



Properties of Screws Made of Special Materials

● Mechanical Properties

Properties	Inconel* ¹ equiv. (NCF600)	Pure Molybdenum		Hastelloy* ² C-276 equiv. (NW0276)	Hastelloy* ² C-22 equiv. (NW6022)	Monel 400 equiv. (UNS N0400)	Nickel (NW2201)
	SNSI	SNSM	SNFCM	SNSH-C276	SNSH-C22	SNSMN	SNSN
Tensile Strength (N/mm ²)	548 - 695	515		690 or Higher	690 or Higher	517 - 620	343 - 411
0.2% Proof Stress (N/mm ²)	205 - 352	380		283 or Higher	310 or Higher	172 - 345	68 - 166
Elongation (%)	35 - 55	15		40 or Higher	45 or Higher	35 - 60	40 - 60
Hardness	65 - 85 (HRB)	—		—	—	60 - 80(HRB)	75 - 100 (HB)

Properties	Super Invar	Phosphor Bronze (C5191)	Aluminum Alloy (A5056)	Tantalum	MAT21* ³ (UNS N06210)
	SNSIV	SNSP	SNSA	SNSTA	SNSMT
Tensile Strength (N/mm ²)	470	590 or Higher	294	271	690
0.2% Proof Stress (N/mm ²)	333	—	245	189	310
Elongation (%)	43	8	12	51.2	45
Hardness	143 (HV)	—	98 (HB)	—	—

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● Physical Properties

Properties	Inconel* ¹ equiv. (NCF600)	Pure Molybdenum		Hastelloy* ² C-276 equiv. (NW0276)	Hastelloy* ² C-22 equiv. (NW6022)	Monel 400 equiv. (UNS N0400)	Nickel (NW2201)
	SNSI	SNSM	SNFCM	SNSH-C276	SNSH-C22	SNSMN	SNSN
Specific Gravity	8.42	10.2		8.89	8.69	8.80	8.89
Longitudinal Elastic Modulus (GPa)	207	327		205	206	179	206
Thermal Conductivity (W/(m·K))	16.7	142		—	—	22	79.5
Linear ExpansionCoefficient (K ⁻¹)	13.4×10 ⁻⁶	5.1×10 ⁻⁶		11.2×10 ⁻⁶	12.4×10 ⁻⁶	14.2×10 ⁻⁶ (100°C)	13.4×10 ⁻⁶
Electric Resistance (μΩ·m)	1.0	0.058		1.23	1.14	0.5	0.085

Properties	Super Invar	Phosphor Bronze (C5191)	Aluminum Alloy (A5056)	Tantalum	MAT21* ³ (UNS N06210)	Tungsten
	SNSIV	SNSP	SNSA	SNSTA	SNSMT	SNCW
Specific Gravity	8.15	8.83	2.64	16.65	8.76	19.3
Longitudinal Elastic Modulus (GPa)	132	105	71.7	185	205	—
Thermal Conductivity (W/(m·K))	10.47	67	112	—	—	174
Linear ExpansionCoefficient (K ⁻¹)	0.69×10 ⁻⁶	18×10 ⁻⁶	24.1×10 ⁻⁶	6.4×10 ⁻⁶	12.0×10 ⁻⁶	4.36×10 ⁻⁶
Electric Resistance (μΩ·m)	0.77	0.13	0.064	—	1.274	0.054

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● Chemical Resistance of Inconel*¹, Hastelloy*², and Nickel Screws

Chemical Name	Temperature	Inconel* ¹	Hastelloy* ²	Nickel
Dilute Sulfuric Acid	Room Temperature	A	AA	A
	Boiling Point	D	A	D
Concentrate Sulfuric Acid	Room Temperature	C	AA	C
	Boiling Point	D	D	D
Dilute Hydrochloric Acid	Room Temperature	B	AA	A
	Boiling Point	D	D	D
Concentrate Hydrochloric Acid	Room Temperature	D	AA	D
	Boiling Point	D	B	D
Dilute Nitric Acid	Room Temperature	D	AA	D
	Boiling Point	—	AA	D
Concentrate Nitric Acid	Room Temperature	A	AA	D
	Boiling Point	—	D	D
Dilute Phosphoric Acid	Room Temperature	AA	AA	AA
	Boiling Point	—	AA	D
Concentrate Phosphoric Acid	Room Temperature	AA	AA	AA
	Boiling Point	—	B	D
Sodium Hydroxide (Diluted)	Room Temperature	AA	—	AA
	Boiling Point	C	—	AA
Sodium Hydroxide (Diluted)	Room Temperature	AA	—	AA
	Boiling Point	C	—	AA

AA : Highly Excellent

C : Limit

A : Very Good

D : Not satisfactory

B : Satisfactory

* 1 : Inconel is a registered trademark of Special Metals Corporation.

* 2 : Hastelloy is a registered trademark of Haynes International, Inc.

* 3 : MAT and MAT21 are registered trademarks of Proterial, Ltd.

⚠ Important Information about Chemical Resistance Data

- A test piece was used to acquire the test data. Chemical resistance changes with performance conditions. Always carry out tests under performance conditions similar to actual conditions in advance.

● Magnetic Flux Density of Phosphor Bronze Screws

	Phosphor Bronze	SUSXM7(S.S. grade: A2)
Magnetic Flux Density (T)	0	5×10 ⁻⁵

Measuring device : 5080 Gauss (Tesla) Meter by F.W.BELL

Measuring conditions : DC magnetic field measuring mode

Probe and sample separation distance: 5 mm

● Chemical resistance of MAT21*³

Chemical Name	Composition (%)	Temperature	MAT21* ³ (UNS N06210)
HCl	1	Boiling Point	●
	2	Boiling Point	●
	4	Boiling Point	△
	5	Boiling Point	△
	10	Boiling Point	●
H ₂ SO ₄	40	Boiling Point	△
	10	Boiling Point	●
Mixed Fluids	H ₂ SO ₄ 10 HCl 2	Boiling Point	●
	H ₂ SO ₄ 20 HCl 1.5	80°C	○
Mixed Fluids	H ₂ SO ₄ 50 HCl 1.5	50°C	○
	HNO ₃ 10	Boiling Point	●
H ₃ PO ₄	85	Boiling Point	○
Method B	※	Boiling Point	○

※ 23.0% sulfuric acid + 1.2% hydrochloric acid + 1% iron (III) chloride + 1% copper (II) chloride

● : <0.127 mm/year △ : 0.508 - 1.27 mm/year

○ : 0.127 - 0.508 mm/year × : >1.27 mm/year

The Properties of Ceramic Screws

● Physical Properties

	Al ₂ O ₃ (99.5% Alumina)
Specific Gravity	3.9 - 3.939
Flexural Strength (N/mm ²)	360
Volume Resistivity (Ω · m)	> 10 ¹²
Thermal Conductivity (W/ (m · K))	32 (20°C)
Linear Expansion Coefficient (K ⁻¹)	7.2 × 10 ⁻⁶ (40 - 400°C)
Vickers Hardness (GPa)	15.5
Maximum Duty Temperature (°C)	1500

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● Chemical Resistance

● Al₂O₃

Chemical Name	Temperature	Hour	Effect
35% Hydrochloric Acid	Boiling	30 minutes	⊙
70% Nitric Acid	Boiling	30 minutes	⊙
98% Sulfuric Acid	Boiling	30 minutes	⊙
90% Phosphoric Acid	Boiling	30 minutes	○
60% Hydrofluoric Acid	20°C	24 hours	△
10% Potassium Hydroxide	80°C	7 Days	⊙
Potassium Hydroxide	500°C (Boiling)	24 hours	△
Sodium Hydroxide	500°C (Boiling)	24 hours	○
Sodium Carbonate	900°C (Boiling)	24 hours	○
Sodium Sulfate	1000°C (Boiling)	24 hours	⊙
Potassium Fluoride	90°C (Boiling)	4 hours	×

⊙ : No Corrosion △ : Moderate Corrosion
○ : Slight Corrosion × : Heavy Corrosion

● SiC

Chemical Name	Temperature	Effect
Ammonia (28.0 - 30.0%)	Room Temperature	⊙
Hydrogen peroxide solution (30.0 - 35.5%)	Room Temperature	⊙
Hydrofluoric Acid (49.5 - 50.5%)	Room Temperature	⊙
50% sulfuric acid	Room Temperature	⊙

⊙ : No Corrosion △ : Moderate Corrosion
○ : Slight Corrosion × : Heavy Corrosion

⚠ Precautions for Ceramic Screws

- When tightening ceramic screws, use a torque driver or torque wrench and do not exceed the torsional torque. The recommended torque is 50% of the torsional torque.

M	Torsional Torque (N · m)
M3	0.04
M4	0.05
M5	0.10
M6	0.15
M8	0.30
M10	0.50

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- Heat resistance and chemical resistance change with performance conditions. Always carry out tests under performance conditions similar to actual conditions in advance.
- Ceramic screws may be damaged by impact. Take care when handling these screws.
- Also, ceramics screws with special specifications such as ventilation holes, dimensions, shapes, and cleanroom washing are available. Please contact us for details.

