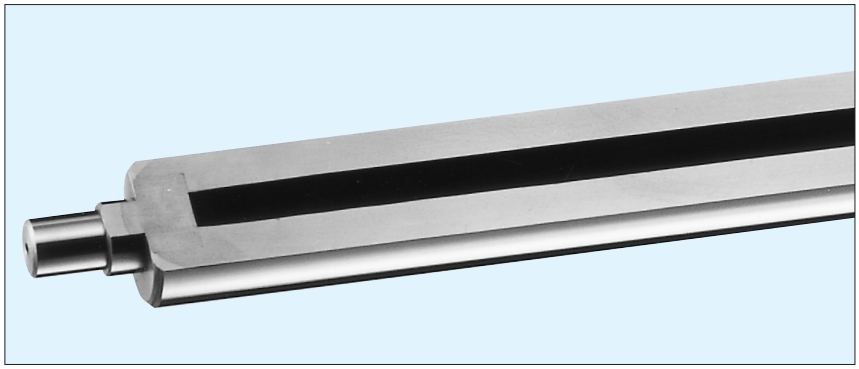
Table G-6 Deep Hole Machining Range unit/mm

	hole diameter	maximum length
gun drill machining	ϕ2～	850(single-side machining)
BT machining	ϕ30～	2000(single-side machining)

Contact NB for maximum length versus hole diameter information.
Machining of up to twice the maximum length listed above for double-side machining.

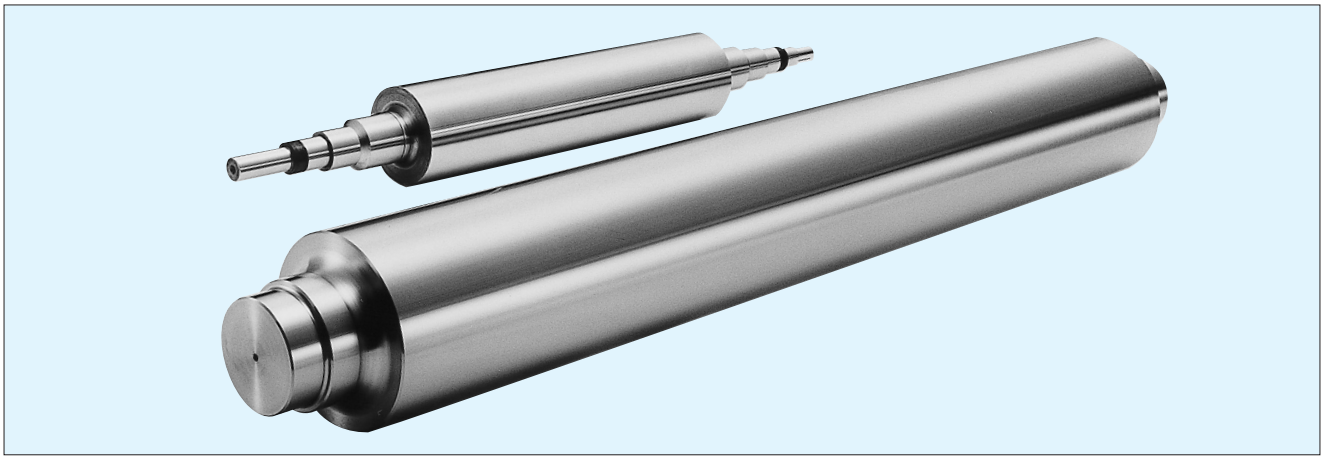
Gun Drill Machining



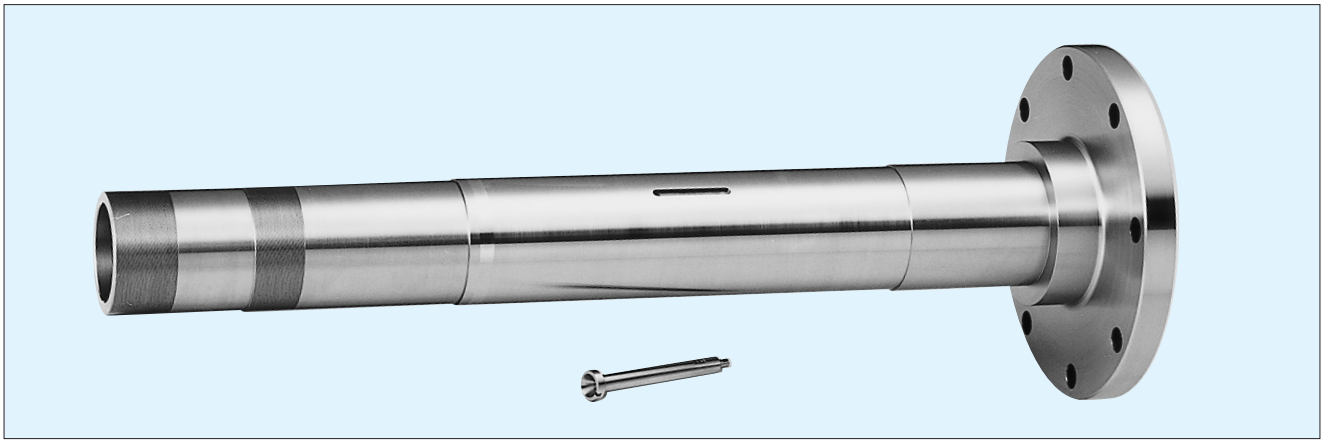


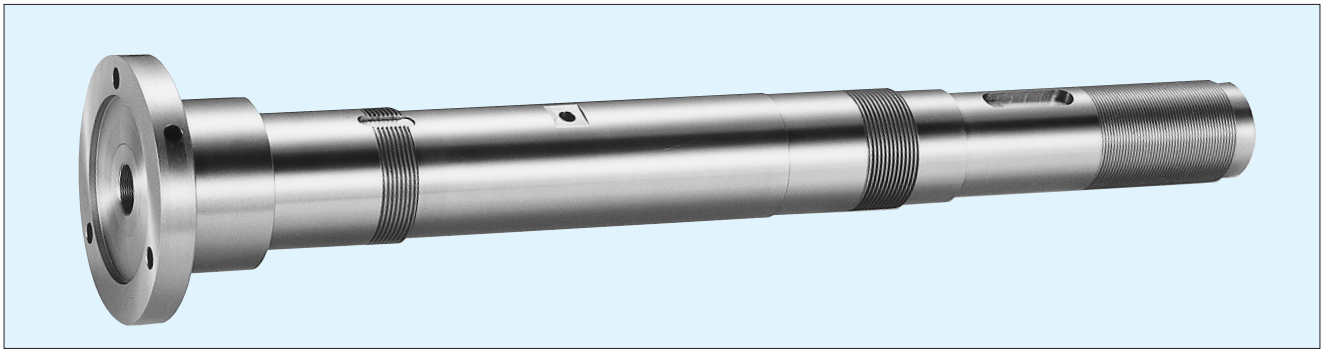
MACHINING EXAMPLES

Roll Shaft

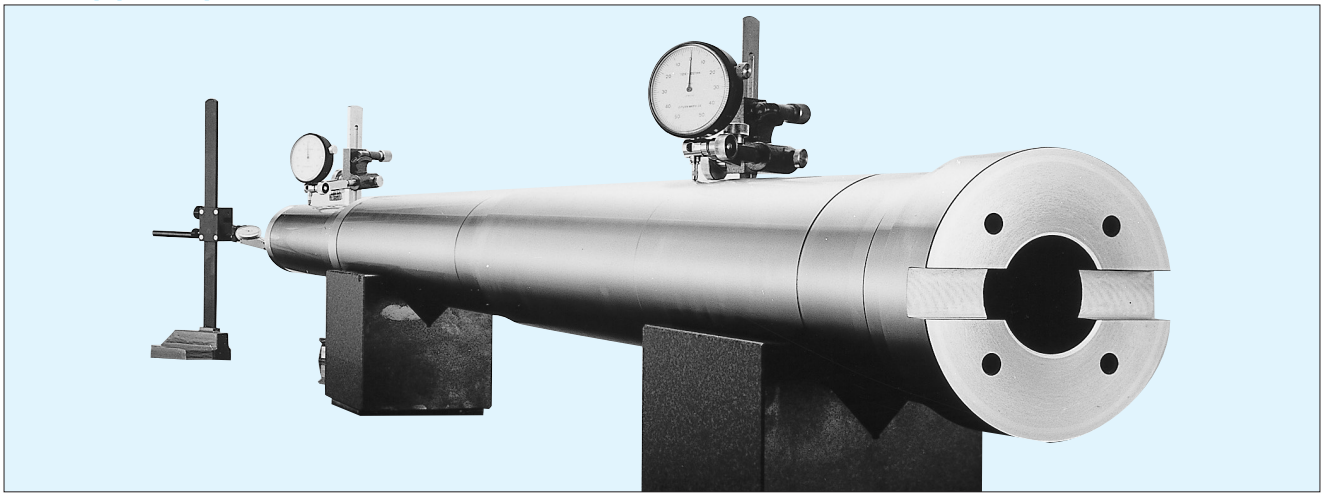


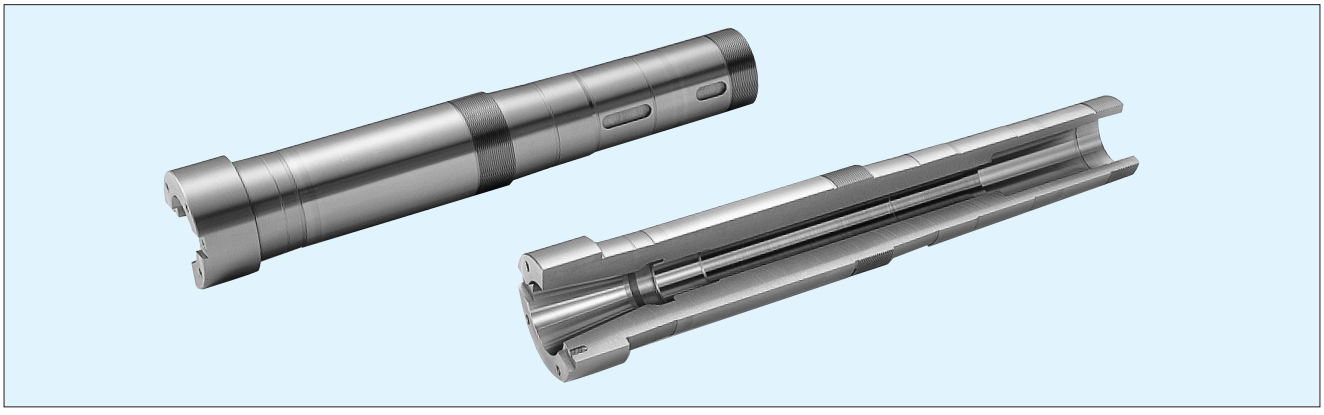
Flanged Shaft



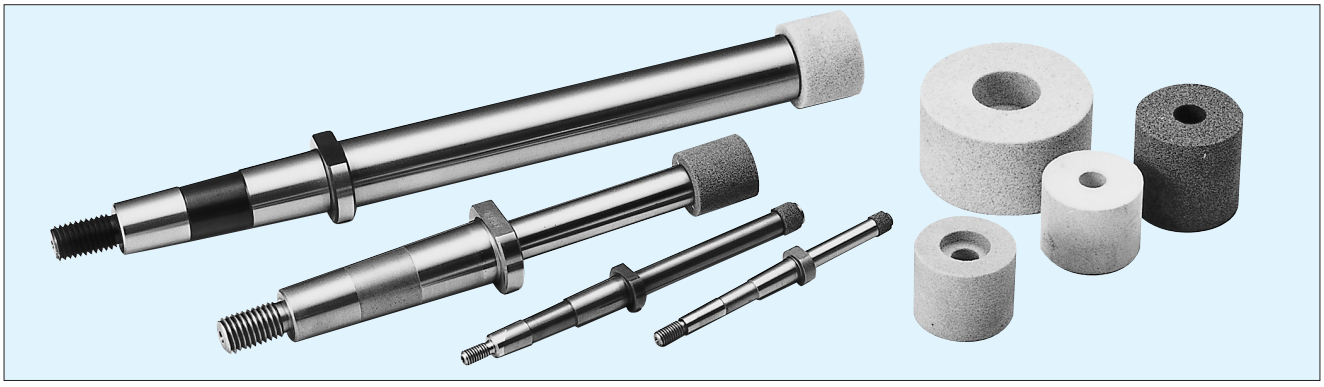


Shaft (spindle)



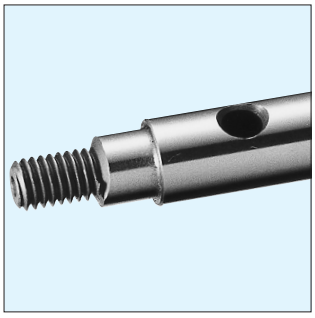
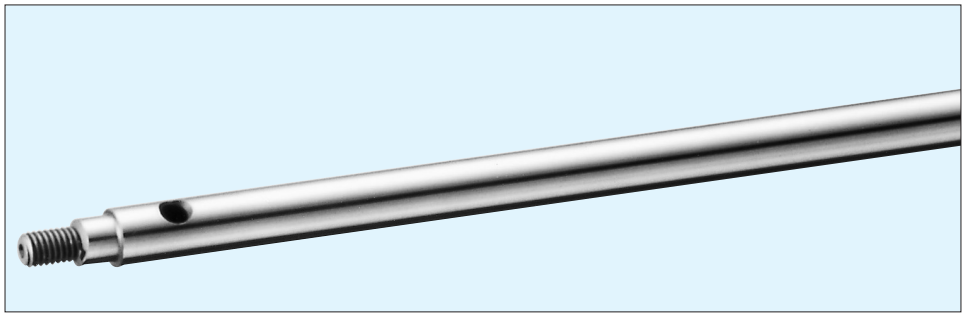
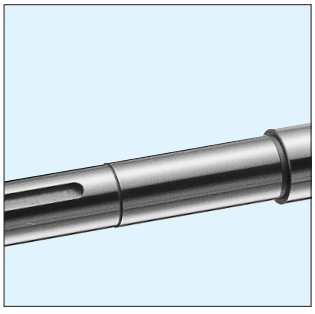
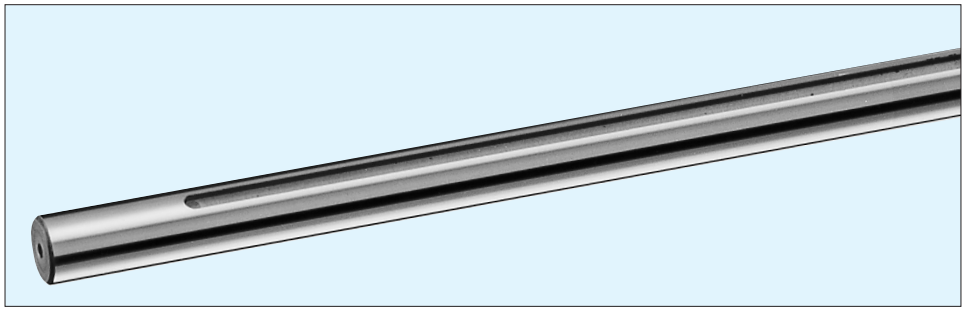
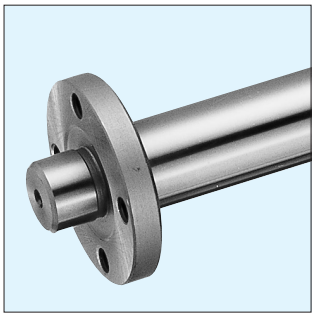
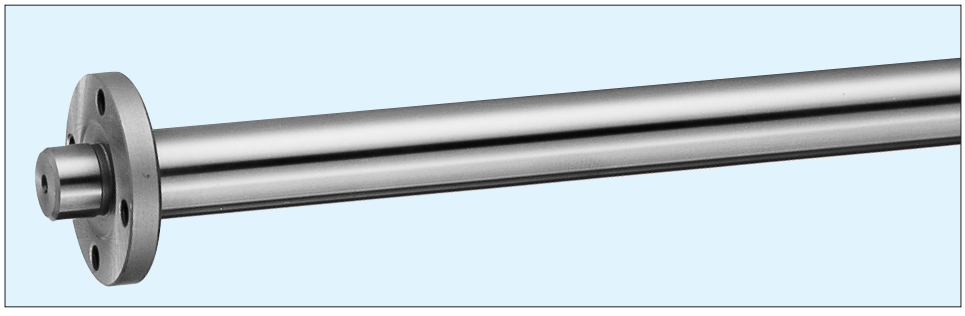
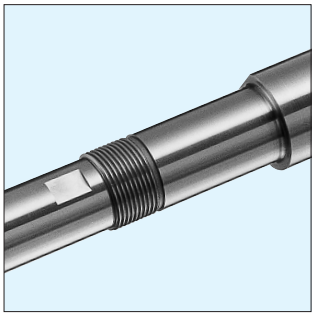
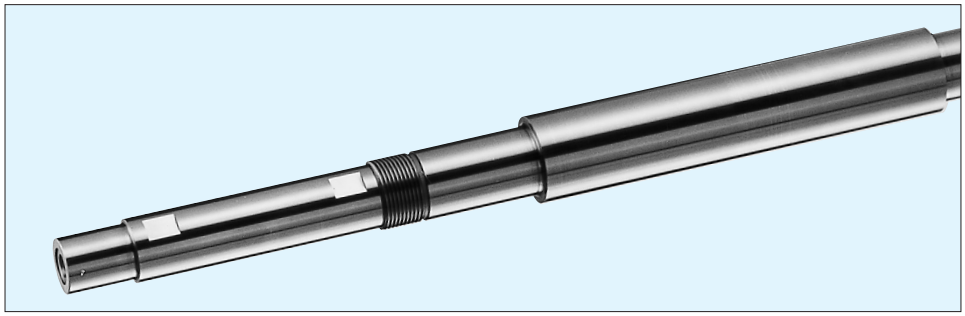


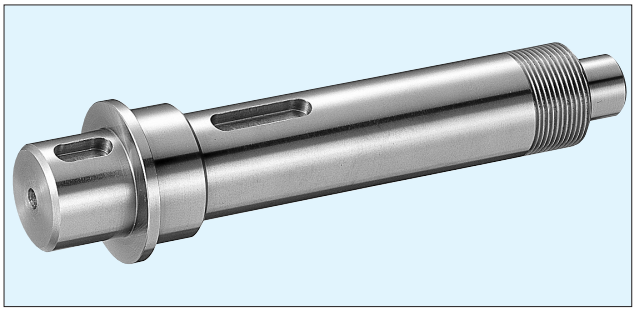
Shaft (Quill)

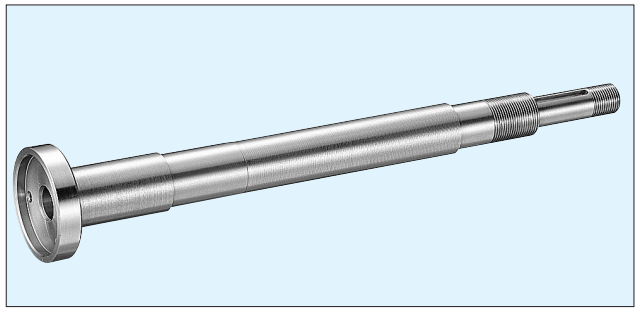


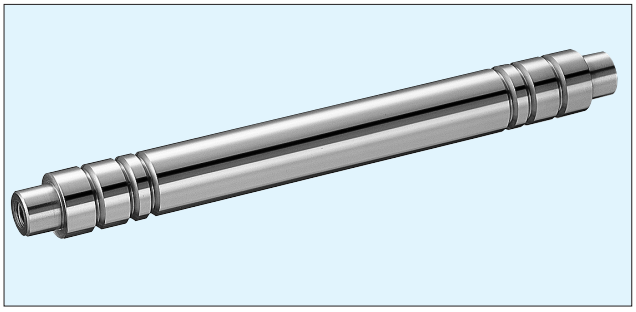
Please send drawing for quotation on custom configurations.

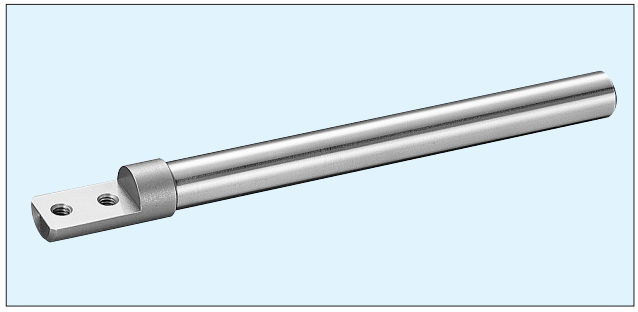
MACHINING EXAMPLES

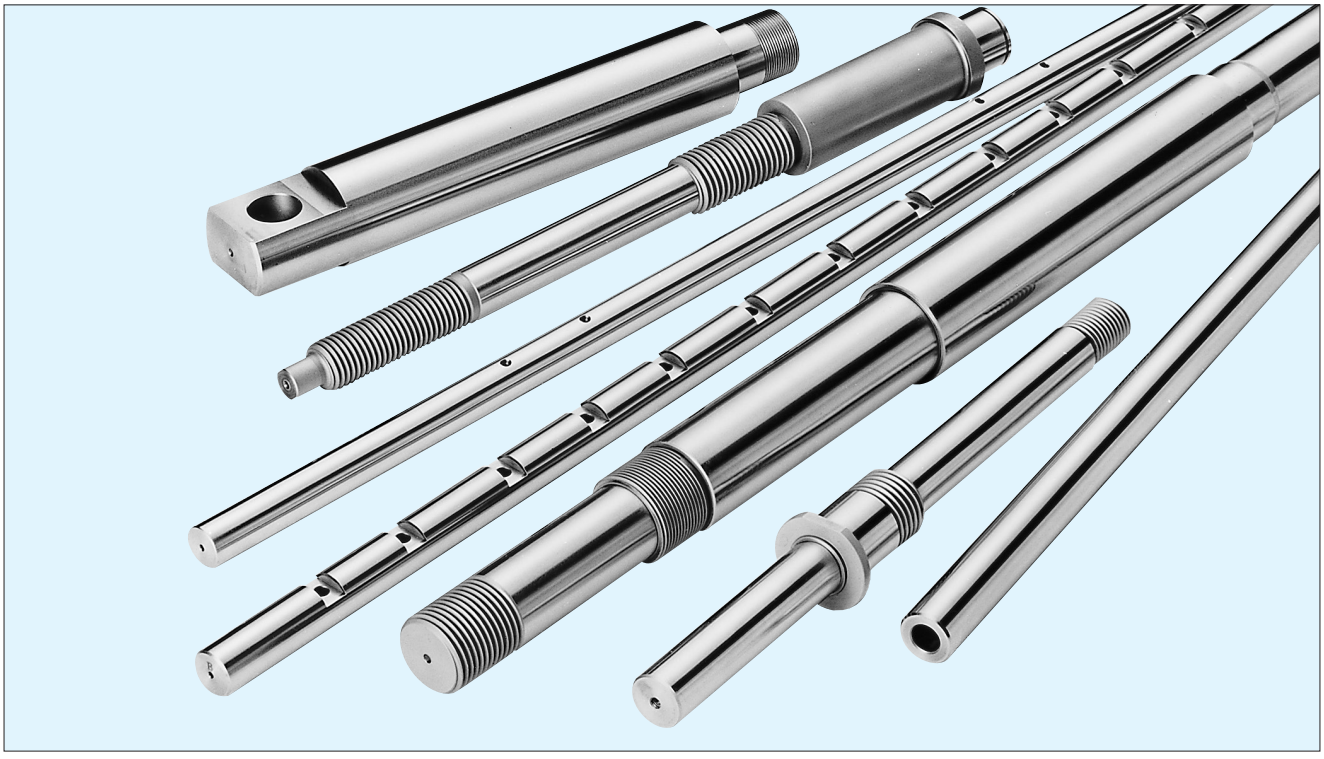



















Please send drawing for quotation on custom configurations.