

proximately the same as the tensile yield strength

Hardness. See Table 58.

Poisson's ratio. 0.33

Elastic modulus. Tension, 71.7 GPa ( $10.4 \times 10^6$  psi); shear, 25.9 GPa ( $3.75 \times 10^6$  psi); compression, 73.1 GPa ( $10.6 \times 10^6$  psi)

**Mass Characteristics**

Density. 2.64 Mg/m<sup>3</sup> (0.095 lb/in.<sup>3</sup>) at 20 °C (68 °F)

**Thermal Properties**

Liquidus temperature. 638 °C (1180 °F)

Solidus temperature. 568 °C (1055 °F)

Coefficient of thermal expansion. Linear, O temper:

Temperature range °C	Temperature range °F	Average coefficient	
		μm/m·K	μin./in.·°F
-50 - +20	-58 - +65	22.5	12.5
20 - 100	68 - 212	24.1	13.7
20 - 200	68 - 392	25.2	14.0
20 - 300	68 - 572	26.1	14.5

Volumetric:  $70 \times 10^{-6}$  m<sup>3</sup>/m<sup>3</sup>·K ( $3.89 \times 10^{-5}$  in.<sup>3</sup>/in.<sup>3</sup>·°F) at 20 °C (68 °F)

Specific heat. 904 J/kg·K (0.216 Btu/lb·°F) at 20 °C (68 °F)

Thermal conductivity. At 20 °C (68 °F): O temper, 120 W/m·K (69.3 Btu/ft·h·°F); H38 temper, 112 W/m·K (64.7 Btu/ft·h·°F)

**Electrical Properties**

Electrical conductivity. Volumetric, at 20 °C (68 °F): O temper, 29% IACS; H38 temper, 27% IACS

Electrical resistivity. At 20 °C (68 °F): O temper, 59 nΩ·m; H38 temper, 64 nΩ·m. Temperature coefficient, O and H38 tempers: 0.1 nΩ·m per K at 20 °C (68 °F)

Electrolytic solution potential. -0.87 V vs 0.1N calomel electrode in an aqueous solution containing 53 g NaCl plus 3 g H<sub>2</sub>O<sub>2</sub> per litre

**Fabrication Characteristics**

Annealing temperature. 413 °C (775 °F); holding at temperature not required

Hot working temperature. 316 to 482 °C (600 to 900 °F)

**Table 61 Typical tensile properties of alloy 5083**

Temper	Tensile strength(a)		Yield strength		Elongation(a)(b), %
	MPa	ksi	MPa	ksi	
O	290	42	145	21	22
H112	303	44	193	28	16
H116	317	46	228	33	16
H321	317	46	228	33	16
H323, H32	324	47	248	36	10
H343, H34	345	50	283	41	9

(a) Strengths and elongations are unchanged or improved at low temperatures. (b) 1.6-mm (1/16-in.) thick specimen.

**Table 62 Mechanical-property limits for alloy 5083**

Temper	Tensile strength				Yield strength				Elongation (min), % (a)
	Minimum MPa	Maximum MPa	Minimum ksi	Maximum ksi	Minimum MPa	Maximum MPa	Minimum ksi	Maximum ksi	
O									
0.051-1.5000 in. thick	275	40	350	51	125	18	200	29	16
1.501-3.000 in. thick	270	39	345	50	115	17	200	29	16
3.001-5.000 in. thick	260	38	...	...	110	16	...	...	14-16
5.001-7.000 in. thick	255	37	...	...	105	15	...	...	14
7.001-8.000 in. thick	250	36	...	...	95	14	...	...	12
H112									
0.250-1.500 in. thick	275	40	...	...	125	18	...	...	12
1.501-3.000 in. thick	270	39	...	...	115	17	...	...	12
H116									
0.063-1.500 in. thick	305	44	...	...	215	31	...	...	12
1.501-3.000 in. thick	285	41	...	...	200	29	...	...	12
H321									
0.188-1.500 in. thick	305	44	385	56	215	31	295	43	12
1.501-3.000 in. thick	285	41	385	56	200	29	295	43	12
H323	310	45	370	54	235	34	305	44	8-10
H343	345	50	405	59	270	39	340	49	6-8

(a) In 2 in. or 4d, where d is diameter of reduced section of tensile test specimen. Where a range of values appears in this column, the specified minimum elongation varies with thickness of the mill product.

**Table 63 Typical tensile properties of alloy 5083-O at various temperatures**

Temperature °C	Temperature °F	Tensile strength(a)		Yield strength(a)(b)		Elongation, %
		MPa	ksi	MPa	ksi	
-195	-315	405	59	165	24	36
-80	-112	295	43	145	21	30
-30	-22	290	42	145	21	27
25	80	290	42	145	21	25
100	212	275	40	145	21	36
150	302	215	31	130	19	50
205	400	150	22	115	17	60
260	500	115	17	75	11	80
315	600	75	11	50	7.5	110
370	698	41	6	29	4.2	130

(a) Lowest strength for exposures up to 10 000 h at temperature, no load; test loading applied at 5000 psi/min to yield strength and then at strain rate of 10%/min to fracture. (b) 0.2% offset.

## 104/Aluminum

### 5083

#### 4.4Mg-0.7Mn-0.15Cr

#### Specifications

AMS. Sheet and plate: 4056, 4057, 4058, 4059

ASTM. Sheet and plate: B209. Extruded wire, rod, bar, shapes and tube: B221. Extruded seamless tube: B241. Drawn seamless tube: B210. Welded Tube: B547. Forgings: B247.

Gas and oil transmission pipe: B345 SAE. J454

UNS number. A95083

Government. Sheet and plate: QQ-A-250/6. Extruded wire, rod, bar, shapes, and tube: QQ-A-200/4. Forgings: QQ-A-367. Armor plate: MIL-A-46027. Extruded armor: MIL-A-46083. Forged armor: MIL-A-45225  
 Foreign. Canada: CSA GM41. United Kingdom: BS N8. Germany: DIN AlMg4.5Mn; Werkstoff-Nr. 3.3547. ISO: AlMg4.5Mn

#### Chemical Composition

**Composition limits.** 0.40 max Si; 0.40 max Fe; 0.10 max Cu; 0.40 to 1.0 Mn; 4.0 to 4.9 Mg; 0.05 to 0.25 Cr; 0.25 max Zn; 0.15 max Ti; 0.05 max others (each); 0.15 max others (total); rem Al

#### Applications

**Typical uses.** Marine, auto and aircraft applications, unfired welded pressure vessels, cryogenics, TV towers, drilling rigs, transportation equipment, missile components, armor plate. Applications requiring a weldable moderate-strength alloy having good corrosion resistance

#### Mechanical Properties

**Tensile properties.** See Tables 61, 62 and 63.

**Shear properties.** O temper: shear strength, 172 MPa (25 ksi); shear yield strength, approximately 55% of tensile yield strength

**Compressive yield strength.** Approximately the same as tensile yield strength

**Elastic modulus.** Tension, 70.3 GPa ( $10.2 \times 10^6$  psi); shear, 26.4 GPa ( $3.83 \times 10^6$  psi); compression, 71.7 GPa ( $10.4 \times 10^6$  psi)

**Fatigue strength.** H321 and H116 tempers: 160 MPa (23 ksi) at  $5 \times 10^8$  cycles; R. R. Moore type test

**Table 64 Tensile properties of alloy 5086**

Temper	Tensile strength		Yield strength		Elongation(a), %
	MPa	ksi	MPa	ksi	
<b>Typical Properties</b>					
O	260	38	115	17	22
H32, H116	290	42	205	30	12
H34	325	47	255	37	10
H112	270	39	130	19	14
<b>Property Limits</b>					
	<b>Minimum</b>	<b>Maximum</b>	<b>Minimum</b>	<b>Minimum</b>	
O(0.020 - 2.000 in. thick)	240	35	95	14	15 to 18
H32(0.020 - 2.000 in. thick)	275	40	195	28	6 to 12
H34(0.009 - 1.000 in. thick)	305	44	235	34	4 to 10
H36(0.006 - 0.162 in. thick)	325	47	260	38	3 to 6
H38(0.006 - 0.020 in. thick)	345	50	285	41	3
H112					
(0.188 - 0.499 in. thick)	250	36	125	18	8
(0.500 - 1.000 in. thick)	240	35	110	16	10
(1.001 - 2.000 in. thick)	240	35	95	14	14
(2.001 - 3.000 in. thick)	235	34	95	14	14
H116(0.063 - 2.000 in. thick)	275	40	195	28	8 to 10

(a) In 2 in. or 4d, where d is diameter of reduced section of tensile test specimen. Where a range of values appears in this column, specified minimum elongation varies with thickness of the mill product.

#### Mass Characteristics

**Density.** 2.66 Mg/m<sup>3</sup> (0.096 lb/in.<sup>3</sup>) at 20 °C (68 °F)

#### Thermal Properties

**Liquidus temperature.** 638 °C (1180 °F)

**Solidus temperature.** 574 °C (1065 °F)

**Coefficient of thermal expansion.** Linear:

Temperature range		Average coefficient	
°C	°F	μm/m·K	μin./in.·°F
-50 - +20	-58 - +68	22.3	12.4
20 - 100	68 - 212	24.2	13.4
20 - 200	68 - 392	25.0	13.9
20 - 300	68 - 572	26.0	14.4

**Volumetric.**  $70 \times 10^{-6}$  m<sup>3</sup>/m<sup>3</sup>·K ( $3.89 \times 10^{-5}$  in.<sup>3</sup>/in.<sup>3</sup>·°F) at 20 °C (68 °F)

**Specific heat.** 900 J/kg·K (0.215 Btu/lb·°F) at 20 °C (68 °F)

**Thermal conductivity.** 120 W/m·K (69.3 Btu/ft·h·°F) at 20 °C (68 °F)

#### Electrical Properties

**Electrical conductivity.** Volumetric, average of all tempers: 29% IACS at 20 °C (68 °F)

**Electrical resistivity.** 59.5 nΩ·m at 20 °C (68 °F); temperature coefficient,

0.1 nΩ·m per K at 20 °C (68 °F)

**Electrolytic solution potential.** -0.91 V vs 0.1N calomel electrode in an aqueous solution containing 53 g NaCl plus 3 g H<sub>2</sub>O<sub>2</sub> per litre

#### Fabrication Characteristics

**Annealing temperature.** 413 °C (775 °F); holding at temperature not required

**Hot working temperature.** 316 to 482 °C (600 to 900 °F)

### 5086, Alclad 5086 4.0Mg-0.4Mn-0.15Cr

#### Specifications

ASTM. Sheet and plate: B209. Extruded wire, rod, bar, shapes and tube: B221. Extruded seamless tube: B241. Drawn, seamless tube: B210. Welded tube: B313, B547. Gas and oil transmission pipe: B345. Alclad 5086, sheet and plate: B209 SAE. J454

UNS number. A95086

Government. Sheet and plate: QQ-A-250/7, QQ-A-250/19. Extruded wire, rod, bar, shapes and tube: QQ-A-200/5. Drawn, seamless tube: WW-T-700/5.

Foreign. France: NF A-G4MC. Germany: DIN AlMg4. ISO: AlMg4