



# **ALLOY 7475 PLATE AND SHEET**

**HIGHEST TOUGHNESS/STRENGTH**

**SUPPLYING THE WORLD'S BEST**



# ALLOY 7475

## DESCRIPTION

Alloy 7475 is a controlled toughness alloy developed by Alcoa for sheet and plate applications that require a combination of high strength, superior fracture toughness and resistance to fatigue crack propagation. Typical fracture toughness values for alloy 7475 plate are approximately 40 percent greater than alloy 7075 in the same tempers. Corrosion resistance and fatigue behavior of alloy 7475 are equal to and, in some cases, better than many of the current high strength aerospace alloys such as 7075, 7050 and 2024.

Alloy 7475 sheet is available as bare and alclad in the T61 and T761 tempers. Plate is available in T651, T7651 and T7351 tempers. Alcoa guarantees a minimum fracture toughness level along with standard minimum tensile properties for alloy 7475 plate and sheet products in all available temper conditions except "O".

## APPLICATIONS

Alloy 7475 plate and sheet is currently being specified for fracture critical components of high performance aircraft...applications where high fracture toughness is a major design consideration. It should be considered for fuselage skins, wing skins, wing spars and fuselage bulkheads.

### CHEMICAL COMPOSITION LIMITS (WT. %)

|              | Alloy 7475 | Alloy 7075 | Alloy 7475              | Alloy 7075 |
|--------------|------------|------------|-------------------------|------------|
| Si . . . . . | 0.10       | 0.40       | Zn . . . . .            | 5.2-6.2    |
| Fe . . . . . | 0.12       | 0.50       | Ti . . . . .            | 0.06       |
| Cu . . . . . | 1.2-1.9    | 1.2-2.0    | Others, each . . . . .  | 0.05       |
| Mn . . . . . | 0.06       | 0.30       | Others, total . . . . . | 0.15       |
| Mg . . . . . | 1.9-2.6    | 2.1-2.9    | Aluminum . . . . .      | Remainder  |
| Cr . . . . . | 0.18-0.25  | 0.18-0.28  |                         | Remainder  |

Note: Value maximum if range not shown.

## MECHANICAL PROPERTIES

### 7475 PLATE AND SHEET (ALL GAUGES NOT SHOWN) GUARANTEED MINIMUM LONG TRANSVERSE MECHANICAL PROPERTIES.

#### PLATE 7475-T651

| Thickness: in.<br>(mm)      | 0.250-0.499<br>(6.35-12.675) | 1.001-1.500<br>(25.425-38.10) |
|-----------------------------|------------------------------|-------------------------------|
| Tensile Strength, ksi (MPa) | 78 (538)                     | 78 (538)                      |
| Yield Strength, ksi (MPa)   | 67 (462)                     | 68 (469)                      |
| Elongation, %               | 10                           | 9                             |

#### 7475-T7351

| Thickness: in.<br>(mm)      | 1.001-1.500<br>(25.43-38.10) | 2.001-2.500<br>(50.83-63.50) | 3.001-3.500<br>(76.25-88.90) |
|-----------------------------|------------------------------|------------------------------|------------------------------|
| Tensile Strength, ksi (MPa) | 71 (490)                     | 69 (476)                     | 65 (448)                     |
| Yield Strength, ksi (MPa)   | 60 (414)                     | 57 (393)                     | 53 (365)                     |
| Elongation, %               | 9                            | 8                            | 8                            |

**BARE AND ALCLAD SHEET  
7475-T61**

| Thickness: in.<br>(mm)      | Bare                         | Alclad                     |
|-----------------------------|------------------------------|----------------------------|
|                             | 0.040-0.249<br>(1.016-6.325) | 0.063-0.187<br>(1.60-4.75) |
| Tensile Strength, ksi (MPa) | 75 (517)                     | 70 (485)                   |
| Yield Strength, ksi (MPa)   | 64 (441)                     | 60 (415)                   |
| Elongation, %               | 9                            | 9                          |

**7475-T761**

| Thickness: in.<br>(mm)      | Bare                         | Alclad                     |
|-----------------------------|------------------------------|----------------------------|
|                             | 0.040-0.249<br>(1.016-6.325) | 0.063-0.187<br>(1.60-4.75) |
| Tensile Strength, ksi (MPa) | 71 (490)                     | 67 (462)                   |
| Yield Strength, ksi (MPa)   | 60 (414)                     | 56 (386)                   |
| Elongation, %               | 9                            | 9                          |

**FRACTURE TOUGHNESS - 7475 PLATE**

7475 plate provides a significantly higher level of fracture toughness than alloy 7075 in comparable tempers; ie. T651, T7651 and T7351 tempers. This toughness/strength relationship is superior to that of other high-strength aerospace aluminum alloys.

**TYPICAL FRACTURE TOUGHNESS VALUES (ALLOY 7075 SHOWN FOR COMPARISON.)**

| Alloy  | Temper | $K_{IC}$ :ksi $\sqrt{in.}$ (MPa $\sqrt{m}$ )* |           |
|--------|--------|---|-----------|
|        |        | L-T   | T-L       |
| 7475   | T651   | 42 (46.0)                                     | 37 (41.0) |
|        | T7351  | 50 (55.0)                                     | 41 (45.0) |
| 7075** | T651   | 26 (28.6)                                     | 22 (24.2) |
|        | T7351  | 30 (32.0)                                     | 26 (28.6) |

\*\*These alloys/products do not have guaranteed minimum fracture toughness values.

**GUARANTEED MINIMUM FRACTURE TOUGHNESS VALUES**

| Temper | Thickness                            | $K_{IC}$ :ksi $\sqrt{in.}$ (MPa $\sqrt{m}$ )* |             |
|--------|--------------------------------------|---|-------------|
|        |                                      | L-T   | T-L         |
| T651   | 1.250-1.500 in.<br>(31.75-38.10 mm)  | 30.0 (33.0)                                   | 28.0 (30.8) |
| T7351  | 1.250-4.000 in.<br>(31.75-101.60 mm) | 40.0 (44.0)                                   | 33.0 (36.3) |

\*Compact specimen (ASTM E399)

## FRACTURE TOUGHNESS - 7475 SHEET

Alloy 7475 sheet is available bare or alclad in the T61 and T761 tempers. Bare and alclad 7475-T761 sheet has been the preferred sheet product for aerospace applications because of its resistance to general and exfoliation corrosion combined with higher toughness in comparison with bare and alclad 7475-T61 sheet. On the basis of tensile yield strength, 7475 sheet offers a significantly better combination of strength and toughness than either 2024-T3 or 7075-T6.

### GUARANTEED MINIMUM FRACTURE TOUGHNESS VALUES

| Temper                | Thickness                         | $K_{Ic}$ :ksi $\sqrt{in.}$ (MPa $\sqrt{m}$ )*<br>T-L | Temper                 | Thickness                         | $K_{Ic}$ :ksi $\sqrt{in.}$ (MPa $\sqrt{m}$ )*<br>T-L |
|-----------------------|-----------------------------------|--|------------------------|-----------------------------------|--|
| <b>T61<br/>bare</b>   | 0.040-0.125 in.<br>(1.02-3.18 mm) | 75.0 (82.4)  | <b>T761<br/>bare</b>   | 0.040-0.125 in.<br>(1.02-3.18 mm) | 87.0 (95.6)  |
|                       | 0.126-0.249 in.<br>(3.20-6.32 mm) | 60.0 (65.9)  |                        | 0.126-0.249 in.<br>(3.20-6.32 mm) | 80.0 (87.9)  |
| <b>T61<br/>alclad</b> | 0.040-0.125 in.<br>(1.02-3.18 mm) | 75.0 (82.4)  | <b>T761<br/>alclad</b> | 0.040-0.125 in.<br>(1.02-3.18 mm) | 87.0 (95.6)  |
|                       | 0.126-0.249 in.<br>(3.20-6.32 mm) | 60.0 (65.9)  |                        | 0.126-0.249 in.<br>(3.20-6.32 mm) | 80.0 (87.9)  |

\*K<sub>c</sub>-16 in. (406.4 mm) x 44 in. (1117.6 mm) center cracked panels (ASTM Method B646-78)

## FATIGUE AND FATIGUE CRACK PROPAGATION PROPERTIES

The fatigue strength of 7475 sheet and plate products is similar to those of 7075 in comparable tempers. Alcoa has conducted extensive constant amplitude fatigue crack growth rate tests on 7475 sheet and plate products in various environments. At near threshold regime, 7475-T651 has a lower rate of fatigue crack propagation than 7475-T7351. At higher stress intensities, 7475-T7351 has a lower rate of fatigue crack propagation compared with 7475-T651. The fatigue crack propagation rates of 7475-T7351 and 2024-T351 plate are similar.

Fatigue crack growth behavior under spectrum loading is becoming increasingly important in the selection of alloys for fatigue critical aircraft structures. Based on a specific fighter aircraft load spectra, 7475 had superior fatigue crack growth resistance in comparison with 7050 and 7075 in comparable tempers.

## CORROSION RESISTANCE

Based on similar tempers, the overall corrosion resistance of 7475 is essentially the same as that of 7075 where atmospheric weathering, exfoliation and stress corrosion cracking are involved.

7475-T7351 is recommended for optimum resistance to stress corrosion cracking.

7475-T7651 was developed to provide a high degree of resistance to exfoliation corrosion attack and also improved resistance to stress-corrosion cracking at strength levels only slightly lower than the T651 temper.

## THERMAL TREATMENTS

Alcoa has developed special heat treating practices to optimize the strength and fracture toughness of 7475 sheet and plate products. In situations where forming may be required in the “O” or “W” condition, Alcoa will provide recommended procedures for solution heat treatment and artificial aging of Alcoa-produced 7475 sheet and plate.

### PROCUREMENT SPECIFICATIONS

#### Plate

| Temper     | Specification | MIL-HDBK-5D |
|------------|---------------|-------------|
|            |               | Coverage    |
| 7475-T651  | AMS 4090B     | Approved    |
| 7475-T7651 | AMS 4089B     | Approved    |
| 7475-T7351 | AMS 4202C     | Approved    |

#### Bare Sheet

| Temper    | Specification | MIL-HDBK-5D |
|-----------|---------------|-------------|
|           |               | Coverage    |
| 7475-T61  | AMS 4084C     | Approved    |
| 7475-T761 | AMS 4085B     | Approved    |

#### Alclad Sheet

| Temper    | Specification | MIL-HDBK-5D |
|-----------|---------------|-------------|
|           |               | Coverage    |
| 7475-T61  | AMS 4207A     | Approved    |
| 7475-T761 | AMS 4100A     | Approved    |

## OTHER PRODUCT FORMS

Alloy 7175 is the companion controlled toughness alloy for extrusions and forgings.

### References:

1. Alcoa Green Letter No. 216
2. The Aluminum Association, *Position on Fracture Toughness Requirements and Quality Control Testing T-5*
3. MIL-H-6088, *Heat Treatment of Aluminum Alloys*



PRODUCT SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

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