

# Aluminium Sheet, Coil, Plate, Treadplate & Extrusions



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7

# Aluminium



## Advantages of using Aluminium

- Light weight – approximately  $\frac{1}{3}$  the density of steel.
- Strength – some alloys can be substantially strengthened by work or by heat treatment.
- Workability – easy formability, machinability and readily welded.
- Corrosion resistance – varies depending on the alloy; the best resist marine exposure.
- Non-toxic – often used in contact with food.
- Non-magnetic and non-sparking.
- Electrical conductivity – very high; sometimes used for electrical conductors.
- Thermal conductivity – high.
- Reflectivity – bright finish options available.

## Specifications

Flat rolled aluminium alloy products stocked by Atlas generally comply with ASTM B209M or ASTM B928M with dimensions in ANSI H35.2. There is very close agreement between these standards and Australian/New Zealand standard AS/NZS 1734 and again close agreement with European standard EN 573.

Aluminium Association publication “Aluminium standards and data” gives a very accessible summary of both specified data and useful information. Aluminium products are often cited as compliant with “AA specs” based on this.

Treadplate is specified in ASTM B632M but this does not cover the product well. Most mills produce to their own specifications and particularly to their own tread patterns. If tread pattern is important this should be discussed with Atlas staff prior to purchase.

## Aluminium Alloy Compositions

Typical compositions of some common alloys. All values are percent.

| Alloy | Al        | Si  | Cu   | Mn  | Mg   | Cr   | Others            |
|-------|-----------|-----|------|-----|------|------|-------------------|
| 1050  | 99.5 min  |     |      |     |      |      |                   |
| 1145  | 99.45 min |     |      |     |      |      |                   |
| 1200  | 99.0 min  |     |      |     |      |      |                   |
| 2011  | rem       |     | 5.5  |     |      |      | Pb & Bi 0.4% each |
| 2003  | rem       |     | 0.12 | 1.2 |      |      |                   |
| 3004  | rem       |     |      | 1.2 | 1.0  |      |                   |
| 3105  | rem       |     |      | 0.6 | 0.50 |      |                   |
| 5005  | rem       |     |      |     | 0.8  |      |                   |
| 5052  | rem       |     |      |     | 2.5  | 0.25 |                   |
| 5083  | rem       |     |      | 0.7 | 4.4  | 0.15 |                   |
| 5186  | rem       |     |      | 0.4 | 4.3  |      |                   |
| 5251  | rem       |     |      | 0.3 | 2.0  |      |                   |
| 5383  | rem       |     |      | 0.8 | 4.6  |      |                   |
| 5454  | rem       |     |      | 0.8 | 2.7  | 0.12 |                   |
| 6005  | rem       | 0.8 |      |     | 0.5  |      |                   |
| 6060  | rem       | 0.5 |      |     | 0.5  |      |                   |
| 6061  | rem       | 0.6 | 0.28 |     | 1.0  | 0.20 |                   |
| 6063  | rem       | 0.4 |      |     | 0.7  |      |                   |
| 6106  | rem       | 0.4 |      | 0.1 | 0.6  |      |                   |
| 6262  | rem       | 0.5 | 0.28 |     | 1.0  | 0.09 |                   |
| 6351  | rem       | 1.0 |      | 0.6 | 0.6  |      |                   |

Only major alloying elements are listed.

Normal impurities are also present.

Refer to specifications for limits to both major elements and impurities

## Alloy Characteristics and Forms

| Alloy       | Typical Application  | Characteristics <sup>1</sup>      |               |                          |                        | Commercial Form |       |      |            |
|-------------|--|-----------------------------------|---------------|--------------------------|------------------------|-----------------|-------|------|------------|
|             |  | Corrosion Resistance <sup>4</sup> | Machinability | Weldability <sup>3</sup> | Anodising <sup>2</sup> | Plate           | Sheet | Coil | Extrusions |
| 1050        | Chemical & process plant & equipment   | A,A                               | D,C           | A,A                      | B,B                    | ✓               | ✓     | ✓    |            |
| 1145 & 1200 | Commercial pure aluminium. Used in cooking utensils and for deep frying.   | A,A                               | D,C           | A,A                      | B,B                    |                 | ✓     | ✓    |            |
| 2011        | Screw machine products not requiring decorative anodizing  | D,D                               | A,A           | D,D                      | D,D                    |                 |       |      | ✓          |
| 3003        | Chemical equipment, sheet metal work, rigid foil containers & closures   | A,A                               | D,C           | A,A                      | B,B                    |                 | ✓     | ✓    |            |
| 3004        | Sheet metal work, car bodies, seam welding tubing, roofing sheet   | A,A                               | D,C           | A,A                      | B,B                    |                 | ✓     | ✓    |            |
| 3105        | Painted sheet products   | A,A                               | D,C           | A,A                      | B,B                    |                 | ✓     | ✓    |            |
| 5005        | Appliances & utensils, general sheet metal work & high strength foil   | A,A                               | D,C           | A,A                      | B,B                    | ✓               | ✓     | ✓    |            |
| 5052 & 5251 | Sheet metal work, appliances, marine applications  | A,A                               | C,B           | A,A                      | C,C                    | ✓               | ✓     | ✓    |            |
| 5083        | High strength alloy used in transport, marine & structural applications  | A,C                               | C,B           | A,A                      | C,C                    | ✓               | ✓     |      |            |
| 5383        | Specific to the marine industry with characteristics similar to 5083 with enhanced weldability   | A,C                               | C,B           | A,A                      | C,C                    | ✓               | ✓     |      |            |
| 5454        | Welded structures, pressure vessels for use at elevated temperatures, marine applications  | A,A                               | C,B           | A,A                      | C,C                    | ✓               | ✓     |      |            |
| 6005        | Good strength for structural applications  | A,A                               | B,C           | A,A                      | B,B                    |                 |       |      | ✓          |
| 6061 & 6351 | Structural applications where strength & corrosion resistance is needed. Used in transport applications.   | B,B                               | B,C           | A,A                      | B,B                    |                 |       |      | ✓          |
| 6063 & 6060 | General purpose extrusion alloy for architectural applications where additional strength is required & for structural applications not involving welding | A,A                               | C,C           | A,A                      | A,A                    |                 |       |      | ✓          |
| 6106        | Medium strength alloy used for architectural applications where additional strength is required & for structural applications not involving welding.     | A,A                               | C,C           | A,A                      | A,A                    |                 |       |      | ✓          |
| 6262        | Screw machining products suitable for decorative anodizing   | B,B                               | A,A           | B,B                      | B,B                    |                 |       |      | ✓          |

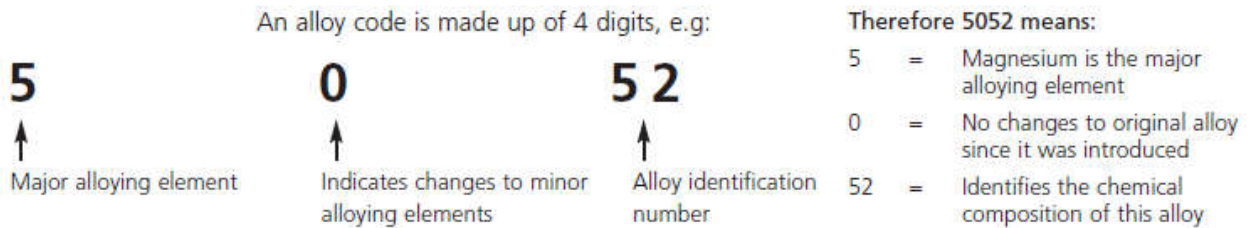
<sup>1</sup> Relative ratings in decreasing order of merit = A B C D (where A = most applicable). Two ratings e.g. AC are for annealed and hardest tempers.

<sup>2</sup> Rating indicates suitability of alloy for decorative quality anodizing; all aluminium alloys can be anodized for increased corrosion and wear resistance. See separate note "Anodising Quality".

<sup>3</sup> Weldability rating quoted is for arc welding. Some alloys have lesser weldability by gas processes.

<sup>4</sup> General corrosion resistance rating. Resistance to stress corrosion cracking can be less.

## Understanding an Alloy Code



## Alloy Systems

| Alloy series | Major alloying element                    | Heat Treatable or Not |
|--------------|---|-----------------------|
| 1??? =       | Pure aluminium (99.0% min. and greatest)  | Non-heat treatable    |
| 2??? =       | Copper is major addition                  | Heat treatable        |
| 3??? =       | Manganese is major addition               | Non-heat treatable    |
| 4??? =       | Silicon is major addition                 | Non-heat treatable    |
| 5??? =       | Magnesium is major addition               | Non-heat treatable    |
| 6??? =       | Magnesium and Silicon are major additions | Heat treatable        |
| 7??? =       | Zinc is major addition                    | Heat treatable        |
| 8??? =       | Alloys not covered above                  | -                     |

Non-heat treatable alloys can only be hardened by cold work. The degree of work hardening is designated by the Temper. Heat treatable alloys (the 2000, 6000 and 7000 series) are able to be solution treated and then age-hardened. These have "T" tempers.

| "H" Temper designation systems |                 |
|--------------------------------|-----------------|
| Strain hardened alloys         |                 |
| O                              | Soft (annealed) |
| H?2                            | ¼ hard          |
| H?4                            | ½ hard          |
| H?6                            | ¾ hard          |
| H?8                            | Hard            |

Where "?" can be:

1 = As rolled – - strain hardened only e.g. H12

2 = Strain hardened and then partially annealed (200°C – 260°C) e.g. H24

3 = Strain hardened and then stabilised (150°C) e.g. H36

Temper F – "as fabricated" temper with no special control over conditions and no mechanical property limits.

## Three-Digit H Tempers

### Plate Temper Codes

| Code | Description  |
|------|--|
| H111 | Minor strain hardening so the product does not comply with annealed properties but also not enough hardening to comply with H11.   |
| H112 | Product strain hardened at elevated temperatures. Strength only slightly higher than annealed Temper O.  |
| H116 | 5xxx series alloys for marine applications. Final operation is strain hardening. Strength equivalent to H32. Product is tested for intergranular and exfoliation corrosion resistance.           |
| H321 | 5xxx series alloys for marine applications. Strain hardened and then thermally stabilised. Strength equivalent to H32. Product is tested for intergranular and exfoliation corrosion resistance. |
| H114 | Treadplate in Alloys 3003 or 5052 rolled from Temper O.  |
| H224 | Treadplate in Alloys 3003 or 5052 rolled from Temper H21.  |

Note: Plate tempers generally restricted to ½ hard maximum owing to heavy gauge – cannot get sufficient cold work for higher tempers.

### Plate and Sheet Standards

| Standard  | Description   |
|-----------|---|
| ASTM B209 | Product for a non-marine applications where additional corrosion testing is not required. This is typically applied to plate for the transport industry where surface finish and bright levels are critical. Material is ordered to a standard “H” temper e.g. H32. The material does not require identification line marking from the manufacturer.    |
| ASTM B928 | Typically a marine standard requiring additional testing for exfoliation and inter-granular corrosion resistance. Material for marine application is ordered as tempers H116 or H321 and possibly reference to an international recognised testing authority such as DNV. All material to this standard is line marked with manufacturing traceability. |
| DNV       | Plate for marine applications can be supplied with testing certified by Det Norske Veritas (DNV).   |

### Anodising Quality Aluminium Sheet

Atlas standard stock is not classified as “anodizing quality” and as such is not guaranteed to give acceptable anodizing appearance in any particular conditions. Much of this standard stock has been shown by considerable production experience to anodize well, particularly in smaller items and where exact colour consistency is not required. The acceptability of anodizing outcomes should be established by trial on a case by case basis with this product. Alloy 5005 is the usual choice for decorative anodized finishing. Other alloys can be anodized and this will improve corrosion resistance but the visual appearance may not be “decorative”. Trial anodising of any new alloy or source is always recommended.

Atlas can source “anodising quality” aluminium sheet, usually in grade 5005. Where exact colour matching is required across a batch or even between batches this should be discussed with Atlas sales staff.

### Product Range

#### Aluminium Sheet

Note: Through external processing facilities all sheet product can be slit and cut to length for specific requirements. Linishing is also available.

|                      |                              |
|----------------------|------------------------------|
| Alloys               | 5005, 5052, 5251             |
| Tempers              | O, H32, H34, H38, H116, H321 |
| Thickness range (mm) | 0.15 to less than 6          |
| Width range (mm)     | 900, 1200, 1500              |
| Length range (mm)    | 1800, 2400, 3000, 3600       |

Other grades available on request.

#### Aluminium Coil/Strip

Note: Through external processing facilities, all coil product can be slit and cut to length for specific requirements. Linishing is also available.

|                      |                                    |
|----------------------|------------------------------------|
| Alloys               | 3003, 3004, 3105, 5005, 5052, 5251 |
| Tempers              | O, H32, H34, H38, H116, H321       |
| Thickness range (mm) | 0.15 to less than 6                |
| Width range (mm)     | 25 to 1575                         |

#### Aluminium Plate

Note: Through external processing facilities, all plate product can be slit and cut to length for specific requirements.

|                      |                              |
|----------------------|------------------------------|
| Alloys               | 5083, 5005, 5052, 5454, 5186 |
| Tempers              | H32, H34, H116, H321         |
| Thickness range (mm) | 6 to 25                      |
| Width range (mm)     | 1200 to 2500                 |
| Length range (mm)    | 2400 to 12000                |

**Aluminium Treadplate**

Note: Mill orders can be supplied to a customer's desired width and length.

|                           |  |
|---------------------------|--|
| Alloys (Commonly stocked) | 5052, 3003   |
| Tempers                   | O, H112, H114, H224  |
| Finish                    | Standard 5 bar Mill Finish (Alloy 5052 Temper O, H114, H224) |
|                           | Propeller Pattern Bright (Alloy 3003 Temper H114, H224)      |
| Thickness range (mm)      | 1.6 to 8   |
| Width range (mm)          | 1200 to 1525   |
| Length range (mm)         | 2400 to 6100   |

**Aluminium Extrusions Product Range****Flat Bar**

|           |               |
|-----------|---------------|
| Alloys    | 6060, 6063    |
| Tempers   | T5            |
| Thickness | 1.6mm to 10mm |
| Width     | 12mm to 100mm |

**Angle**

|           |                        |
|-----------|------------------------|
| Alloys    | 6060                   |
| Tempers   | T5                     |
| Thickness | 1.6mm to 3mm           |
| Width     | 20 x 20mm to 50 x 50mm |

**Channel**

|           |                                      |
|-----------|--------------------------------------|
| Alloys    | 6060, 6063                           |
| Tempers   | T5                                   |
| Thickness | 1.6mm to 3mm                         |
| Width     | 16 x 16mm to 50 x 25mm and 50 x 50mm |

**Square and Rectangular Hollow Sections**

|           |   |
|-----------|---|
| Alloys    | 6005, 6060, 6063                                |
| Tempers   | T5  |
| Thickness | 1.6mm to 3mm                                    |
| Width     | 20 x 20mm to 50 x 50mm, 25 x 40mm to 50 x 150mm |

**Non Standard Product Range**

Aluminium product can be sourced outside the standard stock range nominated above. For such enquiries please contact the local Atlas sales office.

**Finishes****Aluminium Plate**

- Elval Bright Transport Plate: this material is sourced from a select mill. Atlas market and stock this quality of plate in Alloy 5083, Temper H32.
- Mill Finish: this refers to plate supplied ex mill with a commercial finish. This material is typically used in the marine industry, general engineering and transport industry where bright plate is not critical.

**Tread Plate**

Pattern – 5 Bar  
Available in Alloy 5052



Pattern – Propeller or 1 Bar  
available in Alloy 3003



If tread pattern is critical this should be discussed with Atlas prior to purchase.

**Mass per Square Metre** (based on theoretical density of 2700kg/m<sup>3</sup>)

| Thickness (mm) | Sheet/Plate | Thickness (mm) | Sheet/Plate | Treadplate | Thickness (mm) | Sheet/Plate | Treadplate |
|----------------|-------------|----------------|-------------|------------|----------------|-------------|------------|
| 0.3            | 0.81        |                | 4.3         |            |                | 21.6        | 22.3       |
| 0.45           | 1.22        | 2              | 5.4         |            | 10             | 27.0        | 27.7       |
| 0.55           | 1.49        | 2.5            | 6.8         | 7.4        | 12             | 32.4        | 33.1       |
| 0.8            | 2.16        | 3              | 8.1         |            | 16             | 43.2        | 43.9       |
| 0.9            | 2.43        | 3.2            | 8.6         | 9.3        | 20             | 54.0        |            |
| 1.0            | 2.70        | 4              | 10.8        | 11.5       | 25             | 67.5        |            |
| 1.2            | 3.24        | 5              | 13.5        | 14.2       | 30             | 81.0        |            |
| 1.5            | 4.05        | 6              | 16.2        | 16.9       | 40             | 108         |            |
| 1.6            |             | 8              |             |            |                |             |            |

## Bending Radius Chart

Recommended minimum inside bending radii for 90 degree cold forming of sheet and plate <sup>123</sup>, bending transverse to rolling direction. Bending along the rolling direction may require a larger bend radius.

| Radii for various thickness expressed in terms of thickness t |                   |         |         |         |         |         |         |          |          |
|---|-------------------|---------|---------|---------|---------|---------|---------|----------|----------|
| Alloy   | Temper            | t=0.4mm | t=0.8mm | t=1.6mm | t=3.0mm | t=4.0mm | t=6.0mm | t=10.0mm | t=12.0mm |
| 1050  | O                 | 0t      | 0t      | 0t      | 0t      | 0t      | 0.5t    | 0.5t     | 1t       |
| 1350  | H12               | 0t      | 0t      | 0t      | 0t      | 0t      | 0.5t    | 1t       | 1.5t     |
| 1150  | H14               | 0t      | 0t      | 0t      | 0.5t    | 0.5t    | 1t      | 1.5t     | 2t       |
|   | H16               | 0t      | 0t      | 0.5t    | 1t      |         |         |          |          |
|   | H18               | 0.5t    | 1t      | 1.5t    | 2t      |         |         |          |          |
| 1100<br>1200  | O                 | 0t      | 0t      | 0t      | 0t      | 0t      | 1t      | 1t       | 1.5t     |
|   | H12               | 0t      | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1.5t     | 2t       |
|   | H14               | 0t      | 0t      | 0t      | 1t      | 1t      | 1.5t    | 2t       | 2.5t     |
|   | H16               | 0t      | 0.5t    | 1t      | 1.5t    | 1.5t    | 2.5t    | 3t       | 4t       |
|   | H18               | 1t      | 1.5t    | 2t      | 3t      |         |         |          |          |
| 2024 <sup>2</sup>   | O                 | 0t      | 1t      | 1t      | 1t      | 1t      | 1t      | 2.5t     | 4t       |
|   | T42               | 2.5t    | 3t      | 4t      | 5t      | 5t      | 6t      | 7t       | 8t       |
| 3033  | O                 | 0t      | 0t      | 0t      | 0t      | 0.5t    | 1t      | 1t       | 1.5t     |
| 3203  | H12               | 0t      | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1.5t     | 2t       |
| 3005  | H14               | 0t      | 0t      | 0t      | 1t      | 1t      | 1.5t    | 2t       | 2.5t     |
| 5005  | O                 | 0       | 0       | 0       | 0       | 0.5t    | 1t      | 1t       | 1.5t     |
|   | H12               | 0       | 0       | 0       | 0.5t    | 1t      | 1t      | 1.5t     | 2t       |
|   | H14               | 0       | 0       | 0       | 1t      | 1.5t    | 1.5t    | 2t       | 2.5t     |
| 5005  | H16               | 0.5t    | 1t      | 1t      | 1.5t    |         |         |          |          |
|   | H18               | 1t      | 1.5t    | 2t      | 3t      |         |         |          |          |
|   | H32               | 0t      | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1.5t     | 2t       |
|   | H34               | 0t      | 0t      | 0t      | 1t      | 1.5t    | 1.5t    | 2t       | 2.5t     |
|   | H36               | 0.5t    | 1t      | 1t      | 1.5t    | 2.5t    | 3t      | 3.5t     | 4t       |
|   | H38               | 1t      | 1.5t    | 2t      | 2.5t    | 3.5t    | 4.5t    | 5.5t     | 6.5t     |
| 3004  | O                 | 0t      | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1t       | 1.5t     |
|   | H32               | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1.5t    |          |          |
|   | H34               | 0t      | 1t      | 1t      | 1.5t    | 1.5t    | 2.5t    |          |          |
|   | H36               | 1t      | 1t      | 1.5t    | 2.5t    |         |         |          |          |
|   | H38               | 1t      | 1.5t    | 2.5t    | 3t      |         |         |          |          |
| 5050  | O                 | 0t      | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1t       | 1.5t     |
|   | H32               | 0t      | 0t      | 0t      | 1t      | 1t      | 1.5t    |          |          |
|   | H34               | 0t      | 0t      | 1t      | 1.5t    | 1.5t    | 2t      |          |          |
|   | H36               | 1t      | 1t      | 1.5t    | 2t      |         |         |          |          |
|   | H38               | 1t      | 1.5t    | 2.5t    | 3t      |         |         |          |          |
| 5052<br>5251  | O                 | 0t      | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1.5t     | 1.5t     |
|   | H32               | 0t      | 0t      | 1t      | 1.5t    | 1.5t    | 1.5t    | 1.5t     | 2t       |
|   | H34               | 0t      | 1t      | 1.5t    | 2t      | 2t      | 2.5t    | 2.5t     | 3t       |
|   | H36               | 1t      | 1t      | 1.5t    | 2.5t    | 3t      | 3.5t    | 4t       | 4.5t     |
|   | H38               | 1t      | 1.5t    | 2.5t    | 3t      | 4t      | 5t      | 5.5t     | 6.5t     |
| 5154<br>5454  | O                 | 0t      | 0t      | 0.5t    | 1t      | 1t      | 1t      | 1.5t     | 1.5t     |
|   | H32               | 0t      | 0.5t    | 1t      | 1.5t    | 1.5t    | 2t      | 2.5t     | 3.5t     |
|   | H34               | 0.5t    | 1t      | 1.5t    | 2t      | 2.5t    | 3t      | 3.5t     | 4t       |
|   | H112              |         |         |         |         |         | 2t      | 2.5t     | 3t       |
| 5083  | O                 |         |         | 0.5t    | 1t      | 1t      | 1t      | 1.5t     | 1.5t     |
|   | H32               |         |         | 1t      | 1.5t    | 1.5t    | 1.5t    | 2t       | 2.5t     |
|   | H321              |         |         | 1t      | 1.5t    | 1.5t    | 1.5t    | 2t       | 2.5t     |
| 5086  | O                 | 0t      | 0t      | 1.5t    | 1t      | 1t      | 1t      | 1.5t     | 1.5t     |
|   | H32               | 0t      | 1.5t    | 1.5t    | 2t      | 2t      | 2t      | 2.5t     | 3t       |
|   | H34               | 0.5t    | 1t      | 1.5t    | 2t      | 2.5t    | 3t      | 3.5t     | 4t       |
|   | H36               |         |         |         | 3t      | 3.5t    |         |          |          |
|   | H112 <sup>3</sup> |         |         |         |         | 1.5t    | 2t      | 2t       | 2.5t     |
| 6061 <sup>2</sup>   | O                 | 0t      | 0t      | 0t      | 1t      | 1t      | 1t      | 1.5t     | 2t       |
|   | T4 & T42          | 0t      | 0.5t    | 1t      | 1.5t    | 2.5t    | 3t      | 3.5t     | 4t       |
|   | T6 & T62          | 1t      | 1t      | 1.5t    | 2.5t    | 3t      | 4t      | 4.5t     | 5t       |

### Notes

<sup>1</sup> The radii listed are the minimum recommended for bending sheets and plates without fracturing in a standard press break with air bend dies. Other types of bending operations may require larger radii or permit smaller radii. The minimum permissible radii will also vary with the design and condition of tooling.

<sup>2</sup> Heat-treatable alloys can be formed over appreciably smaller radii immediately after solution heat treatment.

<sup>3</sup> The H112 temper (applicable to non-heat treatable alloys) is supplied in the as-fabricated condition without special property control, but usually can be formed over radii applicable to the H14 (or H34) temper or smaller.