SLOVENSKI STANDARD
SIST ISO 16622:2004

01-junij-2004

Meteorologija ï Zvoļ ni anemometri/termometri ï Preskus sprejemljivosti metode za doloļ anje povpreļ ne vrednosti vetra

Meteorology - Sonic anemometers/thermometers - Acceptance test methods for mean wind measurements

Météorologie - Anémomètres/thermomètres soniques - Méthodes d'essai d'acceptation pour les mesurages de la vitesse moyenne du vent

Ta slovenski standard je istoveten z: ISO 16622:2002

ICS:

07.060	Geologija. Meteorologija. Hidrologija	Geology. Meteorology. Hydrology

SIST ISO 16622:2004 en

INTERNATIONAL STANDARD

ISO 16622

First edition
2002-09-15

Meteorology — Sonic anemometers/thermometers — Acceptance test methods for mean wind measurements

Météorolgie — Anémomètres/thermomètres soniques — Méthodes d'essai d'acceptation pour les mesurages de la vitesse moyenne du vent

Reference number
ISO 16622:2002(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16622 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 5, *Meteorology*.

Annex C forms a normative part of this International Standard. Annexes A, B and D are for information only.

Introduction

Most human activity influencing the dispersion of anthropogenic pollutants occurs within the surface layer (SL), that portion of the atmosphere which lies within a few tens of metres of the earth's surface. The SL is typified by sharp gradients and time-varying fluxes of heat, moisture and momentum. Three-dimensional flow and turbulence information resolved over short temporal and spatial scales is needed to characterize the SL. This information must be presented not only as time-mean quantities, but also as the turbulent fluctuations of those quantities which contribute to the production, transport, dispersion and dissipation processes operating within the SL. The sonic anemometer/thermometer (shortened to "sonic" in the following) is an instrument well suited to obtain measurements necessary for SL characterization.

A sonic consists of a transducer array containing paired sets of ultrasonic transmitter/receivers, and circuitry designed to measure the transit times of acoustic waves propagating over the path (typically 10 cm – 20 cm) between transducer pairs. A three-dimensional array resolves horizontal and vertical wind components plus the speed of sound from which the sonic (virtual) temperature can be derived. Sonic anemometry has been used for several decades in atmospheric research, but recent advances in instrument design and signal processing, coupled with increased sophistication of atmospheric dispersion models, has led to an increasing demand for their use, including routine wind speed and direction measurements. Because they contain no moving parts, sonics offer low maintenance and operational advantages in adverse weather conditions. These factors have stimulated the commercial manufacture of sonics and the drafting of several national sonic standards which form the basis for the following International Standard of performance measurements and test methods.

The procedures presented in this document define methods for acceptance testing of sonics to be used for mean wind measurements. Minimum requirements for conformance with this International Standard include successful completion of the zero wind chamber test (clause 7), the wind tunnel test (clause 8), and the field test (clause 10). The pressure chamber test (clause 9) is recommended if the sonic is to be used at elevations higher than 2 000 m above mean sea level.

Meteorology — Sonic anemometers/thermometers — Acceptance test methods for mean wind measurements

1 Scope

This International Standard defines test methods of the performance of sonic anemometers/thermometers which employ the inverse time measurement for velocity of sound along differently oriented paths. It is applicable to designs measuring two or three components of the wind vector within an unlimited (360°) azimuthal acceptance angle.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ASTM D5741-96, *Standard Practice for Characterizing Surface Wind Using a Wind Vane and Rotating Anemometer*

WMO CIMO, 1996 World Meteorological Organization (ed.) *Guide to meteorological instruments and methods of observation.* WMO-No.8, 6th edn. 1996, Geneva

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
array
mechanical structure to support the sonic transducers in the desired geometric configuration

3.2
array symmetry angle
angular distance about which the array is symmetrical

3.3
mean
mean value over the (selected) averaging interval of the sonic

3.4
sonic
sonic anemometer/thermometer
instrument consisting of a transducer array containing sets of acoustic transmitters and receivers, a system clock, and microprocessor circuitry to measure intervals of time between the transmission and reception of sound pulses

3.5
sound path
path between a pair of transducers

3.6
system delay
difference between the electronically detected total propagation time and the transit time

NOTE The time between the electronic generation of the transmission signal and the electronic detection of the received signal is longer than the transit time due to the propagation times through the transducers and the electronic circuitry.

3.7
transit time
time required by a sound wave front to propagate between a pair of transducers

3.8
turbulence level
turbulence intensity
T_i
ratio of the square root of the turbulent kinetic energy to the mean wind speed

$$T_\mathrm{i} = \frac{\sqrt{\overline{u'^2} + \overline{v'^2} + \overline{w'^2}}}{\bar{U}_0} \quad (1)$$

where

′ denotes deviations from the mean.

EXAMPLE $u' = u - \bar{u}$, etc., where

u' is the instantaneous wind component

$\bar{u}$ is the mean wind component.

3.9
zero offset
wind speed indicated by the sonic in calm air

4 Symbols and abbreviated terms

T	temperature, in kelvin
T_s	sonic temperature, in kelvin [see equation (B.4)]
T_i	turbulence intensity
U_0	speed of the undisturbed flow in the wind tunnel, speed, or wind speed measured by a reference sensor, in metres per second
U_a	wind speed, sonic output, in metres per second with sonic azimuth a
U_b	wind speed, sonic output, in metres per second with sonic azimuth b
$U_{a,n}$	nth sample of U_a, in metres per second
U_v	vectorial average of U_a, in metres per second
U_s	scalar average of U_a, in metres per second
U_max	specified maximum speed measurable with the sonic, in metres per second
U_min	minimum test speed, in metres per second
Z	acoustic impedance ($Z = \rho \cdot c$ [kg·m^{-2}·s^{-1}])
a	sonic azimuth, in degrees
b	sonic azimuth, in degrees
c	speed of sound, in metres per second
d	path length, in metres
e	water vapour partial pressure, in hectopascals
h	height above mean sea level, in metres
p	pressure, in hectopascals
p_e	equivalent pressure, in hectopascals (see Table D.1)
t_a	averaging interval, in seconds
t_+	transit time from transducer+ to transducer– , in seconds
t_-	transit time from transducer– to transducer+ , in seconds
u_0, v_0, w_0	along-axis, cross-axis, and vertical velocity components of the undisturbed flow, in metres per second
u_a, v_a, w_a	along-axis, cross-axis, and vertical velocity components, sonic output, in metres per second
$u_{a,n}, v_{a,n}, w_{a,n}$	nth sample of u_a, v_a, w_a, in metres per second

