

422 Stainless Steel (UNS S42200, ASTM A565 Grade 616) — Material Data

Sheet

ASTM A565 Grade 616 · UNS S42200 · AISI 422

High-temperature 12 percent chromium martensitic stainless steel with Mo, W and V

The turbine bolting stainless: 12-chrome steel alloyed with molybdenum, tungsten and vanadium for creep strength to 1200 °F, heat treated to 140 ksi.

TENSILE, CONDITION HT	140 ksi min	CHARPY, HT (ROOM TEMP.)	8 ft·lbf min
YIELD, CONDITION HT	110 ksi min	SERVICE	To about 1200 °F
HARDNESS, HT	302–352 HBW	MAGNETIC	Yes

Nominal composition



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

Chemical composition — Type 422 (UNS S42200, A565 Grade 616)

Element	Symbol	Min %	Max %
Carbon	C	0.20	0.25
Manganese	Mn	0.50	1.00
Phosphorus	P	—	0.025
Sulfur	S	—	0.025
Silicon	Si	—	0.50
Chromium	Cr	11.00	12.50
Nickel	Ni	0.50	1.00
Molybdenum	Mo	0.90	1.25
Vanadium	V	0.20	0.30
Tungsten	W	0.90	1.25

Values per ASTM A565/A565M-10 Tables 1 and 3 (verified against the specification); 422 is covered by A565 as Grade 616, not by A276. Confirm the edition called out on your purchase order with our estimating team.

Physical properties (typical)

DENSITY	0.280 lb/in ³ (7.75 g/cm ³)
MODULUS OF ELASTICITY	29.0 × 10 ⁶ psi (200 GPa)
THERMAL EXPANSION (68–1000 °F)	6.5 µin/in·°F
MAGNETIC	Yes

Heat treatment

Condition HT: 1875 to 1925 °F, quench in air or oil, temper at 1150 °F minimum for 2 hours minimum. Condition H: same hardening, temper at 1250 °F minimum. Stress relieve 50 °F below the tempering temperature if straightened. Microstructure of tempered martensite with no more than 1 percent delta ferrite when S2 is specified.

Bar properties — ASTM A565 Grade 616 (Type 422)

Condition and nominal diameter (in.)	Tensile strength, min (ksi)	Yield strength 0.2% offset, min (ksi)	Elongation, min (%)	Reduction of area, min (%)	Hardness
Condition A (annealed) — all	—	—	—	—	248 HBW max
Condition T (intermediate) — all	—	—	—	—	285 HBW max
Condition HT (tempered 1150 °F min) — all	140	110	13	30	302 to 352 HBW · 8 ft·lbf
Condition H (tempered 1250 °F min) — all	120	85	17	35	241 to 285 HBW

Values per ASTM A565/A565M-10 Tables 1 and 3 (verified against the specification); 422 is covered by A565 as Grade 616, not by A276. Confirm the edition called out on your purchase order with our estimating team. Impact is Charpy V-notch at room temperature.

Applicable standards

ASTM A565 GRADE 616	Martensitic stainless steel bars for high-temperature service
ASTM A565 S1 / S2 / S3	NDE, microstructure and stress-rupture supplementary requirements
AMS 5655	Aerospace equivalent bar specification
ASTM A370	Mechanical testing

Forms we supply in 422 Stainless

- Hex and heavy hex bolts and cap screws
- Full-thread studs and threaded rod
- Socket head cap and set screws
- Hex, jam and lock nuts
- Washers and spacers
- Machined components from certified bar

Typical applications

- Steam turbine studs, bolts and nuts
- Turbine blade-root and shroud hardware
- Compressor and hot-gas-path fasteners
- Valve internals at high temperature
- OEM turbine repair parts to drawing