

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

This procedure describes the method for measuring the thermal response in heat-treatable aluminum extrusion alloys. The thermal response indices that are measured using this procedure include: T81, T6, Minimum Retained Ductility after paint (MRD) and Long Term Thermal Stability (LTTS).

**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 extrusion alloys in a thickness range of 1.0 mm to 6.0 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 extrusion direction

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

T6 Thermal Treatment: 180 °C (+/- 2) peak metal temperature for 300 (+/- 5) minutes with overall furnace exposure not to exceed 400 minutes.

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

Long-Term Thermal Stability after T81 (LTTS-BH): 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.

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Minimum Retained Ductility after T6 heat treatment (MRD-T6): the total elongation measured after the prescribed T6 thermal treatment.

### Apparatus Required

#### Load Frame

Testing machines used for tension testing shall conform to the requirements of ASTM B557. The forces used in determining yield stress shall be within the verified force application range of the testing machine. Extensometers or digital image correlation techniques shall be used and verified to include all relevant strain information.

#### Heat Treatment Ovens

Heat treatments are to be conducted according to ASTM Standard B918 within an air chamber furnace. Thermal exposures are dictated by the above mentioned definitions.

#### Preparation of Material

#### Test Specimen Dimensions

Rectangular tensile test specimens are to have geometry described in ASTM B557 and in each of the L orientation.

#### Test Specimen Preparation

Specimens may be fabricated with a standard milling machine or by electrical discharge machining (EDM). The milling machine may cause small imperfections on the edge of the specimen that must be filed down with 300 grit (or finer) sand paper for a smoother more uniform edge.

#### Conditioning and Test Conditions

All test values indicated herein are based on material conditioned in a controlled atmosphere of 23 +/- 2 °C and 50% relative humidity for not less than 24 h prior to testing and tested under the same conditions unless otherwise specified.

#### Procedure

#### Quality Assurance Requirements

Unless otherwise specified, the users of this procedure are responsible for all inspection and the test requirements specified herein, and may use internal testing facilities provided they meet the requirements of this procedure and any other test agencies acceptable to Ford Motor Company.

#### Sampling

Testing is conducted in the longitudinal (L) direction with a minimum of three (3) specimens per thermal treatment condition. Average data and calculate standard deviation. Reference Supplemental Data Reporting Package (Table 1) for data entry.

#### Procedure

Heat treatments are to be performed in a calibrated oven with thermocouples attached to sample material to ensure correct thermal exposure times. Tensile testing is to be performed in accordance with ASTM B557.