Designation: B985 – 12 (Reapproved 2016)

# Standard Practice for Sampling Aluminum Ingots, Billets, Castings and Finished or Semi-Finished Wrought Aluminum Products for Compositional Analysis[1]

This standard is issued under the fixed designation B985; 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.

## 1. Scope

1.1 This practice describes procedures for sampling unwrought aluminum ingots, billets, castings and finished or semi-finished wrought aluminum products to obtain a representative sample for determining chemical composition.

1.1.1 Chemical compositions determined from samples obtained in accordance with this standard practice may differ from the bulk chemical composition determined from samples taken when ingots or castings are poured. These differences can be due to elemental segregation that occurs during solidification, procedures that remove enriched material (for example, ingot scalping), or procedures that remove depleted areas (for example, removal of the riser from a casting).

1.1.2 Analysis of samples obtained from unwrought aluminum ingots, billets, and castings and finished or semi-finished wrought aluminum products can be used to determine if the piece sampled meets The Aluminum Association, Inc. registered chemical composition limits or other specified chemical composition limits for the alloy. Analysis of such samples shall not supersede the analysis of samples taken during pouring of castings or ingots in accordance with Practices E716 and analyzed in accordance with Test Methods E34, E607, E1251, or EN 14242 and shall not be used for determining compliance with chemical composition requirements for an entire cast lot or part thereof.

NOTE 1—Pieces may include ingots, forgings, coils, sheets, extrusions, castings, and so forth. A single unwrought ingot or billet may produce multiple finished or semi-finished pieces.

NOTE 2—Certification of entire cast lots should be determined using samples taken during pouring of castings or ingots in accordance with Practices E716 and analyzed in accordance with Test Methods E34, E607, E1251, or EN 14242.

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

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

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

E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spark Atomic Emission Spectrometry

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

2.2 *Other Standards:*[4]

EN 14242 Aluminum and Aluminum Alloys–chemical Analysis—inductively Coupled Plasma Optical Emission Spectral Analysis

## 3. Terminology

3.1 For definitions of terms used in this Standard, refer to Terminologies B881 and E135.

[1] This practice is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.05 on Testing.

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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.

[4] Available from European Committee for Standardization, Central Secretariat (CEN), rue de Stassart 36, B1050 Brussels, Belgium. http://www.cen.eu/esearch.

## 4. Summary of Practice

4.1 The procedures described in this practice involve the cutting and drilling of aluminum products to obtain samples for subsequent chemical analysis in accordance with Test Methods E34, E607, E1251, or EN 14242.

## 5. Significance and Use

5.1 Products covered by this practice are unwrought aluminum ingots, billets, and castings and unclad wrought aluminum sheet, plate, rolled or cold finished extrusions, extruded profiles, wire, rod and bar. Machined wrought products (finished or semi-finished) are excluded (see Note 3). These practices, used in conjunction with the appropriate sample preparation techniques in Practices E716 and the Test Methods E34, E607, E1251, and EN 14242, are suitable to determine if the piece sampled meets the chemical composition limits registered with the Aluminum Association Inc.[5] or other specified chemical composition limits for the alloy. Analysis of such samples shall not supersede the analysis of samples taken during pouring of castings or ingots in accordance with Practices E716 and analyzed in accordance with Test Methods E34, E607, E1251, or EN 14242 and shall not be used for determining compliance with chemical composition requirements for an entire cast lot or part thereof.

NOTE 3—Sampling machined pieces of products pose a particular problem because the piece itself may not be a representative sample of the original cast chemical composition. Larger differences may be expected between an analysis obtained from samples taken in accordance with this practice and the original cast analysis of samples taken during pouring of castings or ingot.

NOTE 4—Portable Spark-AES and hand held XRF instruments should not be used to determine if the piece sampled meets chemical composition limits registered with Aluminum Association Inc or other specified chemical composition limits for the alloy.

5.2 Users should be aware that chemical compositions determined using samples taken from unwrought aluminum ingots, billets, and castings and finished or semi-finished products might differ from the bulk chemical composition determined using samples taken when ingots or castings are poured. This difference can be due to elemental segregation upon solidification, sampling a non-homogenous section of the ingot or billet, removal of enriched material, or depleted areas of solidified material by subsequent procedures such as ingot scalping, the removal of risers from castings, or machining.

NOTE 5—When aluminum solidifies, macro-segregation may cause the chemical composition to vary throughout the ingot or casting. Certain areas may have enhanced or depleted concentrations of some elements relative to the average bulk chemical composition. Remnants of the macro-segregation may be retained in finished and semi-finished products. The sampling procedures described in this practice are designed to provide a laboratory sample for analysis which represents the chemical composition of the piece by taking samples in a way that symmetrically includes the various enhanced and depleted zones for example, sampling across the radius of a round ingot, and so forth.

## 6. Sampling and Handling Requirements Specific to Each Analysis Method

6.1 *Sampling for the Analysis of Chips by Test Method E34 or EN 14242:*

6.1.1 Chips that will be prepared as described in Test Method E34 or EN 14242 can be obtained by drilling or cutting and drilling at the locations specified in Section 7 for each type of product. The chips should be uniformly small in size and free from scale, dirt, oil, grease, and so forth.

6.1.1.1 *Cleaning*—Oil and grease may be removed from the chips by rinsing with alcohol then drying before taking the laboratory sample. Scale and dirt may be removed by washing with a detergent and water then rinsing with distilled deionized water and drying before taking the laboratory sample. Additional chemical cleaning such as soaking the chips in 1% (by volume) nitric acid may be necessary to remove embedded contaminants. Other cleaning procedures may be used provided they do not alter the chemical composition in any way.

6.1.2 Use of a carbide or diamond tipped drill bit should provide satisfactory samples. To obtain chips, use a drill bit between 10 mm [0.4 in.] and 13 mm [0.5 in.] in diameter. A 25 mm [1 in.] deep hole with a 10 mm [0.4 in.] bit typically produces about 5 g [0.18 oz] of sample. Drill enough holes to collect at least 20 g [0.71 oz] of chips. The initial chips from an external surface shall be discarded for any surface that is contaminated; in other words, lubricants, surface conditioning materials, dirt, scale, and so forth. The chips from all locations shall be thoroughly mixed prior to taking the laboratory sample for analysis.

NOTE 6—Using a drill bit made from bare HSS (high speed steel) may contaminate the sample with iron.

6.1.2.1 Other machining methods may be used provided that contamination-free chips are obtained from the specified area of the product being sampled. Products that are too thin to drill may be sampled by clipping off small samples.

6.2 *Sampling for Remelt Analysis using Practices E716 in Combination with Test Method E1251:*

6.2.1 Samples that will be re-melted (see Notes 8 and 9) in accordance with Practices E716 for subsequent elemental analysis using Test Method E1251 should be obtained by cutting, (in other words, sawing, snipping, or shearing) at the locations specified in Section 7 for each type of product.

6.2.1.1 If it is not possible to obtain laboratory samples by cutting, laboratory samples may be obtained by drilling and re-melting the chips. Due to the high surface area of chips, it may be necessary to press the chips into solid pellets with sufficient pressure to compact the chips to reduce dross formation. Pressure of 140 MPa [20,000 psi] has been shown to be adequate for compressing chips.

6.2.2 The amount of laboratory sample required depends on the sampler type in use and the method used to preheat the sampler as required by E716. Preheating the sampler by taking and discarding a laboratory sample requires enough material for two laboratory samples. Preheating by other means requires enough material for one laboratory sample. The type B book molds and Alcoa vacuum samplers require approximately 150 g [6 oz] and 60 g [2.5 oz] of metal per laboratory sample respectively to completely fill the mold and sprue.

NOTE 7—A 25 mm [1 in.] cube of aluminum weighs approximately 45 g [1.5 oz].

[5] Available from The Aluminum Association, Inc., 1400 Crystal Drive Suite 430 Arlington, VA 22202, http://www.aluminum.org.

6.2.3 If possible, combine all cut samples into a single laboratory sample in the remelt furnace. If the cut samples are too big for the remelt crucible, they may be cut into smaller size samples or multiple laboratory samples may be analyzed separately. When analyzed separately, the chemical composition reported should be the average analysis determined from multiple remelt and cast laboratory samples for each element analyzed.

NOTE 8—Remelting is not satisfactory for the determination of calcium, lithium, sodium, and strontium. These elements may be lost due to oxidation or volatilization, or both. Calcium, lithium, sodium, and strontium should be analyzed according to Test Method E34 or EN 14242 or by direct analysis on the surface of the original piece according to Test Methods E607 or E1251, and results reported as approximate.

NOTE 9—Because magnesium and zinc may be lost if the melt is overheated or kept molten for an excessive time, the sample should be cast as soon as possible after it reaches a temperature of 700°C.

6.2.4 Using a saw equipped with a carbide or diamond tipped blade should provide satisfactory samples.

NOTE 10—The use of bare steel saw blades may contaminate the sample with iron.

6.2.4.1 *Cleaning*—Oil and grease may be removed from the samples by rinsing with alcohol then drying before taking the laboratory sample. Scale and dirt may be removed by washing with soap and water then rinsing with distilled de-ionized water and drying before taking the laboratory sample. Additional chemical cleaning such as soaking the samples in 1% (by volume) nitric acid may be necessary to remove embedded contaminates. Other cleaning methods may be used provided they do not alter the chemical composition in any way. (**Warning—**Chips and other cut samples must be dry before melting. Moisture captured in the material may cause it to eject heated metal or molten material and cause injury!)

## 7. Procedure for Obtaining Samples by Product Type

7.1 *Ingots and Billets, Round:*

7.1.1 *Sampling a Round Ingot by Drilling*—Prior to drilling, metal must be removed or cropped from the head and butt of round ingots. For ingots 250 mm [10 in.] or less in diameter, remove or crop at least 1.5 times the diameter from the head and butt of the ingot. For ingots greater than 250 mm [10 in.] in diameter, remove or crop at least 380 mm [15 in.] from the head and butt of the ingot.

7.1.1.1 Drill holes in both the front and rear of the ingot as described below and shown in Fig. 1.

7.1.1.2 Drill two holes near the outer edge approximately 5 mm [0.2 in.] away from the as-cast surface.

7.1.1.3 Drill one hole near the center.

7.1.1.4 Drill three holes in the region approximately midway between the holes at the outer edge and the center.

7.1.1.5 Drill holes at least 25 mm [1 in.] into the face. Drillings from the front and rear of the ingot shall be treated as separate laboratory samples and analyzed separately. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification chemical composition limits if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.1.1.6 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the head or butt locations shown in Fig. 1.

7.1.2 *Sampling a Billet by Drilling*—Drill holes in both the front and rear of the billet as described below and shown in Fig. 1.

7.1.2.1 Drill two holes near the outer edge approximately 5 mm [0.2 in.] away from the as-cast surface.

7.1.2.2 Drill one hole near the center.

7.1.2.3 Drill three holes in the region approximately midway between the holes at the outer edge and the center.

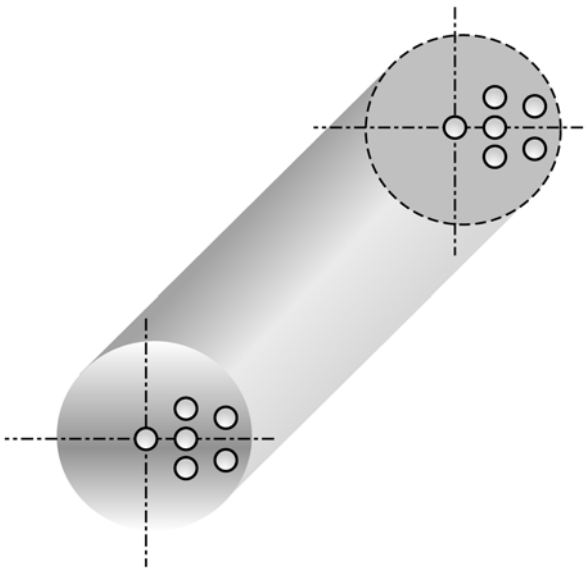

**FIG. 1 Sampling a Round Ingot or Billet by Drilling**

7.1.2.4 Drill holes at least 25 mm [1 in.] into the face. Drillings from the front and rear shall be treated as separate laboratory samples and analyzed separately. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.1.2.5 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the front or rear locations shown in Fig. 1.

7.1.3 *Sampling a Round Ingot by Cutting a Transverse Cross-sectional Slice and Drilling*—For ingots 250 mm [10 in.] or less in diameter, cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from a location at least 1.5 times the ingot diameter from the head and butt of the ingot. For ingots greater than 250 mm [10 in.] in diameter, cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from a location at least 380 mm [15 in.] from the head and butt of the ingot.

7.1.3.1 Drill holes through the full thickness of the cross-sectional slice as described below and shown in Fig. 1.

7.1.3.2 Drill two holes near the outer edge approximately 5 mm [0.2 in.] away from the as-cast surface.

7.1.3.3 Drill one hole near the center.

7.1.3.4 Drill three holes in the region approximately midway between the holes at the outer edge and the center.

7.1.3.5 Drillings from the head and butt slices shall be treated as separate laboratory samples and analyzed separately. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.1.3.6 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the head or butt locations shown in Fig. 1.

7.1.3.7 Alternatively, chips may be collected from milling the complete face or symmetrical section (half, quarter, and so forth.) of the slice.

7.1.4 *Sampling a Billet by Cutting a Transverse Cross-sectional Slice and Drilling*—Cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from the front and rear of the billet.

7.1.4.1 Drill holes through the full thickness of the cross-sectional slice as described below and shown in Fig. 1.

7.1.4.2 Drill two holes near the outer edge approximately 5 mm [0.2 in.] away from the as-cast surface.

7.1.4.3 Drill one hole near the center.

7.1.4.4 Drill three holes in the region approximately midway between the holes at the outer edge and the center.

7.1.4.5 Drillings from the front and rear slices shall be treated as separate laboratory samples and analyzed separately. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.1.4.6 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the front or rear locations shown in Fig. 1.

7.1.4.7 Alternatively, chips may be collected from milling the complete face or symmetrical section (half, quarter, and so forth.) of the slice.

7.1.5 *Sampling a Round Ingot by Cutting Samples from a Transverse Cross-sectional Slice*—For ingots 250 mm [10 in.] or less in diameter, cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from a location at least 1.5 times the ingot diameter from the head and butt of the ingot. For ingots greater than 250 mm [10 in.] in diameter, cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from a location at least 380 mm [15 in.] from the head and butt of the ingot. If the remelt furnace is large enough, it is preferable to melt the entire slice. If the remelt furnace is not large enough, samples should be cut from the slices as described below and shown in Fig. 1.

7.1.5.1 Cut two samples near the outer edge approximately 5 mm [0.2 in.] away from the as-cast surface.

7.1.5.2 Cut one sample near the center.

7.1.5.3 Cut three samples in the region approximately midway between the samples at the outer edge and the center.

7.1.5.4 Samples cut from the head and butt shall be treated as separate laboratory samples and analyzed separately. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.1.5.5 If more samples are required to make up the required sample weight, repeat the above pattern. Samples cut from additional locations are to be combined with other samples cut from the head or butt locations shown in Fig. 1.

7.1.6 *Sampling a Billet by Cutting Samples from a Transverse Cross-sectional Slice*—Cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from the front and rear of the billet. Samples should be cut from the slices as described below and shown in Fig. 1.

7.1.6.1 Cut two samples near the outer edge approximately 5 mm [0.2 in.] away from the as-cast surface.

7.1.6.2 Cut one sample near the center.

7.1.6.3 Cut three samples in the region approximately midway between the samples at the outer edge and the center.

7.1.6.4 Samples cut from the front and rear shall be treated as separate laboratory samples and analyzed separately. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.1.6.5 If more samples are required to make up the required sample weight, repeat the above pattern. Samples cut from additional locations are to be combined with the other samples cut from the front or rear locations shown in Fig. 1.

7.2 *Ingots, Rectangular:*

7.2.1 *Sampling a Rectangular Ingot by Drilling the Ingot*—Prior to drilling, at least 380 mm [15 in.] of metal must be removed or cropped from the head and butt of rectangular ingots.

7.2.1.1 Drill holes in the front and rear of the ingot as described below and shown in Fig. 2.

7.2.1.2 Drill two holes near a corner approximately 5 mm [0.2 in.] away from the as cast surface.

7.2.1.3 Drill one hole near the center.

7.2.1.4 Drill three holes in the region approximately midway between the holes at the corner and the center.

7.2.1.5 Drill holes at least 25 mm [1 in.] into the face. Drillings from the front and rear of the ingot shall be treated as separate laboratory samples. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.2.1.6 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the head or butt locations shown in Fig. 2.

7.2.2 *Sampling a Rectangular Ingot by Cutting a Transverse Cross-sectional Slice and Drilling*—Cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from a location at least 380 mm [15 in.] from the head and butt of the ingot.

7.2.2.1 Drill holes through the entire thickness of the cross-sectional slice as described below and shown in Fig. 2.

7.2.2.2 Drill two holes near a corner approximately 5 mm [0.2 in.] away from the as cast surface.

7.2.2.3 Drill one hole near the center.

7.2.2.4 Drill three holes in the region approximately midway between the holes at the corner and the center.

7.2.2.5 Drillings from the head and butt slices shall be treated as separate laboratory samples. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.2.2.6 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the head or butt locations shown in Fig. 2.

7.2.2.7 Alternatively, chips may be collected from milling the complete face or symmetrical section (half, quarter, and so forth.) of the slice.

7.2.3 *Sampling a Rectangular Ingot by Cutting Samples from a Transverse Cross-sectional Slice*—Cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from a location at least 380 mm [15 in.] from the head and butt of the ingot. If the remelt furnace is large enough, it is preferable to melt the entire slice. If the remelt furnace is not large enough, samples should be cut as described below and shown in Fig. 2.

7.2.3.1 Cut two samples near a corner approximately 5 mm [0.2 in.] away from the as cast surface.

7.2.3.2 Cut one sample near the center.

7.2.3.3 Cut three samples in the region approximately midway between the holes at the corner and the center.

7.2.3.4 Samples cut from the head and butt shall be treated as separate laboratory samples. The results may be reported as individual samples or as the average. Both samples however, must be within the specification chemical composition limits. The piece sampled does not meet the specification if one of the samples is outside of the chemical composition limits; even if the average is within the specification.

7.2.3.5 If more samples are required to make up the required sample weight, samples repeat the above pattern. Samples cut from additional locations are to be combined with the other samples cut from the head or butt locations shown in Fig. 2.

7.3 *Sheet:*

7.3.1 *Sampling Sheet by Drilling*—For sheet 2.5 mm [0.1 in.] or more, the sheet shall be drilled through the full thickness. Drill holes as described below and shown in Fig. 3.

7.3.1.1 Drill two holes near a corner approximately 5 mm [0.2 in.] away from the edge parallel to the rolling direction.

7.3.1.2 Drill one hole near the center.

7.3.1.3 Drill three holes in the region approximately midway between the holes at the corner and the center.

7.3.1.4 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the locations shown in Fig. 3. Sheet thinner than 2.5 mm [0.1 in.] is too thin to drill and shall be sampled by cutting (section 7.3.2).

7.3.2 *Sampling Sheet by Cutting*—If the remelt furnace is large enough, it is preferable to melt an entire transverse cross-sectional slice. If the remelt furnace is not large enough, cut samples containing the full thickness of the sheet as described below and shown in Fig. 3.

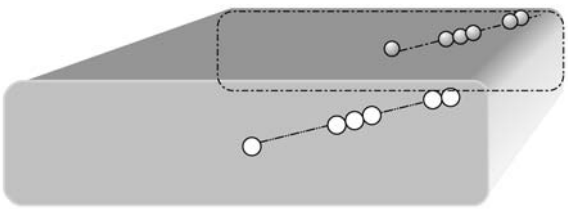

**FIG. 2 Sampling a Rectangular Ingot by Drilling**

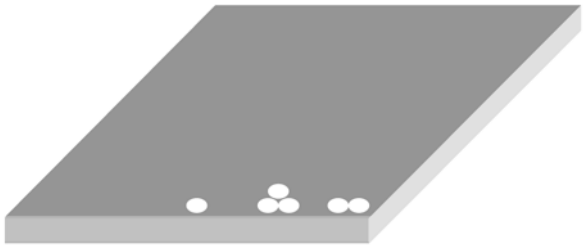

FIG. 3 Sampling Sheet or Plate

7.3.2.1 Cut two samples near a corner approximately 5 mm [0.2 in.] away from the edge parallel to the rolling direction.

7.3.2.2 Cut one sample near the center.

7.3.2.3 Cut three samples in the region approximately midway between the holes at the corner and the center.

7.3.2.4 If more samples are required to make up the required sample weight, additional samples should be evenly spaced between the locations indicated in Fig. 3. Samples cut from additional locations are to be combined with the other samples cut from the locations shown in Fig. 3.

7.4 *Plate:*

7.4.1 *Sampling Plate by Drilling*—For plate 25 mm [1 in.] or less, the plate shall be drilled through the full thickness. For plate greater than 25 mm [1 in.], the plates shall be drilled to at least half of its total thickness. Drill holes as described below and shown in Fig. 3.

7.4.1.1 Drill two holes near a corner approximately 5 mm [0.2 in.] away from the edge parallel to the rolling direction.

7.4.1.2 Drill one hole near the center.

7.4.1.3 Drill three holes in the region approximately midway between the holes at the corner and the center.

7.4.1.4 If more drilling locations are required to make up the required sample weight, repeat the above pattern. Drillings from additional locations are to be combined with the other drillings from the locations shown in Fig. 3.

7.4.2 *Sampling Plate by Cutting*—If the remelt furnace is large enough, it is preferable to melt an entire transverse cross-sectional slice. If the remelt furnace is not large enough, cut samples of the plate as described below and shown in Fig. 3. For plate 50 mm [2 in.] or less, cut samples containing the full thickness of the plate. For plate greater than 50 mm [2 in.], cut samples that are equal to at least half of the total thickness, oriented such that the sample includes metal from the center to surface of the plate.

7.4.2.1 Cut two samples near a corner approximately 5 mm [0.2 in.] away from the edge parallel to the rolling direction.

7.4.2.2 Cut one sample near the center.

7.4.2.3 Cut three samples in the region approximately midway between the holes at the corner and the center.

7.4.2.4 If more samples are required to make up the required sample weight, additional samples should be evenly spaced between the locations indicated in Fig. 3. Samples cut from additional locations are to be combined with the other samples cut from the locations shown in Fig. 3.

7.5 *Cold Finished Extrusions and Extruded Profiles, Wire, Rod and Bar:*

7.5.1 Extrusions must be sampled within saleable metal; not from process scrap generated during transverse welds. If the surface of a fabricated product such as an extruded profile is anodized or powder coated, the anodized surface or powder coatings layer should be removed prior to taking samples, as directed in 7.5.2 and 7.5.3 below. Coatings may be removed by various chemical cleaning procedures such as soaking the piece in boiling hydrogen peroxide or 1% (by volume) nitric acid. Other cleaning methods may be used provided they do not alter the chemical composition in any way. The surfaces may also be removed by mechanical means such as sanding of grinding. Care should be taken to prevent contamination of the surface from the grinding media.

7.5.2 *Sampling of Cold Finished Extrusions and Extruded Profiles, Wire, Rod and Bar by Drilling*—Cold finished extrusions and extruded profiles, wire, rod, and bar shall be drilled through the full thickness of the cross-section of the product. Drill a sufficient number of holes along the product length at the thickest cross-section to acquire the necessary sample size. If the material is too thin to drill, sampling shall be according to 7.5.3.

7.5.3 *Sampling of Cold Finished Extrusions and Extruded Profiles, Wire, Rod and Bar by Cutting*—Cold finished extrusions and extruded profiles, wire, rod and bar shall be sampled by cutting a complete cross-section from the product. If the size of the cut sample is too big for the remelt crucible, it can be further cut or treated as provided in section 6.2.3.

7.6 *Forgings:*

7.6.1 *Sampling a Forging by Drilling Samples from In-process Trim Flash*—Drill through the full thickness of the flash in three or more flash locations spaced equally around the forging.

7.6.1.1 If more drilling locations are required to make up the required sample weight, the locations should be evenly spaced among the three original sample locations. Drillings from additional locations are to be combined with the drillings from the three original locations.

7.6.2 *Sampling a Forging by Cutting a Section and Drilling*—Cut a 25 mm [1 in.] thick section across the forging from a location approximately ⅓ the distance from one edge. Drill through the full section thickness in at least three locations at the center, near the outside edge, and one or more locations on a line between the center and edge locations.

7.6.2.1 If more drilling locations are required to make up the required sample weight, the locations should be evenly spaced among the three original sample locations. Samples cut from

additional locations are to be combined with the other samples cut from the three original locations.

7.6.3 *Sampling a Forging by Cutting In-process Trim Flash*—Cut at least three samples of full thickness sections having approximately equal mass from three or more locations spaced equally around the forging.

7.6.3.1 If more samples are required to make up the required sample weight, additional samples should be evenly spaced among the three original sample locations. Samples cut from additional locations are to be combined with the other samples cut from the three original locations.

7.6.4 *Sampling a Large Forging by Cutting Samples from a Section*—Cut a 25 mm [1 in.] thick section across the forging from a location approximately ⅓ the distance from one edge. Cut samples from at least three locations at the center, near the outside edge, and one or more locations on a line between the center and edge locations.

7.6.4.1 If more samples are required to make up the required sample weight, additional samples should be evenly spaced among the three original sample locations. Samples from additional locations are to be combined with the drillings from the three original locations.

7.6.5 *Sampling a Small Forging by Cutting a Slice*—Cut a 25 mm [1 in.] slice across the forging from a location approximately ⅓ the distance from one edge. If the size of the cut sample is too big for the remelt crucible, it can be further cut or treated as provided in section 6.2.3.

7.6.6 *Direct Analysis of a Forging Prolongation*—Sometimes it is necessary to determine chemical composition by directly sparking a prolongation to avoid damage to the forging. Results from this method shall be considered approximate because it is not in accordance with Practices E716 Subsection 6.3. Because there is no control over solidification, the chemical composition determined from the prolongation may vary from the chemical composition of the forging. If it is necessary to determine the chemical composition using a prolongation, a 25 mm [1 in.] sample should be cut from the prolongation, prepared, and analyzed in accordance with Practices E716, or Test Methods E607 or E1251.

7.7 *Castings:*

7.7.1 *Sampling Castings by Drilling*—Drill through the full thickness of castings at locations spaced equally around the casting. If necessary, drill from both surfaces of the casting to get full thickness samples. Drillings are to be obtained from all the section thicknesses of the casting.

NOTE 11—The geometry of the casting may dictate using a smaller diameter drill bit than recommended in 6.1.2.

7.7.2 *Sampling a Small Casting by Cutting*—Cut the casting into sizes such that the entire casting will fit into the remelt crucible/furnace. If necessary continue to cut up the entire casting until the required sample weight is obtained. If the size of the cut sample is too big for the crucible/furnace, it can be further cut or treated as described in section 6.2.3.

7.7.3 *Sample a Large Casting by Cutting*—If it is not possible to melt the entire casting, cut at least three samples having approximately equal mass from three or more locations spaced equally around the casting. Samples are to be obtained from all the section thicknesses of the casting.

7.8 *Small Form Foundry Ingot:*

7.8.1 *Sampling Foundry Ingot by Drilling*—Drill each of the two sides and each of the two ends plus one hole in the top and if accessible, one hole on the bottom of the foundry ingot. In the four side locations, drill at least 25 mm [1 in.] into the foundry ingot, and in the top and bottom locations, drill at least

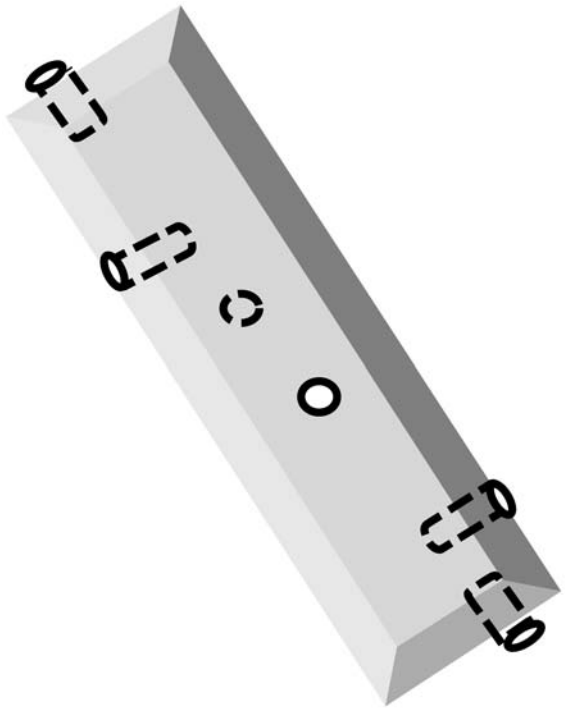

**FIG. 4 Sampling Foundry Ingot by Drilling**

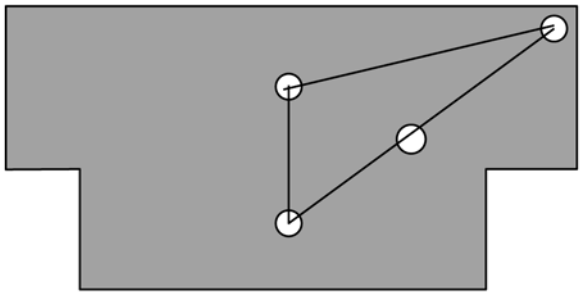

**FIG. 5 Sampling Large Form Foundry T Ingot**

75 mm [3 in.] into the foundry ingot. Drillings shall be combined into one laboratory sample prior to analysis.

7.9 *Large Form Foundry T-Ingot:*

7.9.1 *Sampling a Foundry T-Ingot by Cutting a Transverse Cross-sectional Slice and Drilling*—Cut a transverse cross-section slice that is at least 25 mm [1 in.] thick from a location at least 380 mm [15 in.] from the head and butt of the ingot. Drill holes through the entire thickness of the cross-sectional slice near a corner, near the center of the widest cross-section, and near the center of the narrowest cross section, and approximately midway between the corner and narrowest cross-section holes along the diagonal as indicated in Fig. 5. Drillings from the head and butt slices shall be treated as separate laboratory samples. If more drilling locations are required to make up the required sample weight, the locations should be evenly spaced along the diagonals between the locations indicated in Fig. 5. Drillings from additional locations are to be combined with the other drillings from the head or butt locations shown in Fig. 5.

7.9.2 *Sampling a Foundry T-Ingot by Cutting Samples from a Transverse Cross-sectional Slice*—Cut a transverse cross-sectional slice that is at least 25 mm [1 in.] thick from a location at least 380 mm [15 in.] from the head and butt of the ingot. From the cross-sectional slice, cut samples near a corner, near the center of the widest cross-section, and near the center of the narrowest cross section, and approximately midway between the corner and narrowest cross-section holes along the diagonal as indicated in Fig. 5. Drillings from the head and butt slices shall be treated as separate laboratory samples. If more samples are required to make up the required sample weight, samples should be cut from locations evenly spaced along the diagonals between the locations indicated in Fig. 5. Samples cut from additional locations are to be combined with the other samples cut from the head or butt locations shown in Fig. 5.