Designation: B215 – 15

Standard Practices for Sampling Metal Powders[1]

This standard is issued under the fixed designation B215; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 These practices cover sampling methods used to collect a small quantity of metal powder that is as representative of the entire starting material as possible, and details the procedures that are recommended for reducing this quantity into smaller test portions on which chemical, physical, and mechanical property data may be determined.

1.2 Several sampling practices are described, depending on their applicability to the conditions of storage and transport of the sampled powders:

1.2.1 *Practice 1A (Described in Section 6)*—Applicable to sampling moving powders, as when being transferred from one container to another or to a process stream; or when falling from a conveyor; or in a moving process stream. This is the preferred practice for obtaining the several increments that are combined to form the gross sample.

1.2.2 *Practice 1B (Described in Section 7)*—Applicable to sampling powders that have already been packaged for transport, as in a bag or drum. A hollow tubular slot sampler is the recommended way to sample these packaged powders to obtain the increments (7.1.1). Alternatively, when other methods are not possible or available, a procedure specified here (7.1.2) may be used to randomly scoop samples from the powder, using a scoop of specified material and configuration.

1.2.3 *Practice 2 (Described in Section 8)*—Applicable to obtaining test portions from the composite sample. For larger quantities of powder, a chute splitter is generally used, while a spinning riffler is used for smaller quantities.

1.3 These practices apply to particulate materials or mixtures of particulates with particle sizes generally less than one millimetre and include mixtures containing lubricant, with or without other non-metallic additives, that are ready for compacting.

1.4 These practices do not cover the sampling of flake powders or pastes. For procedures on the sampling and testing of flake metal powders and pastes, refer to Test Methods D480.

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

1.6 *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]

B243 Terminology of Powder Metallurgy

D480 Test Methods for Sampling and Testing of Flaked Aluminum Powders and Pastes

3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology B243. Additional descriptive information is available in the Related Materials section of Vol 02.05 of the *Annual Book of ASTM Standards*.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 See Fig. 1 for the terms hereinafter defined.

3.2.2 *composite sample*—blended entire gross sample.

3.2.3 *increment*—quantity of powder obtained by a sampling device at one time from a larger quantity of powder.

3.2.4 *gross sample*—total quantity of powder adequate for the intended purpose(s), consisting of all the increments combined.

3.2.5 *test portion*—quantity of powder (generally taken from the composite sample) on which the test is performed, or from which a test piece is produced.

4. Significance and Use

4.1 Specifications and test methods for metal powders and metal powder products require the sampling, testing, and

[1] These practices are under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and are the direct responsibility of Subcommittee B09.02 on Base Metal Powders.

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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.

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

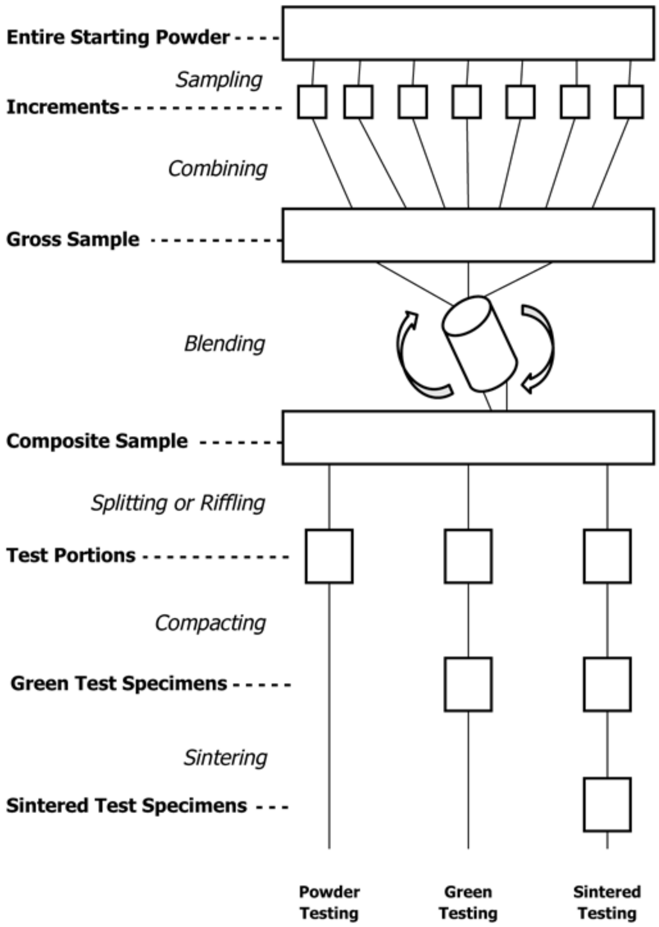

FIG. 1 Scheme of Sampling

performance evaluation of small samples taken from large quantities of powder. The sampling procedure is equally as important as the testing and evaluation; the sampling methods used must include every precaution to ensure that the samples obtained will show the true nature and condition of the large powder quantity that they represent.

4.2 The primary objective of any sampling procedure is to obtain a small quantity of material that is truly representative of the larger amount from which it is taken, a condition that is readily comprehended but difficult to define, quantify, and prove. Certain criteria are desirable to meet this condition:[3]

4.2.1 Every sampling increment should have a *non-zero probability* of being selected.

4.2.2 All increments should have an *equal probability* of being selected.

4.2.3 The sampling procedure *should not alter* the material (for example, by changing the particle size or chemical composition).

4.3 Sampling a *moving* powder helps to satisfy these criteria; therefore, Practice 1A should be used whenever possible to obtain the composite sample. Similarly, Practice 2 should be used to obtain the test portions; use of a spinning riffler is preferred when possible and practicable.

4.4 Although not always meeting all the criteria of 4.2.1 – 4.2.3, the other sampling practices described in this standard are based on time-proven experience in the PM industry in sampling granular metal powders. These practices have been shown to produce samples that give reliable and representative evaluation data.

4.5 Since many tests are performed using very small amounts of powder meant to represent much larger quantities, it is most important that the test portions be obtained in a standardized manner. The practices described here take into account the possibility of segregation of the metal powder during and after filling of containers.

4.6 Sample quantities of metal powder are used for chemical analysis and to determine the physical characteristics of the powder. These data are used for production control and quality inspection of finished lots.

4.7 Green compacts produced from powder samples are used to evaluate the compactability properties of metal powders, information that is important to the use of these powders in the manufacture of PM bearings and structural parts.

4.8 Test specimens produced from metal powder samples are compacted and sintered and used to measure physical and mechanical properties of solid PM materials. The data obtained are included in PM material specifications to assist with material selection for PM applications.

4.9 Solid PM articles—structural parts, bearings, etc.—are produced from metal powder samples to evaluate powder performance in the manufacturing and end use of such articles.

5. Apparatus

5.1 *Rectangular Receptacle,* capable of being moved completely across a stream of flowing powder at a constant speed and having a length and width greater than the stream of powder. It must be large enough so that no overflow of powder occurs when collecting the sample.

5.2 *Small Blender*—Of sufficient capacity to blend the entire gross sample, consisting of all the increments combined.

5.3 *Commercial Sampling Device*—Many powder transfer systems are closed for dust control, but there are commercial devices available that can be inserted into a section of a pipe to collect powder increments while maintaining the flowing stream.

5.4 *Powder Sampler*—A slot or tube sampler with an auger point that can be screwed to the bottom of a filled container and is designed to collect powder at one (single-level) or more (multi-level) depths, see Fig. 2 and Fig. 3.

5.5 *Powder Scoop*—A non-magnetic stainless steel scoop with a sharp edge and high sides, of a size and capacity capable of obtaining the desired powder increment. See Fig. 4.

5.6 *Chute Splitter*—Of sufficient size and capacity to split the required amount of powder into two approximately-equal portions, see Fig. 5. Several different sizes of splitter may be

[3] Pierre M. Gy, *Sampling of Heterogeneous and Dynamic Material Systems*. Elsevier: New York, NY, 1992

FIG. 2 Multi-Level Slot Sampler with Auger Point
(Keystone Sampler)

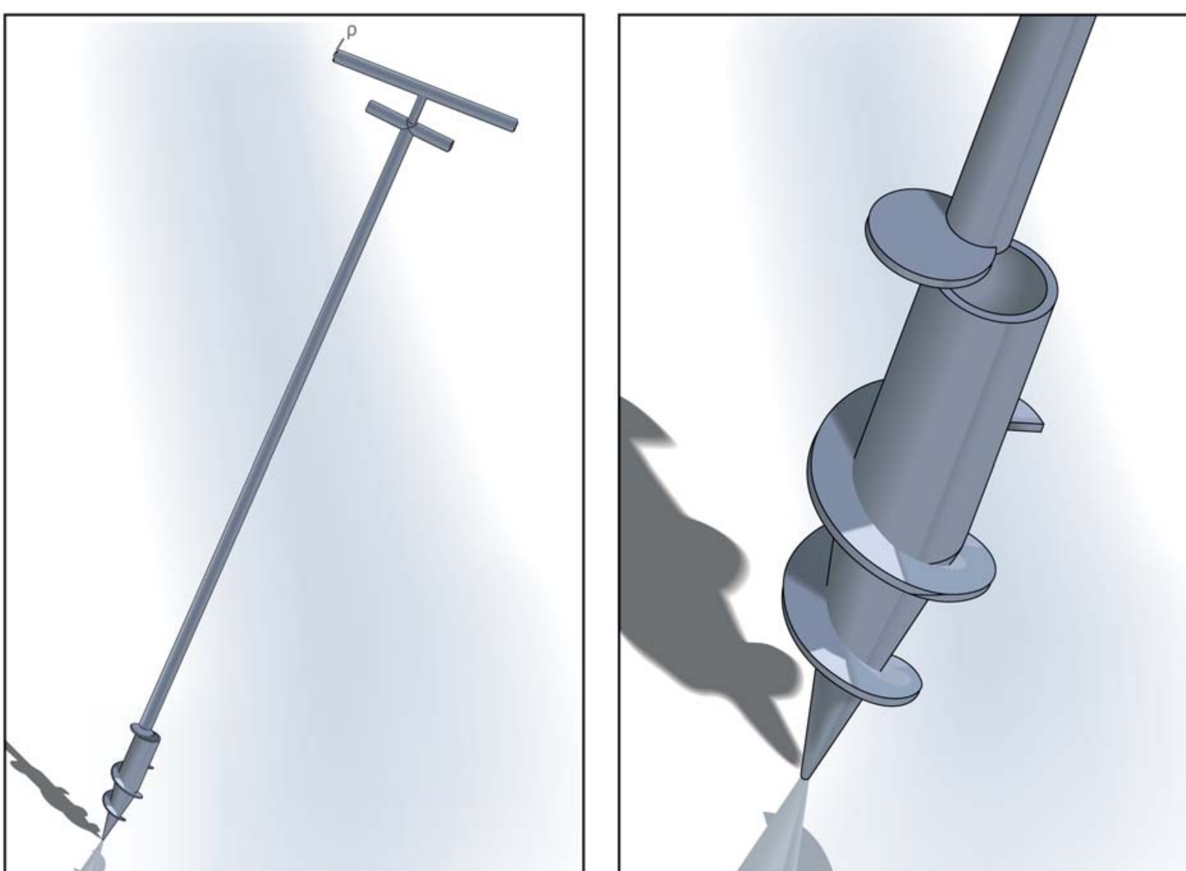

FIG. 3 Single-Level Tube Sampler with Auger Point (Full View and Close-Up of Point) — Schematic

FIG. 4 Stainless Steel Scoop for Sampling Metal Powder

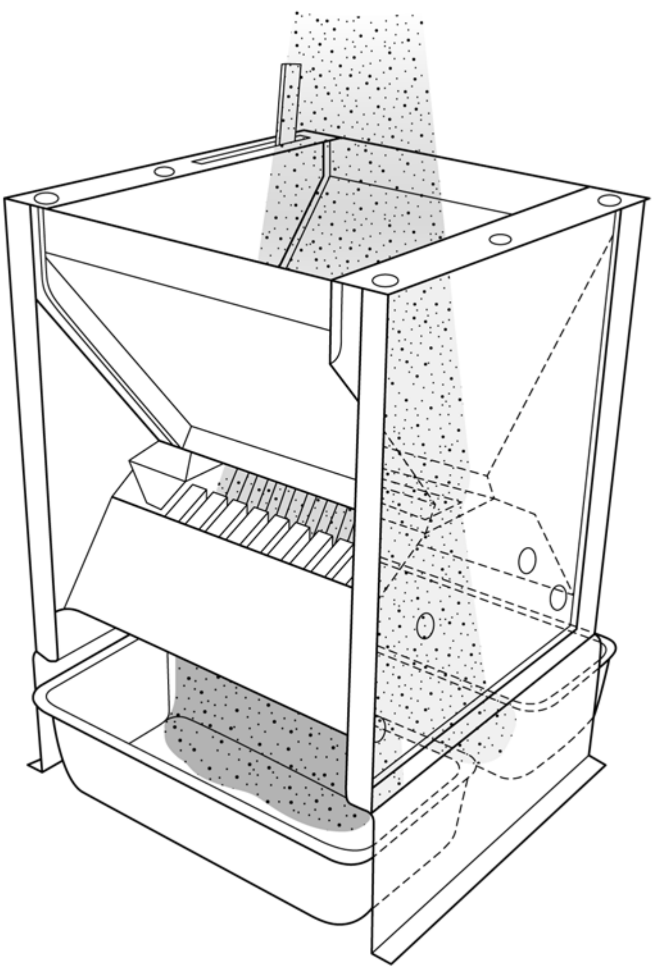

FIG. 5 Chute Splitter — Schematic

necessary throughout the sampling process, depending on the sample size at each step. The size of the chute openings should be at least three times the largest particle size to be sampled, and the chute angle should be at least 45°. The smallest of the chute splitters are often referred to as "micro splitters."

5.7 *Charging Pan*—A pan that is the same width as the chute splitter and large enough to contain the sample to be split.

5.8 *Spinning Riffler*—Of sufficient size and capacity to split the required amount of powder into at least eight approximately-equal portions, see Fig. 6. Several different sizes of riffler may be necessary throughout the sampling process, depending on the sample size at each step. The smallest of these are often referred to as "micro rifflers."

PART 1—OBTAINING THE COMPOSITE SAMPLE

6. Pactice 1A—Sampling a Moving Powder

6.1 The preferred method for sampling powders is always when the powder is in motion, as, for example, when being transferred from a blender or a storage tank, or falling from a conveyor, or in a moving process stream (pipeline).

6.2 Equal powder increments should be taken at random intervals over the life of the flow.

6.3 The number of increments that make up the gross sample should be agreed upon between the parties concerned.

6.4 Pass the rectangular receptacle at a constant speed completely through the stream of flowing powder, starting immediately upon flow. Repeat at random intervals until the agreed-upon number of increments is obtained, taking the last increment near the end of the flow.

6.5 Alternatively, use a commercial sampling device to collect the agreed-upon number of increments, starting immediately upon flow, and taking the last increment near the end of the flow.

6.6 The total amount from all increments shall be adequate for the tests or evaluations to be performed.

NOTE 1—To investigate within-lot and sampling variability, individual increments may be tested rather than being combined to form a composite sample.

6.7 Combine the increments to form the gross sample.

6.8 Blend the gross sample in a small blender to form the composite sample.

7. Practice 1B—Sampling a Stationary Powder

7.1 Although sampling a moving powder is always preferred, it is not always possible to do so with powders that have already been packaged for shipment (for example, in drums, pails, or bags). Such stationary powders must then be sampled using either a tube (slot) sampler or a simple scoop, as specified in the following sections.

7.1.1 *Sampling a Stationary Powder Using a Slot or Tube Sampler*—Using a hollow tubular multi-level slot sampler (Fig. 2) to remove powder from several depths of the container is the recommended way to sample packaged powder. Alternatively, a single-level tube sampler (Fig. 3) may be used repeatedly to remove powder from several depths of the container.

7.1.1.1 Equal powder increments should be taken at each depth.

7.1.1.2 The number of increments that make up the gross sample and the number of increments taken from each container should be agreed upon between the parties concerned.

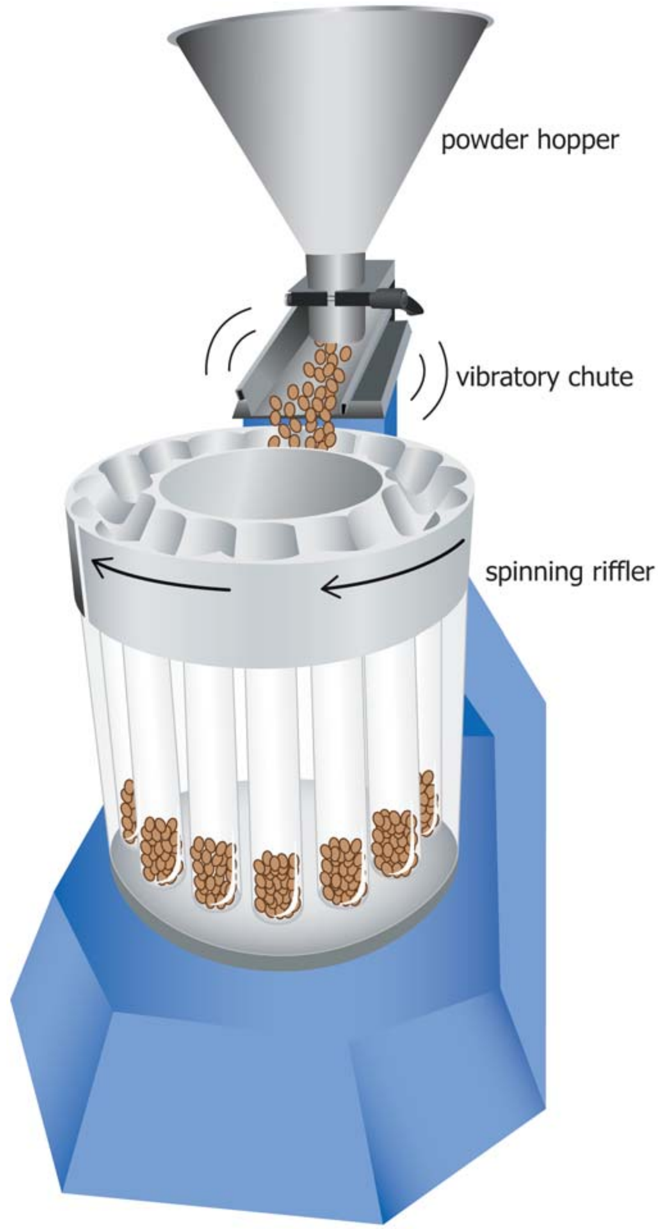

FIG. 6 Spinning Riffler — Schematic

7.1.1.3 Consult Table 1, Sampling Schedule, to determine the recommended minimum number of containers, selected at random, from the lot or batch of powder, that are to be sampled.

TABLE 1 Splitting Schedule

No. of Containers in the Lot or Batch	No. of Containers to be Sampled (Randomly Selected)
1 to 5	all
6 to 11	5
12 to 20	6
21 to 35	7
36 to 60	8
61 to 99	9
100 to 149	10
150 to 199	11
200 to 299	12
300 to 399	13
More than 400	13 + 1 per 100 additional containers

7.1.1.4 Obtain powder increments from each container using either of the following devices:

7.1.1.5 *Multi-Level Slot Sampler*—Insert the sampler, in the closed position, into the powder at a point about 70 % of the distance from the center of the cross-section to the periphery and straight down to the bottom of the container. Each volume of powder from each individual slot in the sampler may be considered an increment.

7.1.1.6 *Single-Level Tube Sampler*—Insert the sampler, in the closed position, into the powder at a point about 70 % of the distance from the center of the cross-section to the periphery and straight down to an appropriate depth for the required increment. After emptying the sampler (7.1.1.8), repeat at different depths for the required number of increments.

7.1.1.7 Open the sampler, allowing powder to flow into the sampler tube. Close the sampler tube when filled and remove it from the container.

7.1.1.8 Empty the contents of the sampler either into a container or onto a sheet of glazed or waxed paper.

7.1.1.9 Repeat 7.1.1.4 through 7.1.1.8 until the required number of containers have been sampled and the required number of increments have been obtained.

7.1.1.10 The total amount from all increments shall be adequate for the tests or evaluations to be performed. Additional increments may be taken from other random containers if necessary.

NOTE 2—To investigate within-lot and sampling variability, individual increments may be tested rather than being combined to form a composite sample.

NOTE 3—To investigate within-container variability, the single-level tube sampler can be used to collect discrete samples from several levels that may then be individually evaluated.

7.1.1.11 Combine the increments to form the gross sample.

7.1.1.12 Blend the gross sample in a small blender for 10 to 15 revolutions to form the composite sample.

7.1.2 *Sampling a Stationary Powder Using a Scoop Sampler*—Scoop sampling is a common practice that has been successfully used in many industries that handle granular or particulate materials. When carefully done following a standardized procedure, it can produce samples that are reliable examples of the powder being tested or evaluated.

7.1.2.1 The design of the scoop is important to minimize sampling error. It shall have a sharp edge and high sides that will contain the sample without overflowing during use, as partial loss of powder may compromise the sample. The scoop shall be fabricated from non-magnetic stainless steel. An ordinary plastic or cast aluminum food scoop or a flat spoon-like instrument should not be used. See Fig. 4.

7.1.2.2 Consult Table 1, Sampling Schedule, to determine the recommended minimum number of containers, selected at random, from the lot or batch of powder that are to be sampled.

7.1.2.3 Using the scoop held sideways, scrape away the top 2 in. (~50 mm) of surface powder from the central region exposing about a 10 x 10 in. (~250 x 250 mm) area of fresh powder.

7.1.2.4 Skim through a short distance of the undisturbed sub-surface with an arcing motion of the scoop to collect a powder sample from the container. The quantity taken shall be completely confined within the scoop without overflowing. This is one increment.

7.1.2.5 Empty the contents of the scoop either into a container or onto a sheet of glazed or waxed paper.

7.1.2.6 Repeat 7.1.2.3 through 7.1.2.5 until the required number of containers have been sampled and the required number of increments have been obtained. Be careful to duplicate the collecting motion in order to collect about the same quantity of powder in each increment.

7.1.2.7 The total amount from all increments shall be adequate for the tests or evaluations to be performed. Additional increments may be taken from other random containers if necessary.

7.1.2.8 Combine the increments to form the gross sample.

NOTE 4—To investigate within-container and sampling variability, individual increments may be tested rather than being combined to form a composite sample.

7.1.2.9 Blend the gross sample in a small blender for 10 to 15 revolutions to form the composite sample.

PART 2—OBTAINING THE TEST PORTIONS FROM THE COMPOSITE SAMPLE

8. Practice 2—Obtaining the Test Portions Using a Chute Splitter or Spinning Riffler

8.1 A chute splitter may be used to divide the composite sample into smaller portions, until each division either becomes small enough to use a spinning riffler or reaches the test portion size. If the composite sample is small enough, or when the divisions from a chute splitter are small enough, use of a spinning riffler is the preferred practice for obtaining one or a multiple number of nearly-identical test portions of powder. There are a number of chute splitters and spinning rifflers commercially available, in various sizes.

8.2 *Chute Splitter*

8.2.1 Pour the entire composite sample quantity into the charging pan of the splitter so it is evenly spread from side to side in the pan.

8.2.2 Locate the edge of the charging pan over the center line of the chute bank and gently pour the composite sample through the splitter at a rate where it will flow freely through all of the chutes and into the collecting bins.

8.2.3 After the initial distribution has been made, measure the sample size by determining the mass (or the volume) of the powder from one of the splitter collecting bins.

8.2.4 Adjustments can then be made by repeatedly splitting the contents of one of the collecting bins to increase the quantity in the remaining previously-filled bin, or repeatedly splitting the contents of one bin to produce two smaller size samples, until the desired sample size or test portion size is reached.

8.3 *Spinning Riffler*

8.3.1 Pour the entire sample quantity—either the entire composite sample or one of the divisions from the prior chute splitter—into the powder hopper and pass it through the spinning riffler, maintaining a constant feed rate and rotation speed such that the entire composite sample passes through in no fewer than 100 rotations.

8.3.2 After the initial distribution has been made, measure the sample size by determining the mass (or the volume) of the powder from one of the riffler collecting containers.

8.4 Adjustments can then be made by: *(1)* using *one* of the previously-riffled samples; *(2)* combining *two or more* of the previously-riffled samples; or *(3)* using *one or more* of the previously-riffled samples to increase the quantity in the remaining previously-filled containers; then repeatedly riffling to produce smaller size samples until the desired test portion size is reached. If each riffled sample becomes too small to be used as a test portion, two or more riffled samples may be combined to make up the test portion quantity.

9. Keywords

9.1 chute sampler; composite sample; gross sample; increment; Keystone sampler; micro riffler; micro splitter; riffler; sampling; scoop; slot sampler; spinning riffler; splitter; test portion; test specimen; tube sampler

SUMMARY OF CHANGES

Committee B09 has identified the location of selected changes to this standard since the last issue (B215 – 010) that may impact the use of this standard.

(1) The standard has been restructured, splitting it into two parts: Part 1, Obtaining the composite sample; and Part 2, Obtaining the test portions from the composite sample.
(2) In each part, multiple sampling practices are specified, with each practice's applicability and preference indicated.
(3) Scoop sampling has been added as a common practice.
(4) For all the practices, more detailed procedures have been described, and a short description of each practice, with regard to applicability, has been added to the scope.
(5) Information has been added to the scope to indicate the types of materials for which these practices can be used.
(6) New, more descriptive, schematic depictions of some of the sampling devices have been added.
(7) The intermediate "test sample" has been eliminated, taking the test portions directly from the composite sample.
(8) The sampling scheme in Fig. 1 has been changed to eliminate the "test sample" and indicate the intermediate steps between sampling practices.
(9) The "Significance and Use" section has been expanded to emphasize the importance of proper sampling practices, to indicate the conditions for good practices, and to describe the use of metal powder samples.
(10) Keywords have been changed and added to reflect the terminology used in the revised standard.