



# Standard Practice for Sampling Aggregates<sup>1</sup>

This standard is issued under the fixed designation D75/D75M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice covers sampling of coarse and fine aggregates for the following purposes:

- 1.1.1 Preliminary investigation of the potential source of supply,
- 1.1.2 Control of the product at the source of supply,
- 1.1.3 Control of the operations at the site of use, and
- 1.1.4 Acceptance or rejection of the materials.

NOTE 1—Sampling plans and acceptance and control tests vary with the type of construction in which the material is used.

1.2 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.3 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.

1.4 *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.*

NOTE 2—The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of Practice D3666 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3666 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of Practice D3666 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.30 on Methods of Sampling.

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## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- C125 Terminology Relating to Concrete and Concrete Aggregates
- C702 Practice for Reducing Samples of Aggregate to Testing Size
- D8 Terminology Relating to Materials for Roads and Pavements
- D2234/D2234M Practice for Collection of a Gross Sample of Coal
- D3665 Practice for Random Sampling of Construction Materials
- D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
- E105 Practice for Probability Sampling of Materials
- E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process
- E141 Practice for Acceptance of Evidence Based on the Results of Probability Sampling

## 3. Terminology

### 3.1 Definitions:

3.1.1 *maximum size of aggregate, n—in specifications for, or descriptions of aggregate*—the smallest sieve opening through which the entire amount of aggregate is required to pass.

3.1.2 *maximum aggregate size, (Superpave) n—in specifications for, or descriptions of aggregate*—one size larger than the nominal maximum aggregate size.

3.1.3 *nominal maximum aggregate size (of aggregate), n—in specifications for, or descriptions of aggregate*—the smallest sieve opening through which the entire amount of the aggregate is permitted to pass.

3.1.4 *nominal maximum aggregate size (Superpave), n—in specifications for, or descriptions of aggregate*—one size larger than the first sieve that retains more than 10 % aggregate.

<sup>2</sup> 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.

3.1.4.1 *Discussion*—The definitions in 3.1.1 and 3.1.2 also appear in Terminologies C125 and D8. They are presented in this standard to illustrate the differences between the aggregate definitions and Superpave definitions of similar terms. The definitions in 3.1.2 and 3.1.4 apply to hot mix asphalt (HMA) mixtures designed using the Superpave system only.

3.1.4.2 *Discussion*—Specifications on aggregates usually stipulate a sieve opening through which all of the aggregate may, but not need to, pass so that a slated maximum portion of the aggregate may be retained on that sieve. A sieve opening so designed is the *nominal maximum size*.

#### 4. Significance and Use

4.1 Sampling is equally as important as the testing, and the sampler shall use every precaution to obtain samples that will show the nature and condition of the materials which they represent.

4.2 Samples for preliminary investigation tests are obtained by the party responsible for development of the potential source (Note 3). Samples of materials for control of the production at the source or control of the work at the site of use are obtained by the manufacturer, contractor, or other parties responsible for accomplishing the work. Samples for tests to be used in acceptance or rejection decisions by the purchaser are obtained by the purchaser or his authorized representative.

NOTE 3—The preliminary investigation and sampling of potential aggregate sources and types occupies a very important place in determining the availability and suitability of the largest single constituent entering into the construction. It influences the type of construction from the standpoint of economics and governs the necessary material control to ensure durability of the resulting structure, from the aggregate standpoint. This investigation should be done only by a responsible trained and experienced person. For more comprehensive guidance, see the Appendix.

#### 5. Securing Samples

5.1 *General*—Where practicable, samples to be tested for quality shall be obtained from the finished product. Samples from the finished product to be tested for abrasion loss shall not be subject to further crushing or manual reduction in particle size in preparation for the abrasion test unless the size of the finished product is such that it requires further reduction for testing purposes.

5.2 *Inspection*—The material to be sampled shall be visually inspected to determine discernible variations. If any discernible variations are noted, corrective action shall be taken to establish homogeneity in the material prior to sampling. If it is necessary to indicate the degree of variability existing within the main pile, separate samples shall be drawn from separate areas of the pile. The seller shall provide suitable equipment needed for proper inspection and sampling.

##### 5.3 Procedure:

5.3.1 *Sampling from a Flowing Aggregate Stream (Bins or Belt Discharge)*—Select units to be sampled by a random method, such as Practice D3665, from the production. Obtain at least three approximately equal increments, selected at random from the unit being sampled, and combine to form a field sample whose mass equals or exceeds the minimum recommended in 5.4.2. Take each increment from the entire

cross section of the material as it is being discharged. It is usually necessary to have a special device constructed for use at each particular plant. This device consists of a pan of sufficient size to intercept the entire cross section of the discharge stream and hold the required quantity of material without overflowing. A set of rails may be necessary to support the pan as it is passed under the discharge stream. Insofar as is possible, keep bins continuously full or nearly full to reduce segregation.

NOTE 4—Sampling the initial discharge or the final few tons from a bin or conveyor belt increases the chances of obtaining segregated material and should be avoided.

5.3.2 *Sampling from the Conveyor Belt*—Select units to be sampled by a random method, such as Practice D3665, from the production. Obtain at least three approximately equal increments, selected at random, from the unit being sampled and combine to form a field sample whose mass equals or exceeds the minimum recommended in 5.4.2. Stop the conveyor belt while the sample increments are being obtained. Insert two templates, the shape of which conforms to the shape of the belt in the aggregate stream on the belt, and space them such that the material contained between them will yield an increment of the required weight (see Fig. 1). Carefully scoop all material between the templates into a suitable container and collect the fines on the belt with a brush and dust pan and add to the container.

NOTE 5—Automatic belt samplers may be used as long as they are properly maintained, and regular inspection ensures all material is being removed from the belt (see Fig. 2).

5.3.3 *Sampling from Stockpiles*—Avoid sampling coarse aggregate or mixed coarse and fine aggregate from stockpiles whenever possible, particularly when the sampling is done for the purpose of determining aggregate properties that may be dependent upon the grading of the sample. If circumstances make it necessary to obtain samples from a stockpile of coarse aggregate or a stockpile of combined coarse and fine aggregate, design a sampling plan for the specific case under consideration to ensure that segregation does not introduce a bias in the results. This approach will allow the sampling agency to use a sampling plan that will give a confidence in results obtained therefrom that is agreed upon by all parties concerned to be



**FIG. 1 Belt Sampling Template**



**FIG. 2 Automatic Belt Sampler**

acceptable for the particular situation. The sampling plan shall define the number of samples necessary to represent lots and sublots of specific sizes. The sampling plan shall also define any specialized site-specific sampling techniques or procedures that are required to ensure unbiased samples for existing conditions. The owner and supplier shall agree upon the use of any specialized site-specific techniques or procedures. When site-specific techniques or procedures are developed for sampling a stockpile, those procedures shall supersede the procedures given in 5.3.3.1. (Note 6). General principles for sampling from stockpiles are applicable to sampling from trucks, rail cars, barges, or other transportation units.

NOTE 6—Specific site sampling plans may include the number of sampling increments (loader buckets) required to construct the sampling pad.

**5.3.3.1 Sampling from Stockpiles with Power Equipment (preferred)**—In sampling material from stockpiles it is very difficult to ensure unbiased samples due to the segregation which often occurs when material is stockpiled, with coarser particles rolling to the outside base of the pile. For coarse or mixed coarse and fine aggregate, every effort shall be made to enlist the services of power equipment to develop a separate small sampling pile.

(1) When obtaining a sample from a stockpile for acceptance testing, a loader shall enter the stockpile nearest the area representing material that is currently being shipped or loaded into a production facility, with the bucket approximately 150 mm [6 in.] above ground level, never allowing the front tires of the loader to ramp up on the pile. Without backing up, the loader shall lift the full bucket of material then tilt the bucket down to gently roll the material out of the bucket back onto the pile, thus re-blending any segregated material on the outside surface of the pile. If prior visual inspection noted discernible variation, or if the loader is not of sufficient size to cause a cascading effect down the face of the pile during this remixing process, several buckets of material shall either be remixed or removed and discarded to prevent use of potentially injurious material.

(2) After re-blending, the loader shall re-enter the stockpile, as before, and obtain a full loader bucket of the

re-blended material, tilt back and lift the bucket only high enough to back up slightly.

(3) At the base of the main stockpile with the bucket only high enough to permit free-flow of the material from the bucket, the loader operator shall tilt the bucket forward to gently roll the material out of the bucket forming a small sampling pile. If the loader bucket is not of sufficient size to create a sample pad of representative size, multiple buckets shall be used, dumped on top of each other and back-dragged to form a single sample pad.

(4) At this point the loader operator shall raise the bucket, drive forward far enough to reach across the small pile with the loader bucket without allowing the loader tires to ramp up on the sampling pile, lower the bucket to about half the height of the small pile, and backup, therefore creating a flat surface for sampling (see Fig. 3). The loader shall only back-drag the small pile once. This flat surface provides a stable and safe area to obtain a representative sample.

(5) Place the sample bucket(s) near the center of the flat, oval-shaped sampling pad. The sample shall be obtained across the entire flat area, but avoid sampling within 0.3 m [1 ft] of the sample pad edge. Divide the sample pad into 4 quadrants and sample equal amounts of materials evenly across each quadrant. Fully insert the shovel as near vertical as possible then gently roll the shovel back and lift slowly to avoid coarse material rolling off the sides of the shovel (Note 7). Obtain additional shovelfuls from different quadrants of the sampling pad, and in areas that avoid previous “shovel holes.”

NOTE 7—Square-tip shovels with the outer edges rolled up approximately 50 mm [2 in.] on each side works well in preventing material from rolling from the side. Spade-tip shovels are not recommended.

**5.3.3.2 Sampling from Stockpiles Without Power Equipment:**

NOTE 8—Sampling coarse aggregate and coarse and fine mixed aggregate stockpiles without the aid of power equipment is not advised.

(1) Where power equipment is not available, samples from stockpiles shall be made up of at least three increments taken from the top third, at the mid-point, and bottom third of the elevation of the stockpile.

(2) Shove a board vertically into the pile just above the sampling point to prevent coarser material from rolling down and further segregating the material and biasing the sample. The board shall be of ample size to prevent material from cascading down into the sampling area.

(3) With the board in place, scrape off the outer most surface of the pile with the shovel, then insert the shovel perpendicular to the angle of the pile, into the freshly exposed material to obtain the sample. Repeat this process across the face of the stockpile until the recommended minimum field sample size in 5.4.2 is obtained but no less than the three increments described in 5.3.3.2(1).

**5.3.3.3 Sampling Fine Aggregate from Stockpiles (Alternative Method for Fine Aggregate Only)**—When sampling fine aggregate from a stockpile, the outer layer, which easily becomes segregated by wind and rain during stockpile storage, shall be removed and the sample taken from the material beneath.





Step 1. Loader enters stockpile with bucket approximately 150mm [6 in.] above ground level



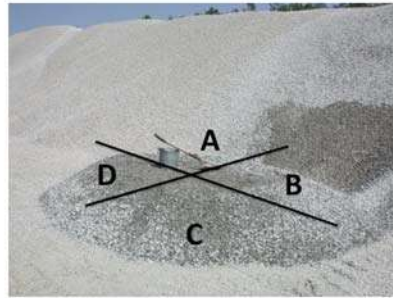
Step 3. Loader reaches across the small pile, lowers bucket, and back-drags small pile to form the sampling pad



Step 2. Loader gently rolls the material out of the bucket to form a small pile



Step 4. Sampling pad



Step 5. Draw sample portions from each quadrant

**FIG. 3 Five-Step Photographic Sequence of Constructing Sampling Pad From Stockpile of Aggregate**

(1) Sampling tubes approximately 30 mm [1.25 in.] minimum by 2 m [6 ft.] in length shall be inserted into the shipping face of the stockpile horizontally at random locations.

NOTE 9—A sampling tube can be constructed of aluminum, PVC, or other sturdy material. The tip being inserted into the pile can be cut at a 45° angle to ease insertion.

(2) Sample shall be taken at a minimum height of 3 ft from the surrounding grade.

(3) A minimum of five tube insertions randomly spaced across the face of the stockpile shall form a single field sample (see Fig. 4). Ensure that the minimum field sample size recommended in 5.4.2 is obtained.

5.3.4 *Sampling from Transportation Units*—Avoid sampling coarse aggregate or mixed coarse and fine aggregate from transportation units whenever possible, particularly when the sampling is done for the purpose of determining aggregate properties that may be dependent upon the grading of the sample. If circumstances make it necessary to obtain samples from a transportation unit, design a sampling plan for the specific case under consideration to ensure that segregation does not introduce a bias in the results. This approach will allow the sampling agency to use a sampling plan that will give

a confidence in results obtained therefrom that is agreed upon by all parties concerned to be acceptable for the particular situation. The sampling plan shall define the number of samples necessary to represent lots and sublots of specific sizes. General principles for sampling from stockpiles are applicable to sampling from trucks, rail cars, barges, or other transportation units.

NOTE 10—Sampling from transportation units should be avoided if at all possible. In sampling material from transportation units it is very difficult to ensure unbiased samples, due to the segregation which often occurs when material is transported, with coarser particles rolling to the outside and finer particles settling.

5.3.4.1 In sampling coarse aggregates from railroad cars or barges, effort shall be made to enlist the services of power equipment capable of exposing the material at various levels and random locations.

5.3.4.2 Where power equipment is not available, a common procedure requires excavation of three or more trenches using a shovel across the unit at points that will, from visual appearance, give a reasonable estimate of the characteristics of the load. The trench bottom shall be approximately level, at least 0.3 m [1 ft] in width and in depth below the surface.

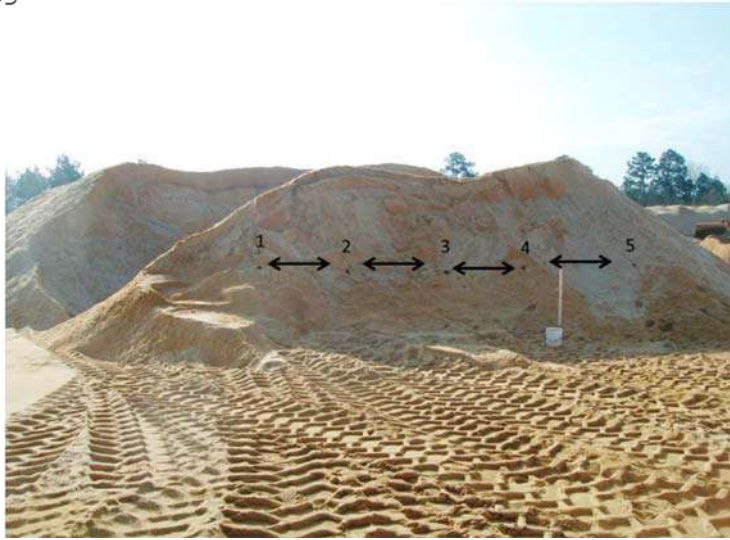


FIG. 4 Sampling Fine Aggregate from Stockpile Using Sampling Tube

5.3.4.3 A minimum of three increments from approximately equally spaced points along each trench shall be taken by pushing a shovel downward into the material.

5.3.4.4 Coarse aggregate in trucks shall be sampled in essentially the same manner as for rail cars or barges, except for adjusting the number of increments according to the size of the truck.

5.3.4.5 For fine aggregate in transportation units, sampling tubes as described in 5.3.3.3, except inserted vertically, may be used to extract an appropriate number of increments from the trenches to form the field sample.

5.3.5 Sampling from Roadway (Bases and Subbases):

5.3.5.1 Sample units selected by a random method, such as Practice D3665, from the construction.

5.3.5.2 Obtain at least three approximately equal increments, selected at random from the unit being sampled, after the material has been placed and prior to compaction, and combine to form a field sample whose mass equals or exceeds the minimum recommended in 5.4.2. Take all increments from the roadway for the full depth of the material, taking care to exclude any underlying material. Clearly mark the specific areas from which each sample increment is to be removed.

5.3.5.3 A metal template placed over the area will aid in securing approximately equal increment weights. Place the template on top of the material to be sampled. Sample material from the center of the template. As material is extracted from the center of the template, the template is continuously lowered to prevent the material outside of the template from falling into the sample hole. The template shall be composed of metal or other sturdy material, no less than 0.3 m [12 in.] in diameter and 0.25 m [9 in.] in height, providing a sampling area not less than 0.07 m<sup>2</sup> [110 in.<sup>2</sup>] (see Fig. 5).

5.4 Number and Masses of Field Samples:

5.4.1 The number of field samples (obtained by one of the methods described in 5.3) required depends on the criticality of, and variation in, the properties to be measured. Designate each unit from which a field sample is to be obtained prior to sampling. The number of field samples from the production shall be sufficient to give the desired confidence in test results.

NOTE 11—Guidance for determining the number of samples required to obtain the desired level of confidence in test results may be found in Test Method D2234/D2234M, Practice E105, Practice E122, and Practice E141.



FIG. 5 Proper Use of Metal Template For Sampling Mixed Coarse and Fine Aggregate From Roadway Grade

**TABLE 1 Minimum Size of Field Samples**

Aggregate Size <sup>A</sup>	Field Sample Mass, min, kg <sup>B</sup> [lb]	Field Sample Volume, min, L [gal]
Fine Aggregate		
2.36 mm [No. 8]	10 [22]	8 [2]
4.75 mm [No. 4]	10 [22]	8 [2]
Coarse Aggregate		
9.5 mm [3/8 in.]	10 [22]	8 [2]
12.5 mm [1/2 in.]	15 [35]	12 [3]
19.0 mm [3/4 in.]	25 [55]	20 [5]
25.0 mm [1 in.]	50 [110]	40 [10]
37.5 mm [1 1/2 in.]	75 [165]	60 [15]
50 mm [2 in.]	100 [220]	80 [21]
63 mm [2 1/2 in.]	125 [275]	100 [26]
75 mm [3 in.]	150 [330]	120 [32]
90 mm [3 1/2 in.]	175 [385]	140 [37]

<sup>A</sup> For processed aggregates, use the nominal maximum size as indicated by the appropriate specification or description. If the specification or description does not indicate a nominal maximum size (for example, a sieve size indicating 90 to 100 % passing), use the maximum size (that sieve indicating 100 % passing).

<sup>B</sup> For combined coarse and fine aggregates (for example, base or subbase aggregate), the minimum weight shall be coarse aggregate minimum mass plus 10 kg.

5.4.2 The field sample masses cited are tentative. The masses must be predicated on the type and number of tests to which the material is to be subjected and sufficient material obtained to provide for the proper execution of these tests. Standard acceptance and control tests are covered by ASTM standards and specify the portion of the field sample required for each specific test. Generally speaking, the amounts specified in **Table 1** will provide adequate material for routine grading and quality analysis. Extract test portions from the field sample according to Practice **C702** or as required by other applicable test methods.

## 6. Shipping Samples

6.1 Transport aggregates in bags or other containers so constructed as to preclude loss or contamination of any part of the sample, or damage to the contents from mishandling during shipment.

6.2 Shipping containers for aggregate samples shall have suitable individual identification attached and enclosed so that field reporting, laboratory logging, and test reporting may be facilitated.

## 7. Keywords

7.1 aggregates; exploration of potential sources; number and sizes needed to estimate character; sampling

## APPENDIXES

### (Nonmandatory Information)

#### X1. EXPLORATION OF POTENTIAL AGGREGATE SOURCES

##### X1.1 Scope

X1.1.1 Sampling for evaluation of potential aggregate sources should be performed by a responsible trained and experienced person. Because of the wide variety of conditions under which sampling may have to be done it is not possible to describe detailed procedures applicable to all circumstances. This appendix is intended to provide general guidance and list more comprehensive references.

##### X1.2 Sampling Stone from Quarries or Ledges

X1.2.1 *Inspection*—The ledge or quarry face should be inspected to determine discernible variations or strata. Differences in color and structure should be recorded.

X1.2.2 *Sampling and Size of Sample*—Separate samples having a mass of at least 25 kg [55 lbs] should be obtained

from each discernible stratum. The sample should not include material weathered to such an extent that it is no longer suitable for the purpose intended. One or more pieces in each sample should be at least 150 by 150 by 100 mm [6 in. by 6 in. by 4 in.] in size with the bedding plane plainly marked, and this piece should be free of seams or fractures.

X1.2.3 *Record*—In addition to the general information accompanying all samples the following information should accompany samples taken from ledges or quarry faces:

X1.2.3.1 Approximate quantity available. (If quantity is very large this may be recorded as practically unlimited.)

X1.2.3.2 Quantity and character of overburden.

X1.2.3.3 A detailed record showing boundaries and location of material represented by each sample.

NOTE X1.1—A sketch, plan, and elevation, showing the thickness and



location of the different layers is recommended for this purpose.

### **X1.3 Sampling Roadside or Bank Run Sand and Gravel Deposits**

X1.3.1 *Inspection*—Potential sources of bank run sand and gravel may include previously worked pits from which there is an exposed face or potential deposits discovered through air-photo interpretation, geophysical exploration, or other types of terrain investigation.

X1.3.2 *Sampling*—Samples should be so chosen from each different stratum in the deposit discernible to the sampler. An estimate of the quantity of the different materials should be made. If the deposit is worked as an open-face bank or pit, samples should be taken by channeling the face vertically, bottom to top, so as to represent the materials proposed for use. Overburdened or disturbed material should not be included in the sample. Test holes should be excavated or drilled at numerous locations in the deposit to determine the quality of the material and the extent of the deposit beyond the exposed face, if any. The number and depth of test holes will depend upon the quantity of the material needed, topography of the area, nature of the deposit, character of the material, and

potential value of the material in the deposit. If visual inspection indicates that there is considerable variation in the material, individual samples should be selected from the material in each well defined stratum. Each sample should be thoroughly mixed and quartered if necessary so that the field sample thus obtained will be at least 12 kg [25 lbs] for sand and 35 kg [75 lbs] if the deposit contains an appreciable amount of coarse aggregate.

X1.3.3 *Record*—In addition to the general information accompanying all samples the following information should accompany samples of bank run sand and gravel:

X1.3.3.1 Location of supply.

X1.3.3.2 Estimate of approximate quantity available.

X1.3.3.3 Quantity and character of overburden.

X1.3.3.4 Length of haul to proposed site of work.

X1.3.3.5 Character of haul (kind of road, maximum grades, and so forth)

X1.3.3.6 Details as to extent and location of material represented by each sample.

NOTE X1.2—A sketch of plans and elevations, showing the thickness and location of different layers, is recommended for this purpose.

## **X2. NUMBER AND SIZE OF INCREMENTS NEEDED TO ESTIMATE CHARACTER OF UNIT SAMPLED**

### **X2.1 Scope**

X2.1.1 This appendix presents the rationale used by the responsible committee in the development of this practice.

### **X2.2 Descriptions of Terms Specific to This Standard**

X2.2.1 *field sample*—a quantity of the material of sufficient size to provide an acceptable estimate of the average quality of a unit.

X2.2.2 *lot*—a sizable isolated quantity of bulk material from a single source, assumed to have been produced by the same process (for example, a day's production or a specific mass or volume).

X2.2.3 *test portion*—a quantity of the material to be tested of sufficient size extracted from the larger field sample by a procedure designed to ensure accurate representation of the field sample, and thus of the unit sampled.

X2.2.4 *unit*—a batch or finite subdivision of a lot of bulk material (for example, a truck load or a specific area covered).

### **X2.3 Test Unit, Size, and Variability**

X2.3.1 The unit to be represented by a single field sample should neither be so large as to mask the effects of significant variability within the unit nor be so small as to be affected by the inherent variability between small portions of any bulk material.

X2.3.2 A unit of bulk material composed of graded aggregate or aggregate mixtures might consist of a full truckload. If it were possible, the entire load might be tested; as a practical matter, a field sample is composed of three or more increments chosen at random from the material as it is loaded or unloaded from the truck. Research has shown that such a procedure permits an acceptable estimate to be made of the average gradation that might be measured from 15 or 20 increments from the truck.

X2.3.3 Significant variability with a lot of material, where it might exist, should be indicated by statistical measures, such as the standard deviation between units selected at random from within the lot.

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