Standard Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

1. Scope

1.1 These test methods cover the chemical analysis of aluminum and aluminum-base alloys having compositions within the following limits:

<table>
<thead>
<tr>
<th>Element</th>
<th>Upper Limit (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beryllium</td>
<td>100</td>
</tr>
<tr>
<td>Bismuth</td>
<td>1.0</td>
</tr>
<tr>
<td>Boron</td>
<td>0.060</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.50</td>
</tr>
<tr>
<td>Chromium</td>
<td>1.0</td>
</tr>
<tr>
<td>Copper</td>
<td>20.0</td>
</tr>
<tr>
<td>Gallium</td>
<td>0.05</td>
</tr>
<tr>
<td>Lead</td>
<td>1.0</td>
</tr>
<tr>
<td>Lithium</td>
<td>4.0</td>
</tr>
<tr>
<td>Magnesium</td>
<td>12.0</td>
</tr>
<tr>
<td>Nickel</td>
<td>4.0</td>
</tr>
<tr>
<td>Silicon</td>
<td>20.0</td>
</tr>
<tr>
<td>Tin</td>
<td>1.0</td>
</tr>
<tr>
<td>Titanium</td>
<td>0.30</td>
</tr>
<tr>
<td>Vanadium</td>
<td>0.16</td>
</tr>
<tr>
<td>Zinc</td>
<td>12.0</td>
</tr>
<tr>
<td>Zirconium</td>
<td>0.30</td>
</tr>
</tbody>
</table>

1.2 The analytical procedures appear in the following sections:

- **Beryllium**: Beryllium by Argon Plasma Optical Emission Spectroscopy
  - Procedure Sections: 283 to 292
- **Bismuth**: Bismuth by the Morin (Fluorometric) Test Method
  - Procedure Sections: 1a
- **Boron**: Boron by the Carmine (Photometric) Test Method
  - Procedure Sections: 1a

2. Procedure

- **Beryllium**: Beryllium by Argon Plasma Optical Emission Spectroscopy
- **Bismuth**: Bismuth by the Morin (Fluorometric) Test Method
- **Boron**: Boron by the Carmine (Photometric) Test Method

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1 These test methods are under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and are the direct responsibility of Subcommittee E01.04 on Aluminum and Magnesium. Current edition approved July 1, 2011. Published August 2011. Originally published as E34 – 60 T. Last previous edition E34 – 94 (Reapproved 2002).

1a Discontinued as of Feb. 25, 1983.
1b Discontinued as of May 29, 1981.
1e Discontinued as of July 1, 2011. DOI: 10.1520/E0034-11.
Silicon by the Molybdosilicic Acid (Photometric) Test Method
Silicon by the Sodium Hydroxide-Perchloric Acid (Gravimetric) Method

Tin:
Tin by the Iodate (Titrimetric) Test Method

Titanium:
Titanium by the Chromotropic Acid (Photometric) Test Method
Titanium by the Diantipyrylmethane Photometric Test Method

Vanadium:
Vanadium by an Extraction-Photometric Test Method using N-Benzoyl-N-Phenylhydroxylamine

Zinc:
Zinc by the Ammonium Mercuric Thiocyanate or the Zinc Oxide (Gravimetric) Test Method
Zinc by the Ethylenediamine Tetraacetate (Titrimetric) Test Method
Copper and Zinc by the Atomic Absorption Spectrometry Test Method
Zinc by the Ion Exchange-EDTA Titrimetric Test Method

Zirconium:
Zirconium by the Arsenazo III (Photometric) Method

1.3 The values stated in SI units are to be regarded as the standard.

1.4 This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Specific hazard statements are given throughout these test methods.

2. Referenced Documents

2.1 ASTM Standards:
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition
E60 Practice for Analysis of Metals, Ores, and Related Materials by Spectrophotometry
E88 Practice for Sampling Nonferrous Metals and Alloys in Cast Form for Determination of Chemical Composition
E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials
E173 Practice for Conducting Interlaboratory Studies of Methods for Chemical Analysis of Metals
E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis
E1024 Guide for Chemical Analysis of Metals and Metal Bearing Ores by Flame Atomic Absorption Spectrophotometry
E1479 Practice for Describing and Specifying Inductively-Coupled Plasma Atomic Emission Spectrometers

E1601 Practice for Conducting an Interlaboratory Study to Evaluate the Performance of an Analytical Method

3. Terminology

3.1 Definitions—For definitions of terms used in this test method, refer to Terminology E135.

4. Significance and Use

4.1 These test methods for the chemical analysis of metals and alloys are primarily intended to test such materials for compliance with compositional specifications. It is assumed that all who use these test methods will be trained analysts capable of performing common laboratory procedures skillfully and safely. It is expected that work will be performed in a properly equipped laboratory.

5. Apparatus, Reagents, and Photometric Practice

5.1 Apparatus and reagents required for each determination are listed in separate sections preceding the procedure.
5.2 Photometric practice prescribed in these test methods shall conform to Practice E60.
5.3 Calculated values shall be rounded to the desired number of places in accordance with the rounding method of Practice E29.

FIG. 1 Type A and Type B Disks

NOTE 1—Shaded areas are suitable for sampling.
6. Precautions

6.1 For precautions to be observed in the use of certain reagents in these test methods, reference shall be made to Practices E50.

7. Sampling

7.1 Wrought products shall be sampled in accordance with Practice E55. Cast products shall be sampled in accordance with Practice E88.

7.2 Chill cast disks produced for analysis by spectrochemical methods (see Practices E716) shall be sampled by drilling or milling through the entire thickness. Drill bits or milling cutters should be carbide to avoid iron contamination.

Note 1—The use of a machined disk may result in the exclusion of an element-rich portion of the sample. This practice should be avoided wherever possible, especially for analyses affecting product acceptance.

7.2.1 If samples are produced by drilling, use a minimum of two positions approximately opposite each other and combine the drillings.

7.2.2 The outer edges of the holes shall be approximately 0.48 cm (3/16 in.) from the edge of the disk. Drill bits shall be not less than 0.95 cm (3/8 in.) in diameter and not larger than 1.27 cm (1/2 in.) in diameter.6

7.2.3 If samples are produced by milling, mill disks at similar points to a distance of 40 % of the sample diameter or other methods that provide a representative sample such as quarter of half milling. A 0.95-cm (3/8 in.) milling cutter has been shown to provide acceptable chips.6

7.2.4 Center pour (Type B, Practices E716) and vacuum cast disks may be sampled around the entire circumference. Fig. 1 illustrates the areas suitable for sampling Type B disks. Vacuum cast disks are sampled in the same manner as Type B disks.6

7.2.5 Drilling or milling techniques ideally should produce uniformly small chips. Break large continuous pieces into smaller pieces 0.64 cm (1/4 in.) to 0.95 cm (3/8 in.) long. Drilling or milling techniques should minimize production of fine, dust-like material.6

BERYLLIUM BY THE MORIN (FLUOROMETRIC) TEST METHOD

(This test method, which consisted of Sections 8 through 19 of this standard, was discontinued in 2008.)

BISMUTH BY THE THIOUREA (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 20 through 29 of this standard, was discontinued in 1983.)

BORON BY THE CARMINE (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 30 through 38 of this standard, was discontinued in 2008.)

CHROMIUM BY THE DIPHENYL CARBAZIDE (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 39 through 47 of this standard, was discontinued in 2008.)

CHROMIUM BY THE PERSULFATE OXIDATION (TITRIMETRIC) TEST METHOD

(This test method, which consisted of Sections 48 through 53 of this standard, was discontinued in 1981.)

COPPER BY THE NEOCUPROINE (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 54 through 63 of this standard, was discontinued in 1983.)

COPPER AND LEAD BY THE ELECTROLYTIC (GRAVIMETRIC) TEST METHOD

(This test method, which consisted of Sections 64 through 72 of this standard, was discontinued in 1985.)

IRON BY THE 1,10-PHENANTHROLINE (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 73 through 81 of this standard, was discontinued in 2008.)

MAGNESIUM BY THE PYROPHOSPHATE (GRAVIMETRIC) TEST METHOD

(This test method, which consisted of Sections 82 through 87 of this standard, was discontinued in 1981.)

MAGNESIUM BY THE ETHYLENEDIAMINE TETRAACETATE (TITRIMETRIC) TEST METHOD

(This test method, which consisted of Sections 88 through 93 of this standard, was discontinued in 2008.)

MANGANESE BY THE PERIODATE (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 94 through 102 of this standard, was replaced in 1984 by Sections 293 through 302.)

NICKEL BY THE DIMETHYLGLYOXIME (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 103 through 111 of this standard, was discontinued in 1983.)

NICKEL BY THE DIMETHYLGLYOXIME (GRAVIMETRIC) TEST METHOD

(This test method, which consisted of Sections 112 through 117 of this standard, was discontinued in 1981.)

SILICON BY THE MOLYBDISILIC ACID (PHOTOMETRIC) TEST METHOD

(This test method, which consisted of Sections 118 through 127 of this standard, was discontinued in 2008.)