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Byggprodukters och byggkomponenters termiska egenskaper – Speciella kriterier för bedömning av laboratorier som mäter värmetekniska egenskaper – Del 2: Plattapparat med skyddszon

Thermal performance of building products and components – Specific criteria for the assessment of laboratories measuring heat transfer properties – Part 2: Measurements by guarded hot plate method

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The European Standard EN 1946-2:1999 has the status of a Swedish Standard. This document contains the official English version of EN 1946-2:1999.

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1946-2

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Descriptors: building products, heat transfer, thermal resistance, testing, laboratory assessment, hot plate, error analysis, performance check

English version

Thermal performance of building products and components - Specific criteria for the assessment of laboratories measuring heat transfer properties - Part 2: Measurements by guarded hot plate method

Performance thermique des produits et composants pour le bâtiment - Critères particuliers pour l'évaluation des laboratoires mesurant les propriétés de transmission thermique - Partie 2: Mesurages selon la méthode de la plaque chaude gardée

Wärmetechnisches Verhalten von Bauprodukten und Bauteilen Technische Kriterien zur Begutachtung von Laboratorien bei der Durchführung der Messungen von Wärmeübertragungseigenschaften - Teil 2: Messung nach Verfahren mit dem Plattengerät

This European Standard was approved by CEN on 13 December 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1946-2:1999 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS**.**

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 1999, and conflicting national standards shall be withdrawn at the latest by July 1999

This European Standard is divided into parts. The first part covers common criteria applicable to all heat transfer property measurements; each subsequent part covers the specific technical criteria applicable to each heat transfer property measurement method described in appropriate standards.

The following parts have been developed:

Part 1: Common criteria
Part 2: Measurements by guarded hot plate method
Part 3: Measurements by heat flow meter method
Part 4: Measurements by hot box methods
Part 5: Measurements by pipe test methods

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This part 2 of this standard provides specific technical criteria for the assessment of laboratories to undertake steady-state heat transfer property measurements by the guarded hot plate method according to prEN 12667 and prEN 12664.

It complements the common criteria in part 1. Guidance is given on the organization and contents of the equipment manual, the calibration and maintenance files and the measurement procedure document.

It provides information on mandatory equipment performance specifications, equipment description and on calculations for the equipment design and error analysis.

It provides information on experimental procedures suitable for the assessment of equipment accuracy.

2 Normative references

This standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1946-1:1999	Thermal performance of building products and components - Specific criteria for the assessment of laboratories measuring heat transfer properties - Part 1: Common criteria
prEN 12664:1996	Building materials - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance
prEN 12667:1996	Building materials - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance
prEN 12939	Building materials - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance
ISO 8302:1991	Thermal insulation - Determination of steady-state thermal resistance and related properties - Guarded hot plate apparatus

3 Definitions

The definitions in EN 1946-1 and in ISO 8302:1991 also apply to this part of the standard.

4 Equipment manual

4.1 General

The equipment manual shall provide the information specified in 5.2.2 to 5.2.5 of EN 1946-1:1999 and the information specified in this clause.

NOTE: Information common to more than one piece of equipment need not be duplicated, e.g. the principle, details of the design and operation of two pieces of equipment built to a common design.

Annex B of prEN 12664:1996 or prEN 12667:1996, which indicates all limiting values for apparatus performance and testing conditions, shall be used as a check-list during the assessment process by the parties concerned to ensure compliance with all the requirements of those standards.

4.2 Equipment performance specifications

According to 2.3.1 of ISO 8302:1991, the upper and lower limits for the following relevant tested properties and testing conditions, including possible interactions among them, shall be specified:

- specimen thickness;
- thermal resistance;
- temperature difference across the specimen;
- heating and cooling unit temperature;
- surrounding environment (temperature, relative humidity) at the edge of the specimen during the test.

4.3 Equipment description

The following information shall be documented and shall be available for examination during the assessment:

- principle of operation (see 1.6.1 of ISO 8302:1991);
- type of apparatus (see 1.6.2.1, 1.6.2.2 and 1.6.4 of ISO 8302:1991);
- principal dimensions of apparatus, in particular heating unit width, guard width and gap width;
- simple diagrams illustrating the design of the equipment with special attention to the gap design (see 2.1.1.5 of ISO 8302:1991), the cooling unit piping (see 2.1.2 of ISO 8302:1991) and edge insulation (see 2.1.3 of ISO 8302:1991);
- position, connections and numbering of temperature sensors (see 2.1.4.1 of ISO 8302:1991);
- electrical components/instruments, apparatus enclosure and main ancillary equipment;
- details of data acquisition system and related computer programs for data analysis.

To avoid duplication, reference can be made to manuals supplied by the instrument manufacturers or to relevant clauses of ISO 8302:1991.

4.4 Equipment design and error analysis

4.4.1 General

With reference to the performance specification given in 4.2, details shall be given of the design guidelines followed, and the error analysis based on 2.2 of ISO 8302:1991, as summarized in 4.4.2 to 4.4.11.

Some guidelines on error analysis are given in this subclause; more specific information on some errors is supplied in annex B, while error calculations are supplied in annex C for some typical cases. Examples of equipment conforming to annex C are supplied in D.2 of prEN 12664:1996 and in D.2 of prEN 12667:1996. For equipment having characteristics exactly as indicated in this subclause or design details as indicated in annex C of this part and in D.2 of prEN 12664:1996 or in D.2 of prEN 12667:1996, no further calculations are needed. In other circumstances similar calculations can be performed by analogy.

4.4.2 Edge heat losses and maximum specimen thickness

According to 3.2.1 of ISO 8302:1991, the sum of the imbalance error and edge heat loss error shall be kept within 0,5 %. In a good equipment design, the two errors will be of the same order of magnitude, hence a 0,25 % limit can be suggested for both. Table 1 shows for some apparatus dimensions the maximum allowed specimen thickness according to 2.2.1 of ISO 8302:1991, when there is no edge insulation and when the edge temperature ratio, *e*, is 0,25; *e* is defined as $(T_e - T_2)/(T_1 - T_2)$, where T_1 and T_2 are respectively the temperatures of the hot and cold surfaces of the specimen, and T_e is the temperature at the edge of the specimen, assumed to be uniform.

Table 1: Minimum and maximum allowed specimen thickness

Dimensions in millimetres

Overall size	Metering section	Guard width	Maximum thickness (edge limit for e = 0,25)	Flatness tolerance (0,025%)	Minimum thickness (flat. tol.)	Max. gap	Minimum thickness [1)] (gap limit)
200	100	50	30	0,05	10,0	1,25	12,5
300	200	50	35	0,08	15,0	2,50	25,0
300	150	75	45	0,08	15,0	1,88	18,8
400	200	100	60	0,10	20,0	2,50	25,0
400	100	150	80	0,10	20,0	1,25	12,5
500	300	100	65	0,13	25,0	3,75	37,5
500	250	125	75	0,13	25,0	3,13	31,3
500	200	150	85	0,13	25,0	2,50	25,0
600	300	150	90	0,15	30,0	3,75	37,5
800	500	150	100	0,20	40,0	6,25	62,5
800	400	200	120	0,20	40,0	5,00	50,0
1000	500	250	150	0,25	50,0	6,25	62,5

1) Thicknesses applicable for gap widths according to the seventh column of table 1 ; for thinner gaps see 4.4.3.

EXAMPLE: e = 0,25 corresponds to a temperature of the edge of the specimen 5 K below the mean test temperature, when the temperature difference between the hot and cold side of the specimen is 20 K.

NOTE: The edge heat loss error is zero for homogeneous isotropic specimens when e is close to 0,5; the absolute value of the edge heat loss error increases almost symmetrically when e deviates on either side from 0,5. In the range $0{,}25 \leq e \leq 0{,}75$, this error is maximum for e = 0,25.

Larger specimen thicknesses can be used for some specimens if edge insulation or edge temperature control is used, if auxiliary or gradient guards are installed, or medium and high conductivity specimens are tested. See annex B for additional information.

When the maximum specimen thickness to be specified according to 4.2 exceeds the appropriate value given in table 1, lateral losses shall be calculated. If, according to these calculations they exceed those permitted by ISO 8302:1991, the performance check data shall be examined and, if no experimental evidence exists to justify the claimed maximum specimen thickness, the maximum specimen thickness to be specified according to 4.2 shall be reduced.

4.4.3 Maximum gap width and minimum specimen thickness

According to 2.1.1.3 of ISO 8302:1991 the gap width, g, shall be such that the gap area is less than 5 % of the metering area, i.e. the gap width, g, shall not be greater than 1,25 % of the metering area side, L. The maximum gap width resulting from this requirement is given in the seventh column of table 1. The minimum specimen thickness, d_m, is related to the gap width. d_m shall be at least ten times the gap width, see 1.7.6 of ISO 8302:1991. Thus, when the gap width reaches its maximum allowed value according to the above criteria, the minimum specimen thickness shall not be less than 12,5 % of the side L of the metering section. The minimum specimen thickness resulting from these requirements is given in the eighth column of table 1. When the minimum specimen thickness to be specified according to 4.2 is less than those of the eighth column of table 1, the actual gap width, g, shall be used to compute $d_m = 10\,g$, see also 4.4.6. If this requirement is not met, then the minimum specified specimen thickness shall be increased to meet this requirement.

Minimum specimen thickness shall also be checked against maximum allowed flatness tolerances, see 4.4.9, 4.4.10 and 4.4.11.

4.4.4 Imbalance error

According to 2.2.1 of ISO 8302:1991, an error heat flow rate Φ_g can be expressed as follows:

$$\Phi_g = (\Phi_o + \lambda\, c)\Delta T_g \qquad (1)$$

where ΔT_g is the actual gap temperature imbalance through the apparatus and Φ_o, representing the heat flow rate for a 1 K gap imbalance through the apparatus itself, is the sum of:

- Φ_a through the air in the gap;
- Φ_r by radiation through the gap;
- Φ_m through the mechanical connections through the gap;
- Φ_c through copper wires;
- Φ_w through metal wires (excluding copper).