REGISTRATION RECORD SERIES

Tempers For Aluminum And Aluminum Alloy Products

The Aluminum Association

1525 Wilson Boulevard, Suite 600, Arlington, VA 22209
www.aluminum.org

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FOREWORD

Listed in this booklet are the tempers for aluminum and aluminum alloy products registered with The Aluminum Association but not contained in The Association's *Aluminum Standards and Data*.

Some of the registered tempers may be the subject of U.S. patents or patent applications, and their listing herein is not to be construed in any way as the granting of a license under such patent rights.

Tempers for wrought products are given on pages 1–30 and for castings on page 31. Inactive alloys and tempers are listed on pages 34–41.

An explanation for The Aluminum Association's "Temper Designation System" is given in the *Aluminum Standards and Data* and in the American National Standard ANSI H35.1/H35.1(M).

All new tempers registered since the previous issue as well as revisions to the prior registrations are marked and defined. In addition, the registration column also includes a revision date to denote the latest revision to the registered information.

July, 2011

TEMPER REGISTRATION

When any aluminum or aluminum alloy material is produced in a temper not previously applied to that material, the temper, along with the alloy designation and product form to which it applies, may be registered with The Aluminum Association.

PROCEDURE FOR INDIVIDUAL REGISTRATION OF TEMPERS

1. Any person, firm or corporation may apply to The Aluminum Association to register a new temper.

2. Selection of the temper designation usually is left to the discretion of the Technical Committee on Product Standards, but consideration will be given to the applicant's choice when circumstances so warrant.

3. The temper is registered when, in the opinion of the Technical Committee on Product Standards, it is judged to be technically correct and complete with respect to the following:

   3.a. The temper designation conforms to ANSI H35.1 "Alloy and Temper Designation Systems for Aluminum" (reprinted in The Aluminum Association manual Aluminum Standards and Data).

   3.b. The material is offered for sale in the proposed temper and is available for use by more than one user.

   3.c. The mechanical property limits applicable to the temper are included. (Limits are shown as tentative unless established in accordance with the data base criteria outlined under "Mechanical Properties" in Section 6, "Standards Section" of Aluminum Standards and Data).

      3.c.1. The following procedure describes a method to register 6xxx and some 7xxx in -T3, -T4, -T6, -T7, -T8 and -T9 Tempers, when the temper being registered is normally produced using extrusion press solution heat treatment, rolling mill solution heat treatment or forging press solution heat treatment.

         3.c.1.1. Collect 100 samples minimum from at least 5 different cast lots and 10 different heat treat lots of extrusion press solution heat treated, rolling mill solution heat treated or forging press solution heat treated material. No more than 10 tests from a given heat treat lot shall be included in the data analysis. Stretch, cold work, straighten or otherwise finish the material as described in Aluminum Standards and Data Section 1, Alloy and Temper Designation System for Aluminum (ANSI H35.1), Paragraph 4.2.2, for the temper being registered. Then either naturally age (T3 and T4) or artificially age (T6, T7, T8, and T9) the material before sampling and tensile testing per ASTM B 557. Statistically analyze the data for Ultimate Tensile Strength, Yield Strength, and Elongation, and report the minimum values for each at which at least 99 percent of the material is expected to conform at a confidence level of 0.95.

            3.c.1.1.1. The 100 tests shall include samples which span the thickness range(s) to be registered, including samples from the thinnest section or diameter, the thickest section or diameter and, if appropriate, intermediate sections or diameters. There shall be a minimum of 30 tests for each thickness range to be registered.

         3.c.1.2. Collect 30 samples minimum from at least 3 different cast lots of material extruded, rolled or forged and solution heat treated in a production or commercial furnace. Stretch, cold work, straighten or otherwise finish the material as described in Aluminum Standards and Data Section 1, Alloy and Temper Designation System for Aluminum (ANSI H35.1), Paragraph 4.2.2, for the temper being registered. Then either naturally age (T3 and T4) or artificially age (T6, T7, T8, and T9) the material before sampling and tensile testing per ASTM B 557. Statistically analyze the data for Ultimate Tensile Strength, Yield Strength, and Elongation, and report the minimum values for each at which at least 99 percent of the material is expected to conform at a confidence level of 0.95.

3.c.1.2.1. The 30 tests may include samples from one or multiple gauge thickness.

3.c.1.3. The registering entity shall report all calculated minimum values to the Technical Committee on Product Standards, along with the minimum limits the registering entity wishes to register.

3.c.1.4. The Technical Committee on Product Standards will then review the temper based on the proposed minimum limits of the registering entity, provided the minimum limits are not larger than the minimum values calculated in steps 3.c.1.1 and 3.c.1.2 of this procedure.

3.c.1.5. Tempers registered using this procedure shall carry the following note in the Remarks column: “The registered properties for this material are calculated in accordance with the procedure described under 3.c.1 on page ii of this document”.

3.c.2. Tentative Limit Registration

3.c.2.1. Tentative limits are temporary in nature and are established to allow the producer to manufacture and sell the product while continuing to collect data. Tentative temper designations shall be reviewed every 2 years for possible resolution of the tentative status.

3.c.2.2. The mechanical property limits defined as tentative are established at levels at which at least 99% of the data conform at a confidence level of 95%. The limited number of observations required for a tentative registration may not represent the property distribution that is expected due to random variation within the manufacturing practice and may not have a normal distribution.

3.c.2.3. For heat treatable alloys, tentative limits are based on the results of a minimum of 30 tests from at least 3 cast lots and at least 3 heat treat lots of material. For non heat treatable alloys, tentative limits are based on the results of a minimum of 30 tests from at least 3 cast lots of material that have separately passed through subsequent processing operations as at least 3 fabricated inspection lots.

3.c.2.4. For heat treatable and non heat treatable alloys, the 30 tests shall include observations from all gauge ranges. Multiple ranges can be proposed when there are at least 10 tests from each gauge range or by using regression analysis of the 30 tests.

3.c.2.5. Tentative limits for 6xxx and some 7xxx in -T3, -T4, -T6, -T7, -T8 and -T9 Tempers, when the temper being registered is normally produced using extrusion press solution heat treatment, rolling mill solution heat treatment or forging press solution heat treatment (see 3.c.1), are based on the results of a minimum of 30 tests from at least 3 cast lots and at least 3 heat treat lots of material processed as described in 3.c.1.1 and a minimum of 30 tests from at least 3 cast lots and at least 3 heat treat lots of material processed as described in 3.c.1.2.

3.c.2.5.1. The 30 tests from the material processed as described in 3.c.1.1 shall include samples which span the thickness range(s) to be registered, including samples from the thinnest section or diameter, the thickest section or diameter and, if appropriate, intermediate sections or diameters. There shall be a minimum of 10 tests for each thickness range to be registered.

3.c.2.5.2. The 30 tests from material processed as described in 3.c.1.2 may be from one or multiple gauge thickness.

TEMPER REGISTRATION (continued)

3.d. The following additional information is included when characteristics, in addition to mechanical properties, are specified for the temper:

3.d.1. Test methods by which conformance with the requirements for specified characteristics can be evaluated, OR

3.d.2. Details of the practice to be followed in producing the temper.

3.e. When not already registered, the minimum tensile strength limit applicable to the O temper shall accompany the request for registration of H tempers.

3.e.1. If the annealed product is not offered for sale and the O temper limits that accompany an H temper registration are based on material annealed in standard production furnaces, the description provided in the Remarks column of the registration shall state “O temper not offered for sale but used as basis for H temper registration.”

3.e.2. If the annealed product is not offered for sale, the O temper limits can be measured on laboratory annealed materials. These limits shall be designated as O2 and the description provided in the Remarks column of the registration shall state “O temper not offered for sale. O2 temper used as basis for H temper registration.”

3.e.3. When the O temper or O2 temper limits are based on the requirements of a tentative registration, the O or O2 limits will be shown as tentative. However, O or O2 temper tentative limits, which are noted as not being offered for sale, shall not be subject to the two year review.

3.f. The indication of a variation in treatment of a basic T temper is limited to one additional digit (excluding zero) unless all available digits have been used, and except as provided for in the Appendix to ANSI H35.1.

3.g. A description of the process variation or the product characteristics of the registration shall be provided when an additional digit, beyond those defined, is requested.

TEMPER REGISTRATION (continued)

PROCEDURES FOR ALUMINUM ASSOCIATION TECHNICAL DIVISION (AATD) REGISTRATION OF TEMPERS

A temper for an aluminum alloy material may be registered as an AATD temper when, through formal ballot of the Technical Committee on Product Standards, all the following requirements are met:

1. The material is offered for sale in the proposed temper and gauges(s) by more than one producer.

2. The material meets all the requirements listed in the *Procedure for Individual Registration of Tempers* section of this document.

3. The temper is not being applied to an alloy designated as experimental (with prefix "X").

4. The temper is not registered with a tentative status.

REQUIREMENTS FOR PROPOSED CHANGES TO REGISTERED TEMPERS

Proposed changes to a registered designation's mechanical properties and/or characteristics:

1. Require approval by formal ballot of the Technical Committee on Product Standards for registered tempers having "minimum" and/or "maximum" mechanical property limits.

2. Require a 30-day review by the Technical Committee on Product Standards for registered tempers having "tentative" mechanical property limits, or tempers applied to experimental alloys (with prefix "X"). The registrant has the final authority to change the temper limits, provided the change complies with item 3 under Individual Registration of Tempers. Changes proposed by others than the registrant are acceptable only with the approval of the registrant.

REQUIREMENTS FOR DELETION OF TEMPERS FROM THE REGISTRATION LIST

1. When any alloy is removed from the active alloy registration list, all tempers applicable to that alloy are automatically removed from the active temper registration list.

2. Approval of the Technical Committee on Product Standards through formal ballot is required to effect deletion of any registered temper from the active registration list, except as provided by the preceding sentence.