Designation: E716 – 16 (Reapproved 2021)ε2

Standard Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spark Atomic Emission Spectrometry[1]

This standard is issued under the fixed designation E716; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—An editorial change was made to 8.3 in January 2022.
ε[2] NOTE—An editorial change was made to 6.2.1 in September 2022.

1. Scope*

1.1 These practices describe procedures for producing a chill cast disk sample from molten aluminum during the production process, and from molten metal produced by melting pieces cut from products.

1.2 These practices describe a procedure for obtaining qualitative results by direct analysis of product using spark atomic emission spectrometry.

1.3 These practices describe procedures for preparation of samples and products prior to analysis.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in 6.1 and 7.2.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B985 Practice for Sampling Aluminum Ingots, Billets, Castings and Finished or Semi-Finished Wrought Aluminum Products for Compositional Analysis

E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials

E401 Practice for Bonding Thin Spectrochemical Samples and Standards to a Greater Mass of Material (Withdrawn 1995)[3]

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)[3]

E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry

3. Terminology

3.1 For definitions of terms used in this practice, refer to Terminology E135.

4. Summary of Practices

4.1 Molten metal representative of the furnace melt is poured or drawn by vacuum into a specified mold to produce a chill-cast disk. The disk is machined to a specified depth that represents the average composition and produces an acceptable surface for analysis by spark atomic emission spectrometry.

[1] These practices 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.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

4.2 Pieces of solid aluminum fabricated, cast, or wrought products are remelted and cast into molds or briquetted then remelted and cast into molds.

4.3 Product can be qualitatively analyzed directly without remelting after suitable surface preparation. Product with insufficient mass for direct analysis may be bonded to more massive material prior to analysis.

4.4 Special practices are included for the sampling and analysis of aluminum-silicon alloys, containing greater than 14 % silicon.

5. Significance and Use

5.1 The practice for taking a sample of molten metal during production and producing a chill cast disk, used in conjunction with the following appropriate quantitative spark atomic emission spectrochemical methods, Test Methods E607 and E1251, is suitable for use in manufacturing control or certifying, or both, that the entire lot of alloy sampled meets established composition limits.

5.2 The practice for melting a piece of a product to produce a chill cast disk analyzed in conjunction with the following appropriate quantitative spark atomic emission spectrochemical methods, Test Methods E607 and E1251, is suitable, if a representative sample is taken, for determining if the piece sampled meets Aluminum Association composition limits.

5.3 The practice for direct analysis of product is suitable for determining an approximate composition of the piece analyzed.

6. Apparatus

6.1 *Ladle,* capable of holding a minimum of 250 g (8.8 oz) of molten metal, with a handle of sufficient length to reach into a furnace, trough, or crucible. The ladle should be lightly coated with a tightly adhering ladle wash that will serve in part to prevent contamination of the sample and also prevent contact of molten aluminum with metal oxides, that is, rust. (**Warning—**Traces of moisture in the coating may cause dangerous spattering.)

NOTE 1—A suitable ladle wash may be prepared as follows: Mix 255 g (9 oz) of fine whiting ($CaCO_3$) with 3.8 L (1 gal) of water and boil for 20 min. Add 127 g (4.5 oz) of sodium silicate solution (40 °Bé to 42 °Bé) and boil for 30 min. Stir well before using.

NOTE 2—Molten aluminum in contact with rust may initiate a thermite reaction.

6.2 *Sample Molds* shall be capable of producing homogenous chill-cast disks having smooth surfaces, free of surface pockets and porosity. These chill cast disks should have a spectrochemical response similar to the reference materials used in preparing the analytical curves and should at least have a spark to spark repeatability of no more than 2 % relative on major elements. They must be representative of the melt in the region excited. Several types of molds have been found acceptable:

6.2.1 *Type B Mold*[4] center-pour mold, is shown in Fig. 1. This mold produces a horizontally cast disk with the sprue over the center of one side. The mold dimensions are such as to produce a disk approximately 50 mm to 64 mm (1.97 in. to 2.5 in.) in diameter by 6 mm to 13 mm (0.24 in. to 0.50 in.) in thickness. A circular central recess 10 mm to 20 mm (0.4 in. to 0.8 in.) in diameter on one side of the disk facilitates machining of that side in preparation for excitation. It also promotes more uniform freezing of the raised peripheral area, but the corresponding raised portion of the mold must not be so large as to restrict the throat for the sprue. A slight taper, 1° to 2°, on the hinged portion of the mold facilitates opening when a disk has been cast. The mold material should be steel or cast iron and should weigh approximately 3.5 kg to 4.5 kg (8 lb to 10 lb). A special Type B mold is recommended for hypereutetic aluminum-silicon alloys. It produces the thinner samples 6 mm (0.24 in.) thick.

NOTE 3—About sample molds: Previously two relatively simple types of massive iron or steel sample molds were considered suitable, Type A and Type B. Type A molds produced vertical chill cast samples with the sprue and riser on the edge of the sample, as opposed to the Type B which produces a horizontal chill cast sample with the sprue and riser on the back of the sample. The Type A sampler was later found to not produce a repeatable sparking surface, even in the restricted sparking areas. The Type A mold was removed from the list of recommended conventional molds. Because many people are familiar with the terms “Type A” and “Type B” molds, reference to “Type B” mold remains in the text of this standard even though reference to the “Type A” no longer appears.

[4] Type B molds, available from Danton Machine and Welding Incorporated, 713 Fortune Crescent, Kingston, ON Canada K7P 2T4, have been found suitable for this purpose.

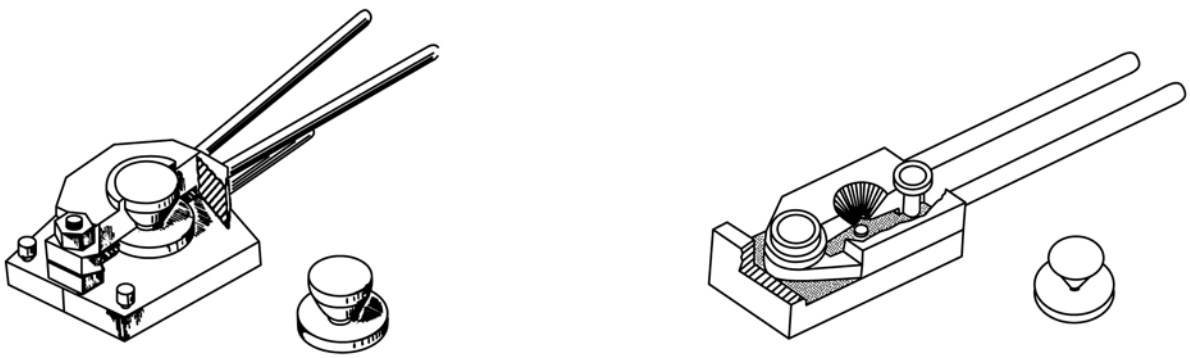

FIG. 1 Type B Mold