BS ISO 23435:2022

BSI Standards Publication

Air quality — Test methods for snow depth sensors

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EH/2/3, Ambient atmospheres.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Published by BSI Standards Limited 2022

ISBN 978 0 539 02408 1

ICS 07.060

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2022.

Amendments/corrigenda issued since publication

Date	Text affected

INTERNATIONAL STANDARD ISO

First edition
2022-04-21

Air quality — Test methods for snow depth sensors

Qualité de l'air — Méthodes d'essai des capteurs de hauteur de neige

Reference number
ISO 23435:2022(E)

Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Solid precipitation is one of the more complex parameters to be observed and measured by automatic sensors. The measurement of precipitation has been the subject of a multitude of studies, but there has been limited information regarding the procedures and performance criteria describing the ability and reliability of automatic sensors to accurately measure solid precipitation[13].

Recently, an increasing percentage of precipitation data used in a variety of applications have been obtained using automatic instruments and stations including the measurement of snow depth, and many new applications have emerged[13].Also, the modern data processing capabilities, data management, and data assimilation techniques provide the means for better assessment and error analysis.

For the past years, various automatic snow depth measurement systems or snow depth sensors have been deployed and tested at different places to take advantages of their efficiency and get more objective measurement results[6].

An ultrasonic snow depth sensor measures the time interval between transmission and reception of ultrasonic pulses reflected from a target surface. This measurement is used to determine the distance between the sensor and the surface. The performance of the acoustic snow depth measurement technique depends on air temperature. Therefore, the ultrasonic sensor requires correction for variations in the speed of sound in air due to temperature. The measurement uncertainty of sonic rangers (distance meters) is 0,5 % to 1 % of the distance, which leads under typical conditions to a measurement uncertainty for snow depth in the order of 1 cm[2].

Laser sensors for snow depth measurement were introduced a few years ago and have already been under test and in operational use in various places[11][14][18]. A laser snow depth sensor uses an optoelectronic distance measurement principle to measure the distance between the sensor and the surface of the snow. Most of the laser snow sensors today employ a single laser distance meter, and, this results in an important drawback of this type of snow sensors, the lack of spatial representativeness. To resolve this issue, there have been a few trials and products with multipoint measurements, including a fixed 3 points sensor and scanning laser snow depth sensors which scan multiple points along a circular path or a segment of line. Apart from the laser distance sensors, there are other optical techniques capable of measurement of the state of ground and snow depth[2].

In spite of some of the drawbacks and difficulties, automated snow depth measurement techniques are evolving to offer more objective results which can be made available continuously and in near real-time.

The procedures presented in this document define methods for performance test of snow depth sensors to be used for snow depth measurements. Minimum requirements for conformance with this document include successful completion of the basic functional test (see Clause 7), the temperature chamber test (see Clause 8), and the field test (see Clause 10).

Air quality — Test methods for snow depth sensors

1 Scope

This document provides requirements for the evaluation and use of test method for snow depth sensors. This document is applicable to the following types of automatic snow depth sensors which employ different ranging technologies by which the sensors measure the distance from the snow surface to the sensor:

a) Ultrasonic type, also known as sonic ranging depth sensors;

b) Optical laser snow depth sensors including single point and multipoint snow depth sensors;

c) Other snow depth sensors.

This document mainly covers two major tests: a laboratory(indoor) test and a field (outdoor) test. The laboratory test includes the basic performance test and other tests under various environmental changes. The field test is proposed to ensure the performance of the snow depth sensors in field measurement conditions. For the field test, both the natural ground and artificial target surface such as snow plates are considered for the procedures defined in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5725 (all parts), *Accuracy (trueness and precision) of measurement methods and results*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
mean
mean value over the (selected) averaging interval of the sonic

3.2
dead zone
area that cannot be measured near the sensor

3.3
half-power beam width
beam angle width that the transmitted acoustic power decreases by half

3.4
beam angle clearance
angular range where obstacles should be excluded to prevent interference due to acoustic reflection

