

ROD & BAR ALLOY 2011



ALLOY DESCRIPTION

2011-T3 is a RoHS compliant, free machining alloy and temper combination that compares favorably with free cutting brass. 2011 is the alloy of choice when good strength and high machining rates are desired. It can be machined to very close tolerances and produces excellent machined surface finishes. Resistance welding, corrosion resistance and anodizeability are only fair. Other forms of welding are not recommended. Additional strength, without a sacrifice in machinability, can be achieved through the use of the T8 temper.

TYPICAL MECHANICAL PROPERTIES

Temper	Tensile (.500" Dia. Specimen)					Hardness Brinell 500 kg 10 mm	Shear		Fatigue*		Modulus	
	Ultimate		Yield		Elongation/4D %		Ultimate Shearing Strength		Endurance Limit - R.R. Moore Type		Modulus of Elasticity	
	KSI	MPa	KSI	MPa			KSI	MPa	KSI	MPa	KSI x 10 ³	Gpa
T3	55	379	43	296	15	95	32	221	18	124	10.2	70
T8	59	407	45	310	12	100	35	241	18	124	10.2	70

*5 x 10E8 cycles of reversed stress

COMPARATIVE CHARACTERISTICS

Temper	Corrosion Resistance		Cold Workability ³	Machinability ³	Anodize Response ³	Brazeability ⁴	Weldability ⁴		
	General ¹	Stress ²					Gas	Arc	Spot
T3	D	D	C	A	C	D	D	D	D
T451	D	D	B	A	C	D	D	D	D
T8	D	B	D	A	C	D	D	D	D

- Ratings A through E are relative ratings in decreasing order of merit, based on exposures to sodium chloride solution by intermittent spraying or immersion. Alloys with A and B ratings can be used in industrial and seacoast atmospheres without protection. Alloys with C, D and E ratings generally should be protected at least on faying surfaces.
- Stress-corrosion cracking ratings are based on service experience and on laboratory tests of specimens exposed to the 3.5% sodium chloride alternate immersion test.
 A= No known instance of failure in service or in laboratory tests.
 B= No known instance of failure in service; limited failures in laboratory tests of short transverse specimens.
 C= Service failures with sustained tension stress acting in short transverse direction relative to grain structure; limited failures in laboratory tests of long transverse specimens.
 D= Limited service failures with sustained longitudinal or long transverse areas.
- Ratings A through D for Workability (cold), A through E for Machinability and A through C for Anodize Response, are relative ratings in decreasing order of merit.
- Ratings A through D for Weldability and Brazeability are relative ratings defined as follows:
 A= Generally weldable by all commercial procedures and methods.
 B= Weldable with special techniques or for specific applications that justify preliminary trials or testing to develop welding procedure and weld performance.
 C= Limited weldability because of crack sensitivity or loss in resistance to corrosion and mechanical properties.
 D= No commonly used welding methods have been developed.



APPLICABLE SPECIFICATIONS

Cold Finished
ASTM B211
AMS-QQ-A-225/3

CHEMICAL COMPOSITION LIMITS

							Others	
Weight %	Si	Fe	Cu	Pb*	Bi	Zn	Each	Total
Minimum			5.00	0.20	0.20			
Maximum	0.40	0.70	6.00	0.4	0.6	0.30	0.05	0.15

*Effective May 1, 2009, the lead maximum limit was changed from 0.6% to 0.4% to be RoHS compliant. Material produced prior to that date may not be RoHS compliant. If in doubt refer to the material certification that was supplied with the material.

TYPICAL PHYSICAL PROPERTIES

Characteristic			English	Metric
Nominal Density (68 °F / 20 °C)			0.102 lbs./in. ³	2.82 Mg/m ³
Melting Range			1005 °F - 1180 °F	541 °C - 638 °C
Specific Heat (212 °F / 100 °C)			0.206 BTU/lb. - °F	864 J/kg - °K
Coefficient of Thermal Expansion	Linear 68 °F - 212 °F 20 °C - 100 °C		12.8 micro in./in. - °F	23.1 micro m/m - °K
	Volumetric 68 °F / 20 °C		3.72 x 10 ⁻⁵ in. ³ /in. ³ - °F	67 x 10 ⁻⁶ m ³ /m ³ - °K
Thermal Conductivity (68 °F / 20 °C)	T3, T451		88 BTU/ft. - hr. - °F	152 W/m - °K
	T8		100 BTU/ft. - hr. - °F	173 W/m - °K
Electrical Conductivity (68 °F / 20 °C)	Equal Volume	T8	45% IACS	
		T3	39% IACS	
	Equal Weight	T8	142% IACS	
		T3	123% IACS	