Designation: E300 – 03 (Reapproved 2009)

# Standard Practice for Sampling Industrial Chemicals[1]

This standard is issued under the fixed designation E300; 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 Department of Defense.*

## 1. Scope

1.1 This practice covers procedures for sampling several classes of industrial chemicals. It also includes recommendations for determining the number and location of such samples, to ensure their being representative of the lot in accordance with accepted probability sampling principles.

1.2 Although this practice describes specific procedures for sampling various liquids, solids, and slurries, in bulk or in packages, these recommendations only outline the principles to be observed. They should not take precedence over specific sampling instructions contained in other ASTM product or method standards.

1.3 These procedures are covered as follows:



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.* Specific precautionary statements are given in Sections 6, 19, 20, 30, 34 and 37.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D270 Method of Sampling Petroleum and Petroleum Products[3]

D2234/D2234M Practice for Collection of a Gross Sample of Coal

E180 Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial and Specialty Chemicals

## 3. Terminology

3.1 *Definitions:*

3.1.1 *simple liquid*—a single-phase liquid having a Reid vapor pressure of less than 110 kPa at 37.8°C (16 psi at 100°F) and a Saybolt viscosity of less than 10 000 s (2160 cSt) at 25°C.

3.1.2 *lot*—a discreet quantity of material. It may contain a single batch or several batches, or be the product of continuous process broken into units on the basis of time or shipment. It is very desirable that individual batches in a lot be specifically identified so that they may become individual or stratified units for inspection.

3.1.3 *average sample*—one that consists of proportionate parts from all sections of the container.

3.1.4 *spot sample*—a sample taken at a specific location in a tank or from a flowing stream in a pipe at a specific time.

3.1.5 *composite sample*—a blend of spot samples mixed in proportion to the volumes of material from which the spot samples were obtained.

3.1.6 *all-levels sample*—one obtained by submerging a closed sampler to a point as near as possible to the draw-off level, then opening the sampler and raising it at a rate such that it is about three fourths full as it emerges from the liquid. An all-levels sample is not necessarily an average sample because the tank volume may not be proportional to the depth and because the operator may not be able to raise the sampler at the variable rate required for proportionate filling. The rate of filling is proportional to the square root of the depth of immersion.

NOTE 1—The tube sampling procedure, 26.3, may be used to obtain an all-levels sample from a drum.

3.1.7 *upper sample*—a spot sample obtained from the middle of the upper third of the tank contents (Fig. 1).

NOTE 2—The taking of samples from various levels of the tank permits the detection of variation in composition of the contents caused by

[1] This practice is under the jurisdiction of ASTM Committee E15 on Industrial and Specialty Chemicals and is the direct responsibility of Subcommittee E15.01 on General Standards.

Current edition approved Oct. 1, 2009. Published December 2009. Originally approved in 1966. Last previous edition approved in 2003 as E300 – 03. Discontinued 2001. Reinstated as E300 – 03. DOI: 10.1520/E0300-03R09.

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

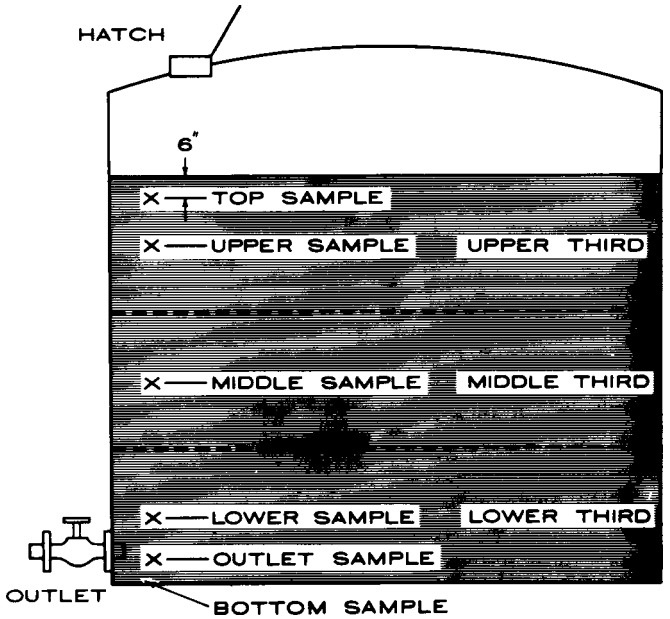

FIG. 1 Sampling Depths

stratification. If it is known that the contents are not subject to this variation, the taking of samples at multiple levels may be eliminated.

3.1.8 *middle sample*—a spot sample obtained from the middle of the tank contents (Fig. 1) (Note 2).

3.1.9 *lower sample*—a spot sample of liquid from the middle of the lower one-third of the tank's content (a distance of one-half of the depth of liquid below the liquid's surface) (Fig. 1).

3.1.10 *single-tank composite sample*—a blend of the upper, middle, and lower samples. For a tank of uniform cross section, such as an upright cylindrical tank, the blend consists of equal parts of the three samples. For a horizontal cylindrical tank, the blend consists of the three samples in the proportions shown in Table 1.

3.1.11 *compartment-tank composite sample (ship, barge, etc.)*—a blend of individual all-levels samples from each compartment, which contains the product being sampled, in proportion to the volume of material in each compartment.

3.1.12 *top sample*—a spot sample normally obtained 150 mm (6 in.) below the top surface of the tank contents (Fig. 1).

**TABLE 1 Sampling Instructions for Horizontal Cylindrical Tanks**

| Liquid Depth, Percent of Diameter | Sampling Level, Percent of Diameter Above Bottom | | | Composite Sample Proportionate Parts of | | |
|---|---|---|---|---|---|---|
| | Upper | Middle | Lower | Upper | Middle | Lower |
| 100 | 80 | 50 | 20 | 3 | 4 | 3 |
| 90 | 75 | 50 | 20 | 3 | 4 | 3 |
| 80 | 70 | 50 | 20 | 2 | 5 | 3 |
| 70 | ... | 50 | 20 | 1 | 5 | 4 |
| 60 | ... | 50 | 20 | ... | 5 | 5 |
| 50 | ... | 40 | 20 | ... | 4 | 6 |
| 40 | ... | ... | 20 | ... | ... | 10 |
| 30 | ... | ... | 15 | ... | ... | 10 |
| 20 | ... | ... | 10 | ... | ... | 10 |
| 10 | ... | ... | 5 | ... | ... | 10 |

3.1.13 *outlet sample*—a spot sample normally obtained with the inlet opening of the sample apparatus at the level of the bottom of the tank outlet (either fixed or a swing line outlet) (Fig. 1).

3.1.14 *continuous sample*—a spot sample obtained from a pipeline conveying the product in such a manner as to give a representative average of the stream throughout the period of transit.

3.1.15 *jar sample*—a spot sample obtained by placing a jar into the path of a free-flowing stream so as to collect a definite volume from the full cross section of the stream.

3.1.16 *mixed sample*—a spot sample obtained after mixing or vigorously stirring the contents of the original container, and then pouring out or drawing off the quantity desired.

3.1.17 *tube or thief sample*—a spot sample obtained with a sampling tube or special thief, either as a core sample or spot sample from the specified point in the container.

3.1.18 *drain sample*—a spot sample obtained from the draw-off or discharge valve. Occasionally, a drain sample may be the same as a bottom sample, as in the case of a tank car.

3.1.19 *bottom sample*—a spot sample obtained from the material on the bottom surface of the tank, container, or line at its lowest point (Fig. 1). (Drain and bottom samples are usually taken to check for water, sludge, scale, etc.).

3.1.20 *laboratory sample*—that portion of the sample which is sent for laboratory testing.

## 4. Summary of Practice

4.1 This practice describes procedures to be followed for obtaining samples of several classes of industrial chemicals. It addresses in detail the various factors which need to be considered to obtain a representative laboratory sample. This practice also covers the statistical considerations in sampling of industrial chemicals whether they are liquids, solids or slurries in bulk or in packages.

## 5. Significance and Use

5.1 Representative samples of industrial chemicals are required for the determination of chemical and physical properties which are used to establish standard volumes, prices, and compliance with commercial and regulatory specifications.

5.2 The objective of sampling is to obtain a small portion (spot sample) of material from a selected area within a container which is representative of the material in the area or, in the case of running or all-level samples, a sample whose composition is representative of the total material in the container. A series of spot samples may be combined to create a representative sample.

5.3 *Manual and Automatic Sampling Considerations*—The selection of manual or automatic sampling devices is part of establishing a sampling plan applied under all conditions within the scope of this practice provided that the proper sampling procedures are followed. Both types of sampling are commonly used for liquid, solid, and slurry sampling and require adherence to the following:

5.3.1 An adequate frequency of sampling must be selected.

5.3.2 The equipment to support manual or automatic sampling systems may be obtained commercially, fabricated from

the designs presented in this practice, or constructed as needed to satisfy process design or other specific requirements.

5.3.3 The sampling equipment must be maintained on a regular basis, and the sampling plan adopted must be strictly followed.

## 6. Safety Precautions

6.1 This practice covers procedures and sampling equipment used to sample industrial chemicals that may be potentially hazardous to personnel or the environment. Accordingly, it is emphasized that all applicable safety rules, regulations, and procedures must be followed in handling and processing the chemicals. Furthermore, this practice does not purport to cover all safety aspects associated with sampling. However, it is presumed that the personnel performing sampling operations are adequately trained with regard to safe application of the procedures contained herein for the specific sampling situation.

6.2 The characteristics of the material to be sampled will govern the type of protective equipment required. Since sampling may present such hazards as splashing or spilling, protective clothing must be worn when the chemical is capable of producing eye or skin irritation or burns. During such potential exposures, chemical-type goggles or face shield and protective gloves, or combination thereof, must be worn.

6.3 Respiratory protection, where required, must be in good condition and must be suitable to protect against chemicals being handled.

6.4 When sampling chemicals that may be dangerous to life by skin absorption, oral ingestion, or by breathing the vapor, unusual precautions will be indicated. In such cases, full-body protection such as supplied by a gas-tight or one-piece air-supplied suit should be worn. A second person must be continuously present to summon help and render aid in the event of an emergency.

# STATISTICAL CONSIDERATIONS[4]

## 7. Objectives

7.1 The sampling and testing of industrial chemicals may have one or more of the following objectives:

7.1.1 The objective may be to estimate the average quality characteristic of a given lot of material and to establish confidence limits for this average. This would be the main objective, for example, if a dollar value is to be placed on the material for customs purposes or for sale.

7.1.2 The objective may be to decide whether the average value for the lot meets a specification. This calls for an acceptance sampling plan with the criterion being related to the estimated mean of the lot.

7.1.3 The objective may be to estimate or make decisions about the variability of a quality characteristic within the lot.

7.1.4 The objective may be to obtain simultaneous estimates of the mean and variance or to make decisions about some joint combination of these estimates.

7.1.5 If the material comes in containers or can be viewed as coming in clearly demarked units, the objective may be that of estimating the number of such units outside of specifications, that is, the "fraction defective."

NOTE 3—Procedures are given below for estimating average quality and for applying acceptance sampling inspection based on the lot mean.

## 8. General Sampling Considerations

8.1 To obtain samples that are representative in a statistical sense, one must consider such factors as physical form, uniformity, type and number of containers, etc. All of these factors influence the choice of method for performing the sampling operation, as well as the number and location of the required samples. Two commonly used practices for selecting the sequence or location of the individual samples are described.

8.2 *Random Sampling* is achieved when every part of the lot has an equal chance of being drawn into the sample.

8.2.1 Designate all units in the lot, choosing numbers in sequence or other serial code so that sampling by random numbers can be employed.

8.2.2 Preferably, this sequence should be in direct relation to order of manufacture of packaging as an aid to observing, from the sample results, any evidence of stratification.

8.2.3 Random selection of the numbers should be accomplished by chance or preferably by the use of a table of random numbers.

8.3 *Stratified Sampling* can be employed to estimate average quality when it is known or suspected that the value of a property of the material varies in non-random fashion throughout the lot for the following typical reasons: (*a*) the lot may contain several production batches, (*b*) the lot may contain units produced by different procedures, equipment, shifts, etc., or (*c*) the lot may be non-uniform because of subsequent size segregation, moisture pickup, surface oxidation, etc. If the assumed pattern is correct, the variance of the population mean estimate will be less than that based on random sampling. If the assumptions are incorrect, the estimate of the mean may be biased. A stratified sample can be obtained as follows:

8.3.1 Based on the known or suspected pattern, divide the lot into a number of real or imaginary strata.

8.3.2 If these sections are not equal in size, the number of samples to be taken from each stratum must be proportional to the size of the various strata.

8.3.3 Further subdivide the major strata into real or imaginary subsections and select the required number of samples by chance or preferably by means of a table of random numbers.

## 9. Estimate of Average Quality

9.1 *Determination of the Variance of a Sample Mean*—If the material comes in, or can be viewed as coming in, realizable primary units, each of which are to be divided into realizable secondary units, and if $n_b$ primary units are selected at random from a lot of $N$ primary units, and if $n_w$ secondary units are selected from each primary unit with $k$ tests being made on each secondary unit drawn, then the variance of the mean of the results is given as follows (Note 4 and Note 5):

$$\sigma_{\bar{x}}^2 = (\sigma_b^2/n_b) \times [(N - n_b)/N] + [\sigma_w^2/(n_b \times n_w)] + (\sigma_t^2/n_t) \quad (1)$$

[4] Prepared by an Ad Hoc Committee of ASTM Committee E11 on Statistical Methods.