The Aluminum Association Alloy and Temper System

Presented by:

John Weritz, Vice President, Standards & Technology
February 24, 2016

ALUMINUM ASSOCIATION

ALLOY TEMPER DESIGNATION SYSTEM

John Weritz – The Aluminum Association
Ladan Bulookbashi – The Aluminum Association
Francesca Licari – The Aluminum Association
WHO WE ARE

The Aluminum Association

- 80-Year Old Trade Association
- Originally created in response to an Act of Congress in 1933
- Represent $65B + U.S. Aluminum Industry
- Promote Aluminum as Most Sustainable Material in Today's Market
- 111 Member Companies
- U.S. and Foreign Primary Producers, Recyclers, Fabricators and Suppliers
**OUR ROLE**

Positioning the Metal

<table>
<thead>
<tr>
<th>Growing Aluminum’s Voice</th>
<th>Developing Key Research</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Enhancing Industry Safety</th>
<th>Essential Standards &amp; Business Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
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</tbody>
</table>
OUR MARKET

- Aerospace
- Aluminum Cans
- Automotive
- Building and Construction
- Electrical
- Electronics and Appliances
- Foil and Packaging
- Other markets
STANDARDS DEVELOPMENT

• ANSI approved registrar of aluminum alloys and tempers in North America

• Secretariat of the ANSI Accredited Standards Committee H35 on Aluminum and Aluminum Alloys
WROUGHT ALUMINUM ALLOYS

1954
- Designation system adopted in US

1957
- Became the national standard

1970
- Dec 15 - System officially adopted by the International Signatories of the Declaration of Accord
ALUMINUM DESIGNATION SYSTEM

75 ALUMINUM ALLOYS
IN 1954
531 REGISTERED ALLOYS
TODAY AND COUNTING
TEMPERS

1948
• Designation system took effect in the US

1962
• Adopted and included in ANSI H35.1
Aluminum products with specific properties and product forms are identified by specifying both an Alloy and a Temper.
UNDERSTANDING THE DESIGNATION SYSTEM

1xxx: Aluminum 99% and greater
2xxx: Copper
3xxx: Manganese
4xxx: Silicon
5xxx: Magnesium
6xxx: Magnesium and Silicon
7xxx: Zinc
8xxx: Other element
WROUGHT ALUMINUM ALLOYS

A system of four-digit numerical designations is used to identify wrought aluminum and wrought aluminum alloys.

The first digit $X_{xxx}$ indicates the alloy group as follows:

- 1xxx: Aluminum 99% and greater
- 2xxx: Copper
- 3xxx: Manganese
- 4xxx: Silicon
- 5xxx: Magnesium
- 6xxx: Magnesium and Silicon
- 7xxx: Zinc
- 8xxx: Other element
WROUGHT ALUMINUM

1xXX

Minimum aluminum percentage

Examples:

1100 99.00% minimum aluminum
1350 99.50% minimum aluminum
WROUGHT ALUMINUM

1Xxx

If zero
- Unalloyed aluminum having natural impurity limits

- Other than zero: Special control of one or more individual impurities
WROUGHT ALUMINUM ALLOYS

xxXX

- In 2xxx-8xxx: no special significance serve only to identify the different aluminum alloys in the group

Note 1: All alloys belonging to a family have the same two last digits
WROUGHT ALUMINUM ALLOYS

If zero
  In 2xxx-8xxx: original alloy of a family
Other than zero
  In 2xxx-8xxx: modifications of the original alloy
WROUGHT ALUMINUM ALLOYS

VARIATIONS OR MODIFICATIONS OF ORIGINAL ALLOYS

- Identified by a serial letter after the numerical designation
  - Serial letters are assigned in alphabetical sequence starting with A but omitting I, O and Q
WROUGHT ALUMINUM ALLOYS

www.aluminum.org/tealsheets
TEMPERS

BASIC TEMPER DESIGNATIONS

F  AS FABRICATED
O  ANNEALED
H  STRAIN HARDENED
W  SOLUTION HEAT-TREATED
T  THERMALLY TREATED
TEMPERS

H TEMPERS

1-4 Following H Indicate Specific Combination of Basic Operation

- **H1**: Strain-hardened only
- **H2**: Strain-hardened and partially annealed
- **H3**: Strain-hardened and stabilized
- **H4**: Strain-hardened and lacquered or painted
TEMPERS

H TEMPERS

H1X  H2X  H3X  H4X

• X Indicates the degree of strain-hardening as identified by the min. value of the ultimate tensile strength
• 8 signifies full hard temper (approx. 75% cold work)
TEMPERS

H TEMPERS

H1xX H2xX H3xX H4xX

• The third digit when used indicates a variation of a two digit temper

Examples:

• H321
• H116
• H128
### TEMPERS

#### T TEMPERS

1-10 Following T Indicate Specific Sequences Of Basic Treatments

<table>
<thead>
<tr>
<th>T1</th>
<th>Cooled from an elevated temp. shaping process &amp; naturally aged</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>Cooled from an elevated temp. shaping process, cold worked &amp; naturally aged</td>
</tr>
<tr>
<td>T3</td>
<td>Solution heat treated, cold worked &amp; naturally aged</td>
</tr>
<tr>
<td>T4</td>
<td>Solution heat treated &amp; naturally aged</td>
</tr>
<tr>
<td>T5</td>
<td>Cooled from an elevated temperature shaping process and then artificially aged</td>
</tr>
<tr>
<td>T6</td>
<td>Solution heat treated and then artificially aged</td>
</tr>
</tbody>
</table>
TEMPERS

T7 Solution Heat Treated And Then Artificially Aged
TEMPERS

T8
• Solution heat treated, cold worked and then artificially aged

T9
• Solution heat treated, artificially aged and then cold worked

T10
• Cooled from an elevated temp. shaping process, cold worked & artificially aged

9 See Footnote
# TEMPERS

<table>
<thead>
<tr>
<th>Stress Relieved By Stretching</th>
<th>Stress Relieved By Compressing</th>
<th>Stress Relieved by Combined Stretching &amp; Compressing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate</td>
<td>Profiles</td>
<td>Die Forgings</td>
</tr>
<tr>
<td>T_51</td>
<td>T_510</td>
<td>T_511</td>
</tr>
<tr>
<td>T_52</td>
<td>T_54</td>
<td></td>
</tr>
</tbody>
</table>

**Plate**

- T_51
- T_510
- T_511

**Profiles**

- T_52

**Forgings**

- T_54

**Die Forgings**
T_2 TEMPERS-
LAB TESTED CAPABILITY

➤ Temper Designations for Producer/Supplier
Laboratory Demonstration of Response to Heat Treatment

T42   Solution heat-treated from annealed or F temper and naturally aged to substantially stable condition.

T62   Solution heat-treated from annealed or F temper and artificially aged.

T7_2  Solution heat-treated from annealed or F temper and artificially overaged to meet the mechanical properties and corrosion resistance limits of the T7_ temper

➤ Temper Designations for Producer/Supplier
Demonstration of Response to Temper Conversion

T4 to T62   Capability Demonstration for response to aging

T4 to T7_2  Capability Demonstration for response to overaging
### Registration Request System

Please read the following eligibility requirements prior to applying for registration:

1. The wrought aluminum and wrought aluminum alloys shall be offered for sale currently and shall have been supplied in the previous 12 months, in both cases in commercial quantities;
2. The complete chemical composition limits of the proposed alloy must be disclosed and former designation, if any, should be shown;
3. The composition must be different from that of any registered alloy.

For detailed information on the registration rules and procedures, refer to the Declaration of Accord as an International Alloy Designation System for Wrought Aluminum and Wrought Aluminum Alloys and its “Recommendations”, as printed in the registration record. International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys (Text Alloys) of the Aluminum Association. This form is intended to assist applicants and reviewers of alloy registration requests. It is not intended to cover all registration requirements and additional information may be requested to complete the registration.

### Registration Form

<table>
<thead>
<tr>
<th>Element</th>
<th>Limits to Max. (unless shown as a Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn</td>
<td>1.80%</td>
</tr>
<tr>
<td>Si</td>
<td>0.10%</td>
</tr>
<tr>
<td>Mg</td>
<td>0.10%</td>
</tr>
<tr>
<td>Mn</td>
<td>0.10%</td>
</tr>
<tr>
<td>Fe</td>
<td>0.10%</td>
</tr>
<tr>
<td>Cu</td>
<td>0.10%</td>
</tr>
<tr>
<td>Other Aluminum</td>
<td>0.40%</td>
</tr>
<tr>
<td>Other Non-Metals</td>
<td>0.10%</td>
</tr>
</tbody>
</table>

Note: This form is intended to assist applicants and reviewers of alloy registration requests. It is not intended to cover all registration requirements and additional information may be requested to complete the registration.

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REGISTRATION PROCESS

Application

Sent to

Aluminum Association

Added to Registration Records

Reviewed by Technical Committee on Product Standards
Wrought alloy is identified by alloy-temp designations & product form

Internationally accepted alloy designation

Peer reviewed process

ANSI approved

Statistically derived values

Base for ASTM, AMS, AMMA & ASME standards

Allow designations not specifically defined in ANSI

Alloys in a group share common characteristics

ATTRIBUTES OF REGISTRATION SYSTEM
BENEFITS OF REGISTRATION SYSTEM

- Harmonized definitions internationally
- Clear path for evolution of new alloys/products
- Means to communicate to multiple suppliers
- Allows identifiability of products in a structure
- Chance to achieve recyclability goals
- Enhances scrap sorting and recyclability
- Facilitates a stable/reliable supply
- Promotes domestic and international commerce

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STANDARDS PUBLICATIONS

- www.aluminum.org/bookstore
THANK YOU
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February 24, 2016

THE ALUMINUM ASSOCIATION

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