

## MECHANICAL PROPERTIES

**Table I** lists minimum yield strength, minimum ultimate tensile strength, and minimum elongation values. Yield strength, ultimate tensile strength, and elongation property values are determined with standard test method ASTM B557. This table also includes hardness screening criteria values, indicated in parentheses. As applicable, minimum electrical conductivity values are also specified.

**TABLE I**

| <u>Alloy &amp; Temper</u> <sup>1</sup> | <u>Specified Thickness</u> <sup>2</sup><br>(in) | <u>Minimum Yield Strength</u> <sup>3</sup><br>(ksi) | <u>Minimum Ultimate Tensile Strength</u> <sup>3</sup><br>(ksi) | <u>Minimum Elongation</u> <sup>3</sup><br>(%) | <u>Hardness Screening Criteria Webster B/Rockwell F</u> <sup>4</sup> | <u>Minimum Electrical Conductivity</u> <sup>5</sup> |
|--|---|---|--|---|--|---|
| 6061-T6                                | Up Thru 0.249                                   | 35.0  | 38.0   | 8   | (15)/(83)  | ---   |
| 6061-T6                                | 0.250 & Over                                    | 35.0  | 38.0   | 10  | (15)/(83)  | ---   |
| 6061-T51                               | Up Thru 0.625                                   | 30.0  | 35.0   | 8   | ---/---  | ---   |
| 6061-T4 <sup>6</sup>                   | All   | 16.0  | 26.0   | 16  | (11)/---   | ---   |
| 6105-T5&T6                             | Up Thru 0.500                                   | 35.0  | 38.0   | 8   | (15)/(83)  | ---   |
| 6005-T5&T6                             | Up Thru 0.124                                   | 35.0  | 38.0   | 8   | (15)/(83)  | ---   |
| 6005-T5&T6                             | 0.125 – 1.000                                   | 35.0  | 38.0   | 10  | (15)/(83)  | ---   |
| 6105-T1                                | Up Thru 0.500                                   | 15.0  | 25.0   | 16  | ---/---  | ---   |
| 6005-T1                                | Up Thru 0.500                                   | 15.0  | 25.0   | 16  | ---/---  | ---   |
| 6082-T6                                | Up Thru 0.197 <sup>7</sup>                      | 37.0 <sup>7</sup>                                   | 43.0 <sup>7</sup>  | 8 <sup>8</sup>                                | ---/(95 <sup>9</sup> H <sub>B</sub> )                                | ---   |
| 6082-T6                                | 0.198 – 0.984 <sup>7</sup>                      | 38.0 <sup>7</sup>                                   | 45.0 <sup>7</sup>  | 10 <sup>8</sup>                               | ---/(95 <sup>9</sup> H <sub>B</sub> )                                | ---   |
| 6082-T4                                | Up Thru 0.197 <sup>7</sup>                      | 16.0 <sup>7</sup>                                   | 30.0 <sup>7</sup>  | 14 <sup>8</sup>                               | (11)/---   | ---   |
| 6063-T6                                | Up Thru 0.124                                   | 25.0  | 30.0   | 8   | (12)/(70)  | ---   |
| 6063-T6                                | 0.125 – 1.000                                   | 25.0  | 30.0   | 10  | (12)/(70)  | ---   |
| 6463-T6                                | Up Thru 0.124                                   | 25.0  | 30.0   | 8   | (12)/(70)  | ---   |
| 6463-T6                                | 0.125 – 1.000                                   | 25.0  | 30.0   | 10  | (12)/(70)  | ---   |
| 6063-T5                                | Up Thru 0.500                                   | 16.0  | 22.0   | 8   | (8)/(50)   | ---   |
| 6063-T5                                | 0.501 – 1.000                                   | 15.0  | 21.0   | 8   | (8)/(50)   | ---   |
| 6463-T5                                | Up Thru 0.500                                   | 16.0  | 22.0   | 8   | (8)/(50)   | ---   |
| 6063-T4                                | Up Thru 0.500                                   | 10.0  | 19.0   | 14  | ---/---  | ---   |
| 6063-T4                                | 0.501 – 1.000                                   | 9.0   | 18.0   | 14  | ---/---  | ---   |
| 6063-T1                                | Up Thru 0.500                                   | 9.0   | 17.0   | 12  | ---/---  | ---   |
| 6063-T1                                | 0.501 – 1.000                                   | 8.0   | 16.0   | 12  | ---/---  | ---   |
| 6063-T52                               | Up Thru 1.000                                   | 16.0 min.<br>25.0 max.                              | 22.0 min.<br>30.0 max.   | 8   | (8)/(50)   | ---   |

**TABLE I (Continued)**

| Alloy & Temper <sup>1</sup> | Specified Thickness <sup>2</sup><br>(in) | Minimum Yield Strength <sup>3</sup><br>(ksi) | Minimum Ultimate Tensile Strength <sup>3</sup><br>(ksi) | Minimum Elongation <sup>3</sup><br>(%) | Hardness Screening Criteria<br>Webster B/<br>Rockwell F <sup>4</sup> | Minimum Electrical Conductivity <sup>5</sup> |
|-----------------------------|--|--|---|--|--|--|
| 6101-T6                     | 0.125 – 0.500                            | 25.0   | 29.0  | (10)                                   | (11)/(66)  | 55.0   |
| 6101-T61                    | 0.125 – 0.749                            | 15.0   | 20.0  | (10)                                   | (6)/(40)   | 57.0   |
| 6101-T61                    | 0.750 – 1.499                            | 11.0   | 18.0  | (10)                                   | (6)/(40)   | 57.0   |
| 6101-T61                    | 1.500 – 2.000                            | 9.0  | 15.0  | (10)                                   | (6)/(40)   | 57.0   |
| 6101-T63                    | 0.125 – 1.000                            | 22.0   | 27.0  | (10)                                   | (9)/(57)   | 56.0   |
| 6101-T64                    | 0.125 – 1.000                            | 8.0  | 15.0  | (20)                                   | ---/---  | 59.5   |
| 6101-T65                    | 0.125 – 0.749                            | 20.0 min.<br>27.0 max.                       | 25.0 min.<br>32.0 max.                                  | ---                                    | (8)/(53)   | 56.5   |
| 6101-H111                   | 0.250- 2.000                             | 8.0  | 12.0  | (20)                                   | ---/---  | 59.0   |
| 1100-H112                   | All                                      | 3.0  | 11.0  | ---                                    | ---/---  | ---  |
| 1350-H111                   | All                                      | 3.5  | 8.5   | ---                                    | ---/---  | 61.0   |

Footnotes for Table

<sup>1</sup> All alloys in the T8 temper shall meet the T6 temper minimum yield strength, minimum ultimate tensile strength and minimum elongation values.

<sup>2</sup> The thickness of the cross section from which the tensile test specimen is taken determines the applicable mechanical properties.

<sup>3</sup> These values may vary with thickness. Refer to the current issue of Aluminum Standards and Data.

<sup>4</sup> Hardness is not a guaranteed value. Hardness screening criteria values are listed in parentheses ( ). Typical

hardness values that can be obtained when material properties are at minimum levels may be lower.

<sup>5</sup> At 20°C (68°F) % IACS (percent International Annealed Copper Standard).

<sup>6</sup> In accordance with ASTM B221, Alloy 6061 produced in the -T4 temper shall conform to the listed property limits after proper solution heat treatment and natural aging, at room temperature, for 96 hours.

<sup>7</sup> Properties are of foreign registration. Specific property minimums for 6082-T6 are 250 to 260 MPa yield

strength, 290 to 310 MPa ultimate tensile strength and 8 to 10 percent elongation dependant on profile thickness (up thru 5 mm; and 5-25 mm), in accordance with DIN 1748 and BS EN755-2. Specific

property minimums for 6082-T4 are 110 MPa yield strength, 205 MPa ultimate tensile strength, and 14%

elongation, in accordance with BS EN755-2.

<sup>8</sup> Elongation value after fracture determined by A<sub>5</sub> method (L=5D; length of tensile specimen equals five diameters).

<sup>9</sup> In accordance with DIN 1748, 6082-T6 has a typical Brinell hardness value of 95.

In addition to the mechanical property requirements listed in **Table I**, Alloy 6101 and Alloy 1350 bus bar profiles must also satisfy bend test requirements. Extrusions of Alloy 6101 in its final temper, and Alloy 1350 bus bar profiles, shall be bent flatwise at room temperature through an angle of 90° to a minimum radius as shown in **Table IA** without cracking and without evidence of slivers. Test frequency shall be a minimum of one per 3,000 lbs. of material, (per ASTM B317, 10.2 and 9.2) or fraction thereof.

**TABLE IA**

| <u>Alloy and Temper</u> | <u>Thickness (in)</u> | <u>Flatwise Bend Radius Minimum Inside Radius</u> <sup>1</sup> | <u>Edgewise Bending Radii</u> <sup>2</sup> |
|-------------------------|-----------------------|--|--|
| 6101-T6                 | 0.125-0.375           | 2 x thickness  |  |
|                         | 0.376-0.500           | 2 1/2 x thickness  |  |
| 6101-T61                | 0.125-0.500           | 1 x thickness  |  |
|                         | 0.501-0.749           | 2 x thickness  |  |
|                         | 0.750-1.000           | 3 x thickness  |  |
|                         | 1.001-1.625           | 4 x thickness  |  |
| 6101-T63                | 0.125-0.375           | 1 x thickness  |  |
|                         | 0.376-0.500           | 1 1/2 x thickness  |  |
|                         | 0.501-1.000           | 2 1/2 x thickness  |  |
| 6101-H111               | 0.250-0.750           | 1 x thickness  | 1/2 section width <sup>3</sup>             |
|                         | 0.751-1.000           | 2 x thickness  |  |
| 6101-T64                | 0.125-0.750           | 1 x thickness  | 1/2 section width <sup>3</sup>             |
|                         | 0.751-1.000           | 2 x thickness  |  |
| 6101-T65                | 0.125-0.500           | 1 x thickness  |  |
|                         | 0.501-0.749           | 2 x thickness  |  |
| 1350-H111               | All                   | 1 x thickness  |  |

<sup>1</sup> All material supplied shall be checked for conformance of flat bend requirement. Applicable to section widths up through six inches (except -T64 and -H111 tempers).

<sup>2</sup> Edge bend tests will be performed only on 6101-H111 and 6101-T64 orders.

<sup>3</sup> 6101-H111 and 6101-T64 material having a maximum thickness of 0.250 inch and a maximum section width of 2.000 inch shall be capable of being bent edgewise at room temperature through an angle of 90° to an inside bend radius equal to one-half the section width without cracking and without ruptures visible to the unaided eye.

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## TYPICAL MECHANICAL PROPERTIES

**Table II** lists typical properties for aluminum alloy and temper combinations. Typical properties, indicated by parentheses, are not guaranteed values. The information in **Table II** is intended only as a guide that can serve as a basis for comparing alloys and tempers. The information in **Table II** should not be specified as engineering requirements and not used for design purposes.

**TABLE II** (Not for Design)

| <u>Alloy<br/>&amp; Temper</u> | <u>Typical<sup>1</sup><br/>Yield<br/>Strength<sup>2</sup></u><br>(ksi) | <u>Typical<sup>1</sup><br/>Ultimate<br/>Tensile<br/>Strength<sup>2</sup></u><br>(ksi) | <u>Typical<sup>1</sup><br/>Elongation<sup>2</sup></u><br>(%) | <u>Typical<sup>1</sup><br/>Webster B/<br/>Rockwell F<sup>3</sup></u> | <u>Typical<sup>1</sup><br/>Electrical<br/>Conductivity<sup>4</sup></u> |
|-------------------------------|--|---|--|--|--|
| 6061-T6                       | (40.0)   | (44.0)  | (12)   | (16)/(86)  | (43.0)   |
| 6061-T4                       | (22.0)   | (35.0)  | (21)   | ---/---  | (40.0)   |
| 6105-T5                       | (38.0)   | (42.0)  | (10)   | (15)/(85)  | (50.0)   |
| 6005-T5                       | (38.0)   | (42.0)  | (10)   | (15)/(85)  | (50.0)   |
| 6063-T6                       | (30.0)   | (34.0)  | (12)   | (13)/(74)  | (53.0)   |
| 6463-T6                       | (30.0)   | (34.0)  | (12)   | (13)/(74)  | (53.0)   |
| 6063-T5                       | (21.0)   | (27.0)  | (12)   | (10)/(60)  | (55.0)   |
| 6463-T5                       | (21.0)   | (27.0)  | (12)   | (10)/(60)  | (55.0)   |
| 6063-T4                       | (13.0)   | (25.0)  | (22)   | ---/---  | ---  |
| 6063-T1                       | ---  | ---   | ---  | ---/---  | (50.0)   |
| 6063-T52                      | (20.0)   | (26.0)  | (12)   | (9)/(55)   | ---  |
| 6101-T6                       | (28.0)   | (32.0)  | (15)   | (12)/(70)  | (57.0)   |
| 6101-H111                     | (11.0)   | (14.0)  | ---  | ---/---  | ---  |
| 1100-H112                     | (5.0)  | (13.0)  | ---  | ---/---  | ---  |

<sup>1</sup> Parentheses ( ) indicate typical values.

<sup>2</sup> These values may vary with thickness. Refer to the current issue of Aluminum Standards and Data.

<sup>3</sup> Hardness is not a guaranteed value.

<sup>4</sup> % IACS at 68°F.