



# Standard Practice for Random Sampling of Construction Materials<sup>1</sup>

This standard is issued under the fixed designation D3665; 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 the determination of random locations (or timing) at which samples of construction materials can be taken. For the exact physical procedures for securing the sample, such as a description of the sampling tool, the number of increments needed for a sample, or the size of the sample, reference should be made to the appropriate standard method. The selection procedures in Section 6 utilize the table of four-digit numbers given in Table 1.

1.2 *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:<sup>2</sup>

- C172 Practice for Sampling Freshly Mixed Concrete
- C183 Practice for Sampling and the Amount of Testing of Hydraulic Cement
- D75 Practice for Sampling Aggregates
- D140 Practice for Sampling Bituminous Materials
- D345 Test Method for Sampling and Testing Calcium Chloride for Roads and Structural Applications
- D979 Practice for Sampling Bituminous Paving Mixtures
- D5361 Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing
- 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

<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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<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.

## Results of Probability Sampling

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *representative sample, n*—(1) a random sample; or (2) an unbiased sample.

3.1.1.1 *random sample, n*—a sample obtained from a lot of material in such a manner that all parts of the lot have a known probability of being included in the sample.

3.1.1.1.1 *Discussion*—An example of random sample is the case where specifications limit roadway sampling to within one foot of the edge, therefore the probability of inclusion of samples within one foot of the edge is zero.

3.1.1.2 *unbiased sample, n*—a sample obtained from a lot of material in such a manner that all parts of the lot have an equal probability of being included in the sample.

## 4. Significance and Use

4.1 This practice is useful for determining the location or time, or both, to take a sample in order to minimize any unintentional bias on the part of the person taking the sample.

NOTE 1—The effectiveness of this practice in achieving random samples is limited only by the conscientiousness of the user in following the stipulated procedures.

4.2 The selection procedures and examples in this standard provide a practical approach for ensuring that construction material samples are obtained in a random manner. Additional details concerning the number of sample increments, the number of samples, the quantities of material in each, and the procedures for extracting sample increments or samples from the construction lot or process are contained in Practices C172, C183, D75, D140, D979, D5361, and Test Method D345.

4.3 This standard contains examples citing road and paving materials. The concepts outlined herein are applicable to the random sampling of any construction material and can easily be adapted thereto.

4.4 Additional sampling guidance is provided in Practice E105 concerning probability sampling, Practice E122 concerning choosing sample sizes to estimate the average quality of a lot or process (see Note 2), and in Practice E141 for acceptance of evidence based on results of probability sampling.























## 5. Instructions for Using the Four-Digit Table of Random Numbers (Table 1)

5.1 Table 1 consists of 10 000 numbers from 0.0001 to 1.0000. Each number appears only once in the Table of 500 rows by 20 columns.

5.2 The Table is most effectively used when a row and column are randomly selected and the entered value from the Table is then used for sample selection.

5.2.1 Several methods of selection of row and column are available including use of the RANDOM function in pocket calculators (if available) to select row and column.

5.2.1.1 For example, for selection of row: the RANDOM function generates 0.6202. Then the row to be used is  $0.6202 \times \text{the number of rows} = 0.6202(500) = 310.1$  or 310. Likewise for the column, the RANDOM function generates 0.9586 and the column is  $0.9586(20) = 19.2$  or 19. The random number to be used for the sample is in row 310, column 19 = 0.3513.

5.2.1.2 Similarly, if Microsoft Excel® is available, the RAND function can be used to generate random numbers for selection of row and column. This can be accomplished by selecting an open cell in Excel entering = followed by opening “Function” in the “Insert” Menu and completing once for row and a second for column. Selection of the random number is by the method shown in Note 4.

NOTE 4—An Excel procedure for direct determination of the random number from Table 1 is available on a disk from ASTM that includes the selection procedure as well as a screen view and printable form of Table 1.

## 6. Selection Procedures

### 6.1 Sampling from a Belt or Flowing Stream of Material:

6.1.1 Determine the length of time,  $t$ , in minutes, for the lot of material to be sampled to pass the sampling point and determine the number of samples,  $n$ , to be taken from the lot. Following the instructions accompanying Table 1, pick  $n$  numbers to determine the times  $t$  to select the necessary samples.

#### 6.1.2 Example:

6.1.2.1 The lot of material to be sampled from a flowing stream at a transfer point is defined as 480 min of production. Five samples are required from the lot. From Table 1, the following five numbers were picked:

0.0918  
0.4205  
0.2171  
0.3702  
0.0061

The first three digits are used directly (decimals disregarded) to determine the sample selection times. Any number over 480 should be discarded and another chosen.

6.1.2.2 Thus, samples will be taken at the following times after production begins (to the nearest 1 min and arranged in chronological order):

min  
6  
91  
217  
370  
420

NOTE 5—The user may wish to decide a minimum time to allow the

plant to become fully operational. In cases where the picked number results in a time less than this, the user should discard the picked number and choose another.

NOTE 6—While the above exact times were picked, in practice, the user may wish to round off actual sampling times to the nearest 5 min.

### 6.2 Sampling From a Windrow of Material:

6.2.1 Determine the total length of one windrow in metres that represents a lot of material and determine the number of samples,  $n$ , to be taken from the lot. Following the instruction accompanying Table 1, pick  $n$  numbers to determine the length, ( $l$ ), from the start of the windrow from which samples will be taken.

#### 6.2.2 Example:

6.2.2.1 A lot of material has been placed in windrows 900 m in length. It is desired to secure three samples from this lot. From Table 1 the following three numbers are picked:

0.5269  
0.7044  
0.1931

6.2.2.2 These numbers are then multiplied by 900 giving the number of metres from the beginning of the windrow at which to sample. Thus, samples (rounded to the nearest metre and arranged in sequence) are selected at the following intervals:

174 m ( $900 \times 0.1931$ )  
474 m ( $900 \times 0.5269$ )  
634 m ( $900 \times 0.7044$ )

### 6.3 Sampling In-Place Paving Material:

6.3.1 Determine the length of one pavement representing a lot of material, the width of the pavement,  $w$ , and the number of samples needed for each lot,  $n$ . Following the instructions accompanying Table 1, pick  $l$  numbers corresponding to the length of pavement, followed by picking  $w$  numbers for width determination.

#### 6.3.2 Example:

6.3.2.1 A lot is defined as 1.6 km of in-place 3.6-m wide pavement. Two samples are to be taken from each lot. Since there are 1600 m in the lot, enter the table and pick two numbers, which are then multiplied by 1600 m. In this instance, the two numbers chosen were:

0.3768  
0.5295

6.3.2.2 Thus, the two samples will be taken at 603 and 847 m from the beginning of the pavement.

6.3.2.3 Determine the location from the edge of the pavement by selecting two additional numbers from Table 1, which are then multiplied by 3.6. In this case, the two numbers chosen were:

0.5127  
0.7082

6.3.2.4 Therefore, the first sample should be taken 603 m from the beginning of the pavement (see 6.3.2.2) and 1.8 m from the designated (right or left) edge of the pavement.

6.3.2.5 The second sample should be taken 847 m from the beginning of the pavement and 2.5 m from the designated (right or left) edge of the pavement.

### 6.4 Sampling From a Loaded Truck:

6.4.1 Determine the number of truck loads that represent a lot of material and determine the number of samples,  $n$ , needed from each lot. To determine which trucks to sample, pick  $n$

numbers from **Table 1** and multiply these numbers by the number of trucks in the lot. To determine the quadrant in each truck to be sampled, choose  $n$  numbers from **Table 1** and multiply by 4. Select the quadrant in accordance with the following criteria. Quadrant locations of the truck are numbered as shown in **Fig. 1**.

Calculated Random Number, N	Quadrant
$N \leq 1.0$	1
$1.0 < N \leq 2.0$	2
$2.0 < N \leq 3.0$	3
$3.0 < N \leq 4.0$	4

6.4.2 *Example:*

6.4.2.1 Twenty trucks are considered a lot and three samples are required. Using **Table 1**, the following three numbers were picked:

0.2516  
0.4243  
0.8657

6.4.2.2 Thus, trucks numbered 5 ( $0.2516 \times 20$ ), 8 ( $0.4243 \times 20$ ), and 17 ( $0.8657 \times 20$ ) should be sampled.

6.4.2.3 To determine the quadrant locations, the following numbers were picked:

0.1100  
0.3809  
0.0641

These are multiplied by 4 with the following results:

Quadrant 1 from truck No. 5 ( $4 \times 0.1100$ )  
Quadrant 2 from truck No. 8 ( $4 \times 0.3809$ )  
Quadrant 1 from truck No. 17 ( $4 \times 0.0641$ )

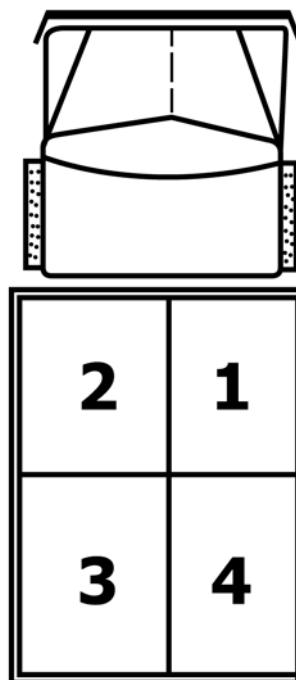


FIG. 1 Quadrants for Random Sampling from a Loaded Truck

7. Keywords

7.1 random number tables; sampling, random

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