
**Thermal insulation — Building
elements — *In-situ* measurement of
thermal resistance and thermal
transmittance —**

**Part 2:
Infrared method for frame structure
dwelling**

*Isolation thermique — Éléments de construction — Mesurage in
situ de la résistance thermique et du coefficient de transmission
thermique —*



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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and units	2
5 Principle	3
6 Requirements for apparatus	4
6.1 General	4
6.2 Infrared camera	5
6.3 Heat transfer coefficient sensor	6
6.4 ET sensor	6
6.5 Thermocouple	6
6.6 Data logger	6
7 Measurement method	6
7.1 Building	6
7.2 Location of the measured area	6
7.3 Measurement conditions	7
7.4 Measurement of heat transfer coefficient	7
7.5 Measurement of environmental temperature	7
7.6 Surface temperature distribution of building elements	8
7.7 Measurement time and measurement interval	8
7.8 Measurement terms	8
7.9 Measurement period	9
8 Calculations	9
8.1 Heat transfer area	9
8.2 Calculation of heat flow rate	9
8.3 Calculation of thermal transmittance	10
9 Measurement accuracy	10
10 Test reports	10
Annex A (informative) Measurement principle	12
Annex B (informative) Calculation of environmental temperature, structure of ET sensor	16
Annex C (informative) Structure and calibration of heat transfer coefficient sensor	19
Annex D (informative) Uncertainty analysis	24
Annex E (informative) The calculation example of uncertainty analysis	27
Bibliography	31

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 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 163, *Thermal performance and energy use in the built environment*, SC 1, *Test and measurement methods*.

A list of all parts in the ISO 9869 series can be found on the ISO website.

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

The ISO 9869 series describes the in-situ measurement of the thermal transmission properties of plane building components, primarily consisting of opaque layers perpendicular to the heat flow and having no significant lateral heat flow. The thermal transmittance of a building element (U -value) is defined in ISO 7345 as the “Heat flow rate in the steady state condition divided by area and by the temperature difference between the surroundings on each side of a system”. Since steady state conditions are never encountered on a site in practice, such a simple measurement is not possible and thereby some statistical methods are introduced. One of the simplest methods is using the mean values over a sufficiently long period of time. The required time for observation for reliable measurements depends on the thermal properties of the building components and the natures of the temperature difference between the surroundings on each side of them.

ISO 9869-1 describes the method which is used to estimate the thermal steady-state properties of a building element from heat flow meter (HFM) measurements through plane building components. [Annex B](#) describes the statistical methods of simple mean and the sophisticated method of dynamic analysis method for steady state properties. This document, describes the calculation method for the density of heat flow rate through both the evaluation of the internal surface thermal resistance and the measuring of the temperature difference between the indoor surface temperature of the building element and the indoor environmental temperature using an infrared camera (thermo-viewer). It also describes the statistical methods of simple mean with less observing duration considering night observation and building components with light heat capacity.

This document provides a preliminary and handy measuring method for the in-situ measurement of the thermal transmission properties of plane building components and thereby the further simplifications are applied compared with the method described in ISO 9869-1. The method described in this document is expected as a method of a handy diagnostic method of the thermal transmission properties of plane building components with light heat capacity such as those in frame structure dwelling.

The thermal performance of a part of the building element is evaluated by obtaining the heat absorption (heat penetration) at the part of the indoor surface by multiplying the indoor total heat transfer coefficient of the part surface by the difference between the part indoor surface temperature and the indoor environmental temperature. The thermal transmittance (U -value) of the building components for steady state condition can be obtained with the averages of the observed values over the certain period of time.

The indoor surface temperature distribution of the building component is measured using an IR camera. The indoor environmental temperature is measured by installing the environmental temperature sensor (ET sensor) on the surface of the building component, and the indoor total heat transfer coefficient of the surface of the building component is measured using a heat transfer coefficient sensor. Even the indoor measurement is intended to be carried on with less influence of solar radiation so the standard can be used on building elements on which indoor sides are not exposed to direct sunlight through adjacent windows.

Thermal insulation — Building elements — *In-situ* measurement of thermal resistance and thermal transmittance —

Part 2: Infrared method for frame structure dwelling

1 Scope

This document describes the infrared method for measuring the thermal resistance and thermal transmittance of opaque building elements on existing buildings when observing high emissivity diffuse surface using an infrared (IR) camera. This document demonstrates a screening test by quantitative evaluation to identify the thermal performance defect area of building elements.

This document aims to measure the thermal transmittance (*U*-value) of a frame structure dwelling with light thermal mass, typically with a daily thermal capacity calculated according to ISO 13786 below 30 kJ/(m²K).

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 7345, *Thermal performance of buildings and building components — Physical quantities and definitions*

ISO 8301, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus*

ISO 8302, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Guarded hot plate apparatus*

ISO 9869-1, *Thermal insulation — Building elements — In-situ measurement of thermal resistance and thermal transmittance — Part 1: Heat flow meter method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345 and the following apply.

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

thermography

image of a specific band of surface radiance detected with an *infrared camera* (3.2)

Note 1 to entry: On known and uniform high emissivity surfaces, with known and controlled irradiance from the background, and with the proper instrument calibration and operator compensation, the radiance image can be converted to a temperature distribution.