



Standard Practices for Measuring Surface Wind and Temperature by Acoustic Means¹

This standard is issued under the fixed designation D5527; 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 These practices cover procedures for measuring one-, two-, or three-dimensional vector wind components and sonic temperature by means of commercially available sonic anemometer/thermometers that employ the inverse time measurement technique. These practices apply to the measurement of wind velocity components over horizontal terrain using instruments mounted on stationary towers. These practices also apply to speed of sound measurements that are converted to sonic temperatures but do not apply to the measurement of temperature by the use of ancillary temperature devices.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *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:²

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

D3631 Test Methods for Measuring Surface Atmospheric Pressure

D4230 Test Method of Measuring Humidity with Cooled-Surface Condensation (Dew-Point) Hygrometer

E337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)

IEEE/ASTM SI-10 American National Standard for Use of the International System of Units (SI): The Modern Metric System

¹ These practices are under the jurisdiction of ASTM Committee D22 on Air Quality and are the direct responsibility of Subcommittee D22.11 on Meteorology. Current edition approved Oct. 1, 2011. Published October 2011. Originally approved in 1994. Last previous edition approved in 2007 as D5527 – 00 (2007). DOI: 10.1520/D5527-00R11.

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. Terminology

3.1 *Definitions*—Refer to Terminology **D1356** for common terminology.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *acceptance angle* ($\pm\alpha$, deg)—the angular distance, centered on the array axis of symmetry, over which the following conditions are met: (a) wind components are unambiguously defined, and (b) flow across the transducers is unobstructed or remains within the angular range for which transducer shadow corrections are defined.

3.2.2 *acoustic pathlength* (d , (m))—the distance between transducer transmitter-receiver pairs.

3.2.3 *sampling period(s)*—the record length or time interval over which data collection occurs.

3.2.4 *sampling rate* (Hz)—the rate at which data collection occurs, usually presented in samples per second or Hertz.

3.2.5 *sonic anemometer/thermometer*—an instrument consisting of a transducer array containing paired sets of acoustic transmitters and receivers, a system clock, and microprocessor circuitry to measure intervals of time between transmission and reception of sound pulses.

3.2.5.1 *Discussion*—The fundamental measurement unit is transit time. With transit time and a known acoustic pathlength, velocity or speed of sound, or both, can be calculated. Instrument output is a series of quasi-instantaneous velocity component readings along each axis or speed of sound, or both. The speed of sound and velocity components may be used to compute sonic temperature (T_s), to describe the mean wind field, or to compute fluxes, variances, and turbulence intensities.

3.2.6 *sonic temperature* (T_s), (K)—an equivalent temperature that accounts for the effects of temperature and moisture on acoustic wavefront propagation through the atmosphere.

3.2.6.1 *Discussion*—Sonic temperature is related to the velocity of sound c , absolute temperature T , vapor pressure of water e , and absolute pressure P by **(1)**.³

³ The boldface numbers in parentheses refer to the list of references at the end of these practices.