

**MECHANICAL PROPERTIES MEASUREMENT AFTER THERMAL PROCESSING OF
ALUMINUM ALLOY SHEET****Application**

This procedure describes the method for measuring the thermal response in heat-treatable aluminum sheet alloys. The thermal response indices that are measured using this procedure include: T52, T72, T73, T81, T82, Long Term Exposure Thermal Treatment (LTE), Long Term Thermal Stability (LTTS), and Minimum Retained Ductility after paint (MRD).

Significance and Use

Common to manufacturing operations, aluminum heat treatable alloys undergo significant changes in mechanical properties during thermal exposure. Tensile testing provides information on the strength and ductility of materials under uniaxial tensile stresses. This information may be useful in comparisons of materials, alloy development, quality control, and design under certain circumstances.

Applicable materials

Heat treatable aluminum sheet alloys in a thickness range of 0.5 mm to 4.0 mm.

Applicable Documents

ASTM Standard B557 – "Standard Test Methods for Tension Testing Wrought and Cast Aluminum Products"

ASTM Standard B918 – "Standard Practice for Heat Treatment of Wrought Aluminum Alloys"

Conflicts

In the event of a conflict between the text of this method and the references cited herein, the text of this method shall take precedence.

Definitions

Yield Strength (YS): 0.2% offset yield stress.

Ultimate Tensile Strength (UTS): maximum tensile stress (engineering)

Uniform Elongation (UE): % elongation at maximum load

Total Elongation (TE): % elongation at fracture

Longitudinal Orientation (L): Tensile axis parallel to rolling direction

Transverse Orientation (T): Tensile axis perpendicular to rolling direction

Diagonal Orientation (D): Tensile axis 45 degrees to rolling direction

Date	Action	Revisions	Rev. 4
2016 04 24	Revised	Added T73 Thermal Treatment	C. Mracna, NA
2015 06 12	Revised	See Summary of Revisions	C. Mracna, NA
2013 11 20	Released		C. Mracna, NA

**T52 Thermal Treatment:**

1. 530°C (± 5) peak metal temperature for a minimum of 45 minutes with overall furnace exposure not to exceed 180 minutes
2. Quench Delay: 15 seconds max
3. Air Quench: Air quench metal at a rate of 10°C/s (± 2) from a minimum metal temperature of 500°C to below 50°C using forced air having a temperature of 25°C (± 5). The quench rate shall be calculated using a linear curve fit of at least 4 time-temperature data points between 475°C to 290°C.
4. Natural Age: Exposure to ambient temperature not to exceed 24 hours
5. Artificial Age: 246°C (± 5) peak metal temperature for a minimum of 45 minutes with overall oven exposure not to exceed 1 hour

T72 Thermal Treatment:

1. 530°C (± 5) peak metal temperature for a minimum of 45 minutes with overall furnace exposure not to exceed 180 minutes
2. Quench Delay: 17 seconds max
3. Immersion Water Quench: 55°C (-5, +10) peak water temperature for a minimum of 10 minutes
4. Natural Age: Exposure to ambient temperature not to exceed 24 hours
5. Artificial Age: 230°C (± 5) peak metal temperature for a minimum of 5 hours with overall oven exposure not to exceed 6 hours

T73 Thermal Treatment:

1. 508°C (± 5) peak metal temperature for a minimum of 45 minutes with overall furnace exposure not to exceed 180 minutes
2. Quench Delay: 17 seconds max
3. Immersion Water Quench: 88°C (-5, +10) peak water temperature for a minimum of 10 minutes
4. Natural Age: Exposure to ambient temperature not to exceed 24 hours
5. Artificial Age: 225°C (± 5) peak metal temperature for a minimum of 5 hours with overall oven exposure not to exceed 6 hours

T81 Thermal Treatment: 180 °C (± 2) peak metal temperature for 20 (± 1) minutes with overall furnace exposure not to exceed 30 minutes.

T81 Thermal Treatment + 2% Strain:

1. Pre-strain: Apply 2% pre-strain to tensile coupons within a tensile machine using an axial extensometer.
2. T81 Heat Treatment: see above

T82 Thermal Treatment: 225 °C (± 2) peak metal temperature for 30 (± 1) minutes with overall furnace exposure not to exceed 45 minutes.

Long-Term Exposure (LTE) Thermal Treatment: 100 °C (± 2) peak metal temperature for 2000 (± 24) hours.

Long-Term Thermal Stability after T81 (LTTS-T81): the change in yield stress due to the LTE thermal heat treatment in material that has been subjected to the T81 thermal treatment.

Minimum Retained Ductility after T81 heat treatment (MRD-T81): the total elongation measured after the T81 thermal treatment.

Minimum Retained Ductility after T82 heat treatment (MRD-T82): the total elongation measured after the prescribed T82 and T81 thermal treatments performed sequentially.