

Alloy 5083 is a non-heat-treatable 4½% magnesium, 0.15% chromium, 0.7% manganese alloy commonly available in flat rolled plate from a range of producing mills. Like all the 5000-series high magnesium alloys 5083 achieves a high strength by cold working, enabling a series of "H" tempers; 5083 is the highest strength of any of these alloys.

Alloy 5083 is best known as a plate for ship building.

The alloy is also produced as extruded seamless tube and other extrusions and as forgings; these are available on indent from Atlas.

Corrosion Resistance

Excellent in a wide range of atmospheric environments, in food processing and architectural applications. The principal application for 5083 is marine environments. The magnesium content is more than 3½% Mg, so this alloy can be susceptible to stress corrosion cracking, which limits its application temperature to below 65°C and also limits the amount of cold work to ¼ Hard.

Special intergranular corrosion and exfoliation corrosion tests are carried out to certify 5083 for marine applications – refer to the later section on B928 and classification society rules.

Heat Treatment

Alloy 5083 is not hardenable by heat treatment. It can be significantly hardened by cold work (eg by cold rolling) and various "H" tempers are produced – most commonly H32 (¼ Hard) or the similar strength marine tempers H116 and H321 – as well as the soft annealed Temper O condition.

The alloy spontaneously age-softens at room temperature immediately after cold work but will eventually reach a stable condition; all flat rolled mill products are supplied with stable properties. This is usually achieved by a stabilisation thermal treatment as the last operation which results in the H32 or H321 tempers. H112 temper is strain hardened as the final operation, again to quickly reach the required stable temper properties.

To soften Alloy 5083 it can be annealed by heating to 345°C, hold until uniform temperature then cool; the rate of cooling is not important.

Welding

Excellent weldability by all standard electric and resistance methods; gas welding is not recommended. GMAW and GTAW are preferred and widely used to produce structural welds. When welding 5083 to itself or another alloy in the 5xxx series, the recommended filler metal is 5183. Other fillers are possible. Welding of strain hardened tempers will reduce strengths in the heat affected zones.

Machining

Machinability of 5083 is poor due to its high strength.

ASTM B928M and Classification Society Rules

ASTM B209M covers a large range of aluminium alloys intended for general applications – architectural, structural and light-duty marine for example. Following serious corrosion problems leading up to 2000 the new standard ASTM B928M was introduced to prevent corrosion of ship structures. Alloy 5083 and only a few other high magnesium alloys are included in B928M. The only tempers permitted – H116 and H321 for 5083 – require testing for exfoliation corrosion and intergranular corrosion resistance, to ASTM G66 and G67. In addition Classification Society (Lloyds, DNV etc) rules are frequently called for in purchase of plate for ship building. Inspection certificates for 5083 H116 or H321 would normally show endorsement by DNV or another Classification Society.

Typical Applications

Plate for ship building, unfired welded pressure vessels, rail and other vehicles, various structural applications that make use of the high strength.

Specified Properties

These properties are specified for flat rolled product (plate, sheet and coil) in ASTM B209M or B928M. Similar but not necessarily identical properties are specified for other products such as tube and bar in their respective specifications.

Composition Specification (%) (single values are maxima except as noted)

Alloy	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Others	
									Each	Total
5083	0.40	0.40	0.10	0.40-1.0	4.0-4.9	0.05-0.25	0.25	0.15	0.05	0.15

Mechanical Property Specification (single values are minima except as noted)

Alloy & Temper	Spec	Tensile Strength (MPa)	Yield Strength 0.2% Proof (MPa)	Elongation (% in 50mm) minimum for sheet or plate thicknesses shown		
				All gauges (Note 2)	5.0-12.5mm	6.31-80.0mm
5083-O	B209M	270-345	115-200			16
5083-H32	B209M	305-385	215 min		12	
5083-H116	B928M	305 min ⁽¹⁾	215 min ⁽¹⁾	10		
5083-H321	B928M	305-385 ⁽¹⁾	215 min ⁽¹⁾	10 - 12		

- Properties for H116 and H321 reduced at thickness over 40mm ... tensile strength 285MPa min and yield strength 200MPa min.
- Elongations specified for H116 and H321 vary slightly depending on gauge. Measurement gauge length also varies. Refer to ASTM B928M for details.
- Properties specified for tempers O and H32 also vary slightly depending on sheet or plate thickness. Specialist tempers F and H112 are also possible in 5083 – refer to ASTM B209M for details.

Physical Properties

(typical values)

Alloy	Density (kg/m ³)	Elastic Modulus (GPa)	Mean Coefficient of Thermal Expansion 20-100°C (µm/m/°C)	Thermal Conductivity at 25°C (W/m.K)	Electrical Conductivity MS/m at 20°C		Electrical Resistivity (nΩ.m)
					Equal Volume	Equal Mass	
5083	2660	71	23.8	117	17	57	59

Grade Specification Comparison

Alloy	UNS No	ISO	BS	DIN	
				No	Name
5083	A95083	AlMg4.5Mn	N8	3.3547	AlMg4.5Mn

These comparisons are approximate only. The list is intended as a comparison of functionally similar materials **not** as a schedule of contractual equivalents. If exact equivalents are needed original specifications must be consulted.

Possible Alternative Alloys

Alloy	Why it might be chosen instead of 5083
3003	Brighter appearance required, particularly when considering treadplate. Much lower strength.
5005	Bright (decorative) anodising finish is required and lower strength is acceptable.
5052	Required as treadplate and lower strength is acceptable.

Bending Radii

Minimum Bend Radius for Sheet or Plate thickness "t"								
Temper	0.4mm	0.8mm	1.6mm	3.2mm	4.8mm	6.0mm	10mm	12mm
O			½ t	1t	1t	1t	1½t	1½t
H321					1½t	1½t	2t	2½t

Recommended minimum bending radius for sheet or plate of thickness given, at 90° to the rolling direction. These values are recommended but are not guaranteed; the minimum possible bend radius will depend on the type of bending equipment and on the tooling and its condition.

References

- ASTM B209M – 10. Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- ASTM B928M – 09. Standard Specification for High Magnesium Aluminum-Alloy Sheet and Plate for Marine Service and Similar Environments.
- Bushfield, H., Marine Aluminum Plate - ASTM Standard Specification B928 And The Events Leading To Its Adoption.
- Aluminum Association – Aluminum Standards and Data – 2009 Metric SI.
- WTIA Technical Note 2 – Successful Welding of Aluminium.

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