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Global Steel Grade Encyclopedia

涵盖的行业或国家与地区类别

国材料与试验协会	GJB 国家军用标准	SAE 动力机械工程师协会	EU 前欧洲标准化	AISI 美国钢铁学会	DIN 德国工业标准	AMS [空航天材料规范	ISO 国际标准	JASO 日本汽车标准组织

EN 欧洲标准	JB [国机械行业标准	UNS 统一编号系统	UNI 意大利标准	ASME 美国机械工程师协会	SS 瑞典标准	GB 国家标准	JIS 日本工业标准

Maraging steels are a class of ultra-high strength, high hardness and high toughness steels which can be welded without preheating either in annealed (easy to machine) or heat-treated condition. These properties make them ideal candidates for the laser powder bed fusion (L-PBF) process to manufacture parts with complex geometries for demanding applications which require an excellent combination of strength, toughness and thermal stability.

The strengthening mechanisms in this type of steel differ from those in classical carbon steels where martensitic, bainitic or pearlitic phases are formed on cooling and tempering is employed to control carbide precipitation. Less than 50% of the overall contribution to strengthening is provided by the extremely tough Fe-Ni **Mar**tensite, while **aging** of this martensite, containing Mo, Al, Ti and Co in supersaturated solid solution, provides additional strengthening by precipitation of nanosized intermetallic particles in the martensitic matrix.

Osprey® 18Ni300-AM Maraging Steel is characterized by high hardness and toughness and is easily heat- treatable using a simple thermal age-hardening process to obtain excellent hardness and strength. Otherwise, depending on the application, the steel can be solution annealed prior to aging treatment. In both as-built and age-hardened states the parts can be machined, spark-eroded, welded, micro shot-peened, polished and coated if required.

STANDARDS

- ASTM A579/579M-17A
- SAE AMS 6514
- MIL-S-46850D
- European 1.2709 DIN 1.2709
- X3NiCoMoTi 18-9-5

CHEMICAL COMPOSITION, WT%

Chemical composition (nominal) %

C	Mn	P	S	Si	Ni	Cr	Mo	Ti	Co	Al
<0.03	<0.1	<0.01	<0.01	<0.1	17 - 19	<0.25	4.6 - 5.2	0.6 - 0.8	8.5 - 9.5	0.05 - 0.15

MECHANICAL PROPERTIES

LPBF process with 50 µm layer thickness

Condition	Direction	0.2% Proof strength	Tensile strength	Elongation	E-modulus	Impact toughness	Hardness
		$R_{p0.2}$	R_m	A lo15		J	HRC
		MPa	MPa	%	GPa		
As built	Horizontal	960±45	1176±9	17.6±0.8	171±7	56.0±10.0	31
	Vertical	785±54	1036±7	16.6±1.7	162±6	46.0±3.0	31
Heat-treated	Horizontal	2013±16	2094±7	5.2±0.8	185±7	9.9±0.5	53
	Vertical	1961±21	2052±10	6.2±1.0	179±8	9.1±0.8	53

Surface roughness, Ra (µm)
Horizontal: 5.6

Vertical: 4.3

PHYSICAL PROPERTIES

Generic data - wrought material

Density
8.1 g/cm^3 (0.29 lb/in^3)

Thermal conductivity

Temperature	
20°C (68°F)	14.2 W/mK
600°C (1200°F)	21.0 W/mK
1300°C (2600°F)	28.6 W/mK

Coefficient of thermal expansion

10.3 x 10^{-6} K^{-1}

Melting point

1413°C; 2575°F

HEAT TREATMENT

Maximum hardness, approximately 53 HRC, is typically reached after a heat treatment at 490°C (914°F) for 6-10 hours, depending on the part size. Lower hardness can be achieved by aging at higher temperatures. The use of maraging steels in applications such as die casting tooling might require an aging temperature of approx. 530 °C (985 °F) to achieve an overaged structure to ensure the thermal stability in service. Higher temperatures and longer holding times should be avoided as softening will occur due to excessive over-aging and austenite reversion. If a specific yield strength is required, it is recommended to use a maraging steel in which the required strength is achieved by conventional aging instead of over-aging a higher strength grade. Contact us to get information on wider range of maraging grades that matches your requirements.