BS ISO 16956:2015

BSI Standards Publication

Thermal performance in the built environment — Determination of air flow rate in building applications by field measuring methods

bsi.

...making excellence a habit.™

Document Sharing Hub

National foreword

This British Standard is the UK implementation of ISO 16956:2015.

The UK participation in its preparation was entrusted to Technical Committee B/540/8, Mirror committee for ISO/TC 163 - Thermal Performance and Energy use in the built Environment.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2015. Published by BSI Standards Limited 2015

ISBN 978 0 580 83498 1

ICS 91.120.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2015.

Amendments issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 16956:2015

INTERNATIONAL STANDARD

ISO 16956

First edition
2015-02-01

Thermal performance in the built environment — Determination of air flow rate in building applications by field measuring methods

Performance thermique des bâtiments — Détermination du taux de renouvellement d'air dans les bâtiments par des méthodes de mesure sur site

Reference number
ISO 16956:2015(E)

Documents
Document Sharing Hub
© ISO 2015

Full document details: BS ISO 16956:2015

COPYRIGHT PROTECTED DOCUMENT

© ISO 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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.org
Web www.iso.org

Published in Switzerland

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 16956:2015

Contents

Page

Foreword ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Symbols and abbreviated terms ... **2**

5 Types and selection of measurement method ... **2**
5.1 Types of measurement methods and their application ... 2
5.2 Selection of measurement method ... 2

6 Basic specifications measuring instruments and utilization methods ... **2**
6.1 General ... 2
6.2 Thermal anemometer ... 2
6.3 Pitot tube and manometer ... 3
6.4 Vane-type anemometer ... 3

7 Field measuring methods of air flow rate of ventilation and air conditioning systems ... **3**
7.1 Multipoint air velocity measurement method ... 3
7.1.1 Measurement in a duct ... 4
7.1.2 Measurement method at duct connection of air-conditioning system ... 6
7.1.3 Selection of measuring instruments ... 7
7.2 Tracer gas measurement method ... 7
7.2.1 Formula ... 7
7.2.2 Tracer gas ... 8
7.2.3 Procedures for measuring air flow rate ... 8
7.2.4 Tracer gas injection procedures ... 9
7.2.5 Tracer gas sampling procedures ... 10
7.3 Flow hood method ... 10
7.3.1 General ... 10
7.3.2 Equipment composition ... 10
7.3.3 Measurement procedures ... 11
7.4 Pressure compensation measurement method ... 11
7.4.1 Equipment composition ... 12
7.4.2 Measurement procedures ... 13
7.4.3 Effective application range ... 13
7.5 Pressure difference measurement method ... 13
7.5.1 Measuring equipment ... 13
7.5.2 Selection of measuring instruments ... 14
7.5.3 Measuring procedures ... 14

8 Uncertainty ... **15**
8.1 Uncertainty of each measurement ... 15
8.1.1 Multipoint air velocity measurement method ... 15
8.1.2 Tracer gas measurement method ... 15
8.1.3 Flow hood method ... 15
8.1.4 Pressure-loss compensation measurement method ... 15
8.1.5 Pressure difference measurement method ... 15
8.2 Analysis of uncertainty ... 15

9 Measurement report ... **16**
9.1 Information related to measured object ... 16
9.2 Items related to measuring method ... 16
9.3 Measurement results ... 16

Annex A (normative) **Position for cross-section measurement in a duct using multipoint measurement method** ... **17**

Documents
Document Sharing Hub

© ISO 2015 – All rights reserved

Full document details: BS ISO 16956:2015

Annex B (normative) **Accuracy of air velocity measurement instrument** **21**
Annex C (informative) **Types of tracer gas** **22**
Bibliography **23**

© ISO 2015 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16956:2015

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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*.

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16956:2015

Documents
Document Sharing Hub

INTERNATIONAL STANDARD ISO 16956:2015(E)

Thermal performance in the built environment — Determination of air flow rate in building applications by field measuring methods

1 Scope

In the cooling and heating loads of a building, the air taken in from outside account for a large portion of the entire load; in order to estimate this load, it is necessary to correctly grasp the air flow rate of ventilation and air-conditioning systems. This International Standard stipulates the methods for measuring the rate of air flow through the ducts in a steadily operating ventilation and air-conditioning system and in the air control ports including air diffuser, suction opening, and exhaust opening.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5168, *Measurement of fluid flow — Procedures for the evaluation of uncertainties*

3 Terms and definitions

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

3.1
orifice plate
thin plate having a hole, or holes, bored through it

Note 1 to entry: These are used for measuring the difference in static pressure of the flow before and after the disc and obtaining the air flow rate in the duct by multiplying by a predetermined coefficient.

3.2
tracer gas
gas used to measure its concentration varying in the air

Note 1 to entry: This gas is mixed with a sufficiently small amount of air so as not to affect the flow, and the amount of air is determined by measuring the gas concentration diluted in the air.

3.3
volumetric concentration
ratio of the volume of the specific gas to the unit volume of the mixture of air

Note 1 to entry: It is expressed in cubic meters per cubic meters or 10-6 · vol.

3.4
mass flow
mass of air or tracer gas flowing in unit time

Note 1 to entry: It is expressed in mg per second or kg per hour.

3.5
volumetric flow
volume of air flowing in unit time

Note 1 to entry: It is expressed in cubic meters per hour.

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16956:2015

4 Symbols and abbreviated terms

Among the symbols used in this International Standard, only those common to all items are shown below. Individual symbols are explained at the relevant sub clauses.

Symbol	Quantity	Unit
A	Area of evaluation section of air flow rate. Sectional area of duct and sectional area of air control port	m^2
N	Number of divisions for measurement of evaluation section. The number of lattice-like divisions of rectangular duct section and radial number of divisions in round duct.	-
V	Average air velocity of section of measured portion. The section is divided into n and if the time average air velocity at the centre of each is v_i, the following formula is applied: $v = \frac{1}{n}\sum_{i=1}^{n} v_i$	m/s

5 Types and selection of measurement method

5.1 Types of measurement methods and their application

The measurement methods covered in this International Standard are the multipoint air velocity measurement method, tracer gas measurement method for air flow rate in air duct, flow hood method, pressure compensation measurement method, and pressure difference measurement method between outlet and inlet. The method selected should be suitable for the purpose, as well as for the field conditions.

5.2 Selection of measurement method

The measurement method is selected considering the following items specified in Clause 7 and Clause 8:

a) ventilation/air-conditioning equipment subject to measurement;

b) position for measurement;

c) measurement period;

d) accuracy;

e) practicability (equipment size and composition simplicity, preparation, ease of data processing, and cost).

6 Basic specifications measuring instruments and utilization methods

6.1 General

The following describes air velocity measuring instruments common to various measurement methods.

6.2 Thermal anemometer

In the category of thermal anemometers, there are the hot-wire anemometer and the semiconductor anemometer. The hot-wire anemometer has less resistance against flow and is suitable for multipoint air velocity measurement in air duct when measuring very low air velocity. Attention should be paid to the directivity of the sensor. The sensor should be calibrated as necessary to avoid errors due to deterioration and adhesion of dust.

© ISO 2015 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 16956:2015

Since the semiconductor anemometer has improved accuracy beyond 1 m/s and the distance between the sensor and transducer can be extended, it is suitable for multipoint air velocity measurement for fixed setting in air duct for permanent installation.

6.3 Pitot tube and manometer

The Pitot tube has less resistance to flow and is suitable for multipoint measurement, but to be accurate, the flow velocity in the straight-pipe section should be 4 m/s or higher. However, when the cross-section of the duct is small, the Pitot tube is not used.

When the air velocity is calculated from the dynamic pressure, it is obtained by using the density of measured air depending on air temperature and atmospheric pressure as given in Formula (1):

$$v = \sqrt{(2/\rho)P_v} \tag{1}$$

where

v is the air velocity, in meter per second;

ρ is the air density, in kg per cubic meters;

P_v is the dynamic pressure, in Pa.

The result of Formula (1) is multiplied by the compensation coefficient k of the Pitot tube, if it is shown. Air density, ρ, is obtained from measured air temperature θ and atmospheric pressure P, using Formula (2):

$$\rho = \rho_0 \cdot \frac{T_0}{T} \cdot \frac{P}{P_{atm}} = 1{,}293 \frac{273{,}15}{273{,}15+\theta} \cdot \frac{P}{101325} \tag{2}$$

where

ρ_0 is the density when dry air temperature Θ is 0,0 °C (= 1,293), in kg per cubic meters;

T is the thermodynamic temperature of dry air, in K;

Θ is the air temperature, in °C;

T_0 is the thermodynamic temperature when Θ is 0,0 °C (273,15), in K;

P is the atmospheric pressure, in Pa;

P_{atm} 1 atmospheric pressure (101 325); in Pa.

6.4 Vane-type anemometer

The vane-type anemometer generally cannot be used for multipoint measurement because the vane is too large. If it is used, it is advisable to select a mini-vane anemometer with the measured portion made smaller.

7 Field measuring methods of air flow rate of ventilation and air conditioning systems

7.1 Multipoint air velocity measurement method

The multipoint air velocity measurement method obtains the air flow rate by measuring the average air velocity in the duct and multiplying it by the sectional area of the duct. For both a round duct and

© ISO 2015 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 16956:2015