

Maraging 350 / VASCOMAX® 350 Steel - AMS 6515

Maraging 350 / VASCOMAX® 350 is an 18% nickel, cobalt strengthened steel (C-type) with excellent properties, workability and heat treatment characteristics.

Maraging is double vacuum melted by VIM (Vacuum Induction Melt) followed by VAR (Vacuum Arc Remelt). Maraging material is supplied in the annealed and descaled condition. The alloy is very tough, relatively soft (RC 30/35), readily machined or formed. Maraging provides a high value for critical parts in aerospace, structural, component and tooling applications.

Chemical Composition:

Symbol	Element	Nominal %
C	Carbon	0.03 max
Si	Silicon	0.10 max
Mn	Manganese	0.10 max
Ni	Nickel	18.50
Co	Cobalt	12.00
Mo	Molybdenum	4.80
Ti	Titanium	1.40
Al	Aluminum	0.10
Fe	Iron	Balance

Maraging 350 Machinability (Annealed):

Operation	Tool Material	Tool Geometry	Depth of cut	Width of cut	Feed	Cutting Speed	Wearland	Cutting Fluid
Turning	M2 or T-15	BR: 0°; SR: 10° SCEA: 15°; ECEA: 5° Relief: 5°; NR: 0.030 in	0.060 in	--	0.009 in/rev	80 ft/min	0.060 in	Soluble oil (1:20)
Turning	C3	BR: -5°; SR: -5° SCEA: 15°; ECEA: 15° Relief: 5°; NR: 0.030 in		--	0.009 in/rev	475	0.010	Soluble oil (1:20)
Face milling	M2 or M-7	AR: 5°; RR: 5°; CA: 45° ECEA: 10°; CI: 8°	0.060	2 in	0.005 in/tooth	140	0.060	Highly chlorinated oil

Face milling	C2	AR: 10°; RR: 0° CA: 45° ECEA: 10° CI: 8°	0.060	2	0.005 in/tooth	330	0.015	Dry
Peripheral end milling	M2	Helix Angle: 30°; RR: 10° CA: 45° x 0.060 in; CI: 7°	0.250	0.750	0.004 in/tooth	225	0.012	Soluble oil (1:20)
End mill slotting	M2	Helix angle: 30°; RR: 10° CA: 45 x 0.060 in; CI: 7°	0.250	0.750	0.002 in/tooth	140	0.012	Highly chlorinated oil
Drilling	M1	118° plain point; CI: 7°	0.500 (through hole)	--	0.005 in/rev	100	0.015	Highly sulfurized oil
Reaming	M2	Helix angle: 0°; CA: 45° CI: 7°	0.500 (through hole)	--	0.009 in/rev	60	0.006	Highly sulfurized oil
Tapping	M1	2 flute plug; 75% thread	0.500 (through hole)	--	--	150	Undersize threads	Highly sulfurized oil

Machining data provided for informational purposes only.

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Maraging

MARtensitic - a very hard form of steel crystalline structure.

Subsequent AGING (precipitation hardening - approx 3-6 hours @ 900°F yields optimum material characteristics)

Excellent Mechanical Properties

- high yield and ultimate tensile strengths
- high toughness, ductility and impact strengths
- high fatigue strength
- high compressive strength
- hardness and wear resistance sufficient for many tooling applications

Excellent Workability

- high resistance to crack propagation
- readily formed – cold, warm, hot (w/o in process anneals)
- good weldability w/o preheating or post heating
- excellent polishability

Advantages During Application

- low coefficient of expansion minimizes heat checking
- pitting and corrosion resistance superior to common tool steel
- good repair weldability
- excellent mechanical properties have led to longer tool life
- easily reworked and retreated for secondary tool life

Common Specifications:

AMS 6515

MIL-S-46850 - Fracture Toughness Applies

Heat Treatment / Aging:

Maraging alloys are essentially carbon-free, a protective atmosphere is not required during annealing or aging. Material is supplied in the solution annealed condition with a hardness of 30/35 Rc. Typical heat treat time/temperature are listed below. Large cross sections should be aged for longer periods.

Temperature	Time	Resulting Hardness
900/925 °F	6 hrs	55/60 Rc
950 °F	3 hrs	56/60 Rc

NOTE: A modified aging cycle is suggested for die casting applications for increased die life. The following thermal treatments have been used to obtain desirable characteristics for die casters. Following the rough machining of the die, anneal at 1500-1525 °F for 1 hour per inch of thickness is typical. After finish machining, an aging heat treatment of 980-1000 °F for 6 hours is typical.