Aluminium Alloy 5251 Data Sheet

Alloy 5251

Alloy 5251 is a non-heat-treatable 2% magnesium, 0.3% manganese alloy commonly available in flat rolled coil, sheet and plate from a few producing mills. Like all the 5000-series high magnesium alloys 5251 has a fairly high strength and is hardenable to a significant degree by cold working, enabling a series of “H” tempers.

Although 5251 is an alloy recognised by the Aluminium Association (AA) it is not included in the usual ASTM specifications such as B209M, nor is it listed in the AA Standards and Data Book. It is listed in the Australian / New Zealand and in the Euronorm standard for flat rolled products, EN 485 and in the now superseded and withdrawn BS 1470.

Use of 5251 in Australia and New Zealand is supported by some distributors that hold floor stocks of this alloy in preference to 5052.

Corrosion Resistance

Excellent in a wide range of atmospheric environments, in food and architectural applications and it is also acceptable in many marine environments. The magnesium content is low enough that it does not suffer from the stress corrosion cracking that can affect alloys with more than about 3½% Mg, such as 5083.

Heat Treatment

Alloy 5251 is not hardenable by heat treatment. It can be significantly hardened by cold work (e.g. by cold rolling) and various “H” tempers are produced – most commonly H32 (¼ Hard) and H34 (½ Hard) – 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, either a low temperature thermal treatment or as a result of heat introduced during rolling, which results in the H3x tempers. H2x tempers are more severely strain hardened and then partially annealed, again to quickly reach the required stable temper properties.

To soften Alloy 5251, 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 methods; gas, electric and resistance welding. GMAW and GTAW are preferred and widely used to produce structural welds. Filler alloys are usually 5356 although other alloys are possible. Welding of strain hardened tempers will reduce strengths in the heat affected zones.

Machining

Machinability of the softer tempers O and H32 is poor, with the harder tempers such as H34 being somewhat easier to machine.

Alloys 5052 & 5251 as Alternatives

It has become common practice in Australia and New Zealand for Alloy 5251 to be offered as an alternative to 5052. The two alloys are similar in composition and properties and in many cases, they may be functionally interchangeable. They are however different alloys and a piece of metal

Aluminium Alloy 5251 Data Sheet

that complies with one cannot also comply with the other. Some users can only accept one alloy or the other. Purchasers of these alloys must decide whether alternatives are acceptable.

Specified strength of 5251, in the common H32 and H34 tempers, is lower than for the same temper in 5052. The most striking difference is that the permitted yield strength of 5251 is substantially lower than for 5052.

Substitution of 5251 for 5052 or vice versa should only be made with full understanding of the differences. Atlas Steels Tech Note No. 14 gives further details of this comparison.

Typical Applications

Small marine craft ("tinnies"), food processing equipment and cabinets. Treadplate is more commonly available in 5052.

Specified Properties

These properties are specified for flat rolled product (plate, sheet and coil) in AS/NZS 1734. Similar but not necessarily identical properties are specified for other products and other specifications.

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

Alloy	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Others	
									Each	Total
5251	0.40	0.50	0.15	0.10-0.50	1.7-2.4	0.15	0.15	0.15	0.05	0.15

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

Alloy & Temper	Tensile Strength (Mpa)	Yield Strength 0.2% Proof (Mpa) min.	Elongation (% in 50mm) min.
			Minimum limits vary depending on product thickness
5251-O	170 - 215	65	15 - 20
5251-H32	200 - 255	160	4 - 11
5251-H34	235 - 285	180	3 - 8
5251-H36	255 - 305	200	3 - 4
5251-H38	270 min	220	3 – 4

- Tempers H22 and H24 etc. are the same as for the corresponding H3x- tempers, but may not meet maximum tensile strength and minimum yield strength limits.
- AS/NZS 1734 does not require yield strength to be measured or guaranteed unless specifically requested.
- For full details of elongation limits refer to the standard.

Aluminium Alloy 5251 Data Sheet

Physical Properties (Typical values)

Alloy	Density (kg/m³)	Elastic Modules (GPa)	Mean Coefficient of Thermal Expansion	Thermal Conductivity	Electrical Conductivity MS/m at 20°C		Electrical Resistivity
			20-100°C (µm/m/°C)	at 25°C (W/m.K)	Equal Volume	Equal Mass	(nΩ.m)
5251	2680	70	23.8	138	20	67	50

Grade Specification Comparison

Alloy	UNS No	ISO	EN	DIN	
				No	Name
5251	A95251	AlMg2	AW-5251	3.3525	AlMg2Mn0.3

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 5251
5052	Very similar properties but with better standards recognition than 5251.
3003	Brighter appearance required, particularly when considering treadplate.
5005	Bright (decorative) anodising finish is required.
5083	Higher strength or improved corrosion resistance required, particularly for ship hull applications.

Bending Radii

Minimum Bend Radius for Sheet or Plate thickness "t"				
Temper	0.4mm	0.8mm	1.6mm	3.2mm
O	0t	0t	0t	½ t
H32	0t	0t	1t	1½t
H34	0t	1t	1½t	2t
H36	1t	1t	1½t	2½t
H38	1t	1½t	2½t	3t

Recommended minimum bending radius for sheet 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

- AS/NZS 1734:1997. Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate.
- ASTM B209M – 10. Standard Specification for Aluminium and Aluminium-Alloy Sheet and Plate.

Aluminium Alloy 5251 Data Sheet

- EN 485-2. Aluminium and alloys - sheet strip and plate - Mechanical Properties.
- Aluminium Association – Aluminium Standards and Data – 2009 Metric SI.
- WTIA Technical Note 2 – Successful Welding of Aluminium.
- Atlas Tech Note No. 14 – Aluminium Alloys 5052 and 5251- Quite Similar but Completely Different.