

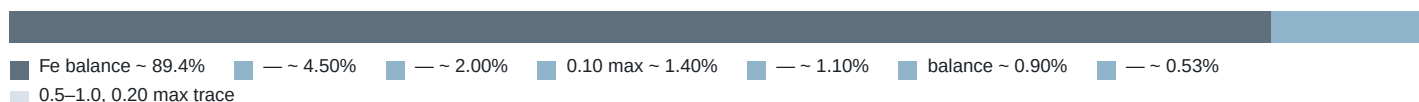
ASTM F468 Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws and Studs — Material Data Sheet

and Study Material Data Sheet

The nonferrous bolt specification: brass, bronze, copper-nickel, Monel, Inconel, Hastelloy, aluminium and titanium bolts, cap screws and studs, each alloy with its own strength, hardness and marking — the specification to call up when the joint cannot be steel.

SILICON BRONZE 651 (1/4-3/4 IN.)	70-100 ksi · 55 ksi yield	MONEL K-500 (1/4-1 1/2 IN.)	130-180 ksi · 90 ksi yield
NAVAL BRASS 464	50-80 ksi · 15 ksi yield	INCONEL 625	120 ksi · 60 ksi yield
MONEL 400 (1/4-3/4 IN.)	80-130 ksi · 40 ksi yield	TITANIUM GRADE 5	130-165 ksi · 125 ksi yield

Nominal composition



Midpoints of the specification ranges, for orientation only. Limits are in the table.

Chemical composition — ASTM F468, six common alloys

Element	464 naval brass	651 silicon bronze	630 Ni- Al bronze	400 Monel	500 Monel K-500	625 Inconel
Copper	59.0– 62.0	balance	balance	balance	balance	—
Nickel	—	—	4.0–5.5	63.0– 70.0	63.0– 70.0	balance
Zinc	balance	1.5 max	0.30 max	—	—	—
Tin	0.5–1.0	—	0.20 max	—	—	—
Silicon	—	0.8–2.0	0.25 max	0.5 max	0.5 max	0.50 max
Aluminium	—	—	9.0–11.0	—	2.30– 3.15	0.40 max
Iron	0.10 max	0.80 max	2.00– 4.00	2.5 max	2.0 max	5.0 max
Manganese	—	0.70 max	1.50 max	2.0 max	1.5 max	0.50 max
Chromium	—	—	—	—	—	20.0– 23.0
Molybdenum	—	—	—	—	—	8.0–10.0
Niobium	—	—	—	—	—	3.15– 4.15
Titanium	—	—	—	—	0.35– 0.85	0.40 max
Lead	0.20 max	0.05 max	—	—	—	—
Carbon	—	—	—	0.3 max	0.25 max	0.10 max

Values per ASTM F468-23 Tables 1 and 2 (verified against the specification). Confirm the edition called out on your purchase order with our estimating team. The full table lists 16 copper alloys, 8 nickel alloys, 3 aluminium alloys and 8 titanium grades.

Physical properties (typical)

DENSITY	Varies by alloy: 0.098 (aluminium) to 0.32 lb/in ³ (nickel-copper)
MODULUS OF ELASTICITY	10 (aluminium) to 30 × 10 ⁶ psi (nickel alloys)
MAGNETIC	No (all listed alloys)
GALVANIC NOTE	Match the fastener alloy to the joint material to avoid galvanic attack

Heat treatment

Copper alloys: as drawn or cold worked; silicon bronze and naval brass are supplied as rolled or drawn. Monel K-500: solution treated and age hardened. Inconel 625, 686 and Hastelloy: solution annealed. Aluminium: T4, T6 or T73 temper. Titanium Grade 5: annealed or solution treated and aged. Stress relieving of copper alloys may be specified to prevent season cracking.

Mechanical properties — ASTM F468 (full-size tests, selected alloys)

Alloy · marking · size (in.)	Tensile strength, full size (ksi)	Yield strength, min (ksi)	Elongation, min (% machined)	Hardness	—
Cu 110 ETP copper · F468A	30–50	10	15	65–90 HRB	
Cu 260 cartridge brass · F468AB	60–90	50	35	55–80 HRB	
Cu 270 yellow brass · F468B	60–90	50	35	55–80 HRB	
Cu 464 naval brass · F468D	50–80	15	25	55–75 HRB	
Cu 510 phosphor bronze · F468E	60–90	35	15	60–95 HRB	
Cu 614 aluminium bronze · F468G	75–110	35	30	70–95 HRB	
Cu 630 Ni-Al bronze · F468H	100–130	50	5	85–100 HRB	
Cu 642 Al-Si bronze · F468J	75–110	35	10	75–95 HRB	
Cu 651 silicon bronze · F468K · ¼–¾	70–100	55	8	75–95 HRB	
Cu 651 silicon bronze · F468K · 1–1½	55–90	40	8	70–95 HRB	
Cu 655 silicon bronze · F468L	50–80	20	20	60–80 HRB	
Cu 675 manganese bronze · F468N	55–85	25	20	60–90 HRB	
Cu 715 copper-nickel 30 % · F468R	55–85	20	45	60–95 HRB	
Ni 400 Monel · F468U · ¼–¾	80–130	40	20	75 HRB–25 HRC	
Ni 400 Monel · F468U · 1–1½	70–130	30	20	60 HRB–25 HRC	
Ni 405 Monel R-405 · F468V	70–125	30	20	60 HRB–20 HRC	
Ni 500 Monel K-500 · F468W · ¼–1	130–180	90	20	24–37 HRC	
Ni 500 Monel K-500 · F468W · 1–1½	130–180	85	20	24–37 HRC	
Ni 625 Inconel · F468AC	120	60	30	85 HRB–35 HRC	
Ni 276 Hastelloy C-276 · F468T	110–140	45	25	20–32 HRC	
Ni 335 Hastelloy B · F468S	115–145	45	35	20–32 HRC	
Ni 686 Grade 1 · F468BN	120–165	85	20	21–45 HRC	
Al 6061-T6 · F468Y	37–52	31	10	40–50 HRB	
Al 2024-T4 · F468X	55–70	36	10	70–85 HRB	
Al 7075-T73 · F468Z	61–76	50	10	80–90 HRB	
Ti 2 · F468BT	50–85	45	20	160–180 HV	
Ti 5 (6Al-4V) Class A · F468DT	130–165	125	10	30–39 HRC	
Ti 7 · F468ET	50–85	45	20	160–180 HV	

Values per ASTM F468-23 Tables 1 and 2 (verified against the specification). Confirm the edition called out on your purchase order with our estimating team. Machined-specimen minimums and elongation are given in the same table.

Applicable standards

ASTM F468	Nonferrous bolts, hex cap screws, socket head cap screws and studs for general use
ASTM F467	Matching nonferrous nuts
ASME B18.2.1 / B18.3	Hex cap screw, bolt and socket screw dimensions
ASTM B98 / B150 / B164 / B446	Bar specifications for silicon bronze, aluminium bronze, Monel and Inconel 625

Forms we supply in F468 nonferrous bolts

- Hex and heavy hex bolts and cap screws
- Socket head cap screws
- Studs and threaded rod
- Nuts and washers to F467
- Machined specials to drawing

Typical applications

- Marine, dock and shipboard hardware in silicon bronze and naval brass
- Water and wastewater treatment in silicon bronze
- Seawater pumps, valves and desalination in Monel and K-500
- Chemical plant in Inconel 625, 686 and Hastelloy
- Non-magnetic and spark-resistant assemblies
- Lightweight structures in aluminium and titanium