



Standard Practice for Determining the Operational Comparability of Meteorological Measurements¹

This standard is issued under the fixed designation D 4430; 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 Sensor systems used for making meteorological measurements may be tested for laboratory accuracy in environmental chambers or wind tunnels, but natural exposure cannot be fully simulated. Atmospheric quantities are continuously variable in time and space; therefore, repeated measurements of the same quantities as required by Practice E 177 to determine precision are not possible. This practice provides standard procedures for exposure, data sampling, and processing to be used with two measuring systems in determining their operational comparability (1,2).²

1.2 The procedures provided produce measurement samples that can be used for statistical analysis. Comparability is defined in terms of specified statistical parameters. Other statistical parameters may be computed by methods described in other ASTM standards or statistics handbooks (3).

1.3 Where the two measuring systems are identical, that is, same make, model, and manufacturer, the operational comparability is called functional precision.

1.4 Meteorological determinations frequently require simultaneous measurements to establish the spatial distribution of atmospheric quantities or periodically repeated measurement to determine the time distribution, or both. In some cases, a number of identical systems may be used, but in others a mixture of instrument systems may be employed. The procedures described herein are used to determine the variability of like or unlike systems for making the same measurement.

1.5 *This standard does not purport to address 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.* (See 8.1 for more specific safety precautionary information.)

2. Referenced Documents

2.1 ASTM Standards:

D 1356 Terminology Relating to Sampling and Analysis of Atmospheres³

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods⁴

3. Terminology

3.1 For additional definitions of terms, refer to Terminology D 1356.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *difference (D)*—the difference between the systematic difference (d) of a set of samples and the true mean (μ) of the population:

$$D = d - \mu \quad (1)$$

3.2.2 *systematic difference (d)*—the mean of the differences in the measurement by the two systems:

$$d = \frac{1}{N} \sum_{i=1}^N (X_{ai} - X_{bi}) \quad (2)$$

3.2.3 *operational comparability (C)*—the root mean square (rms) of the difference between simultaneous readings from two systems measuring the same quantity in the same environment:

$$C = \pm \sqrt{\frac{1}{N} \sum_{i=1}^N (X_{ai} - X_{bi})^2} \quad (3)$$

where:

X_{ai} = i th measurement made by one system,

X_{bi} = i th simultaneous measurement made by another system, and

N = number of samples used.

3.2.3.1 *functional precision*—the operational comparability of identical systems.

3.2.4 *estimated standard deviation of the difference (s)*—a measure of the dispersion of a series of differences around their mean.

$$s = \pm \sqrt{C^2 + d^2} \quad (4)$$

¹ This practice is under the jurisdiction of ASTM Committee D22 on Sampling and Analysis of Atmospheres and is the direct responsibility of Subcommittee D22.11 on Meteorology.

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² The boldface numbers in parentheses refer to the list of references at the end of this practice.

³ *Annual Book of ASTM Standards*, Vol 11.03.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.