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Standard Practice for Determining Buoyancy Corrections During Precision Weighing of Low-Density Samples¹

This standard is issued under the fixed designation D 5595; 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 covers the procedures used to determine true sample mass from scale readings, by determining the effective volume of the sample and applying a correction for the effects of the buoyancy of the air in which samples are weighed.

1.2 This practice provides the information required to determine when buoyancy corrections are warranted, and when they can be safely ignored.

1.3 This practice is used whenever a small difference in mass between two low-density samples (or the same sample on reweighing) must be determined with a high level of accuracy, to achieve the desired test method accuracy.

1.4 Refer to Practice E 380 in using this practice.

NOTE 1—Mass difference errors may be a major source of inaccuracy in methods that do not produce precision results even after careful weighing. The use of this procedure may be warranted, therefore, in test methods that presently display a precision of only $\pm 20\%$, and may subsequently display better precision and repeatability, as well as lower thresholds.

1.5 *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:

- E 380 Practice for Use of the International System of Units (SI) (the Modern Metric System)²
- D 1356 Terminology Relating to Sampling and Analysis of Atmospheres³
- D 3631 Test Methods for Measuring Surface Atmospheric Pressure
- D 4230 Test Method for Measuring Humidity with Cooled-Surface Condensation (Dew-Point) Hygrometer
- D 3670 Practice for Determination of Precision and Accuracy of Methods of Committee D-22

3. Terminology

3.1 Refer to Terminology D 1356, for definitions of other terms used in this practice.

3.2 Description of Terms Specific to This Standard:

3.2.1 *balance*—precision device that is used to determine the weight or mass of a sample. Such a device usually requires ongoing calibration, but users seldom employ a correction for buoyancy effects, as presented in this procedure. It may be a one-pan or two-pan balance, or a device that uses an electronic force measuring system to provide a reading of weight (sometimes displayed as mass).

DISCUSSION—The term *balance* is usually reserved for devices used for precision weighing and the term *scale* for conventional weighing.

3.2.2 *balance, one-pan*—balance that employs one pan for the sample, plus a balancing system that does not have a volume similar to the sample pan.

3.2.3 *balance, two-pan*—balance that employs two pans and precision weights to determine sample weight or mass.

DISCUSSION—This type of balance is usually less sensitive to buoyancy-effect tare problems than a one-pan balance or electronic scales, which do not have similar volumes on each side of the fulcrum.

3.2.4 *effective volume*—volume that is effective in displacing laboratory air, and thus governs the buoyancy force for that sample or component. This buoyancy force is modified by any tare buoyancy of the balance, and is thus a function of both the sample and the balance.

3.2.5 *sample*—component (for example; tracer-gas sampler, tracer-gas source, etc.), piece of material (for example; filter paper, insulation sample, etc.) or container being weighed to a high degree of precision.

3.2.6 *sample, constant volume*—sample that does not significantly change its ability to displace air between readings, even when its mass does change (for example; a sealed, hollow, metal container).

3.2.7 *sample density*—sample mass divided by its effective volume.

3.2.8 *sample, variable volume*—sample that changes the amount of air that it displaces, as it changes mass (for example; particulate-loaded filter paper).

4. Summary of Practice

4.1 Determine the effective volume of the air displaced by a sample which is being weighed or reweighed, by measuring the change in indicated weight of a typical sample, during large changes in laboratory air density caused by a large variation in ambient pressure, then use that information in the correction equation.

4.2 Determine the atmospheric pressure, laboratory ambient temperature, and relative humidity during the weighings and subsequent weighings, and use the data to determine the correction from a balance reading to a sample mass or for a change in a sample mass.

¹ This practice is under the jurisdiction of ASTM Committee D-22 on Sampling and Analysis of Atmospheres and is the direct responsibility of Subcommittee D22.01 on Quality Control.

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² Annual Book of ASTM Standards, Vol 14.02.

³ Annual Book of ASTM Standards, Vol 11.03.