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Building environment design — Design, test methods and control of hydronic radiant heating and cooling panel systems —

Part 2: Determination of heating and cooling capacity of ceiling mounted radiant panels

Conception de l'environnement des bâtiments — Conception, méthodes d'essai et contrôle des systèmes de panneaux hydroniques radiants de chauffage et de refroidissement —

Partie 2: Détermination de la capacité de chauffage et refroidissement des panneaux radiants montés au plafond

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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 Technical Committee ISO/TC 205, *Building environment design*.

A list of all parts in the ISO 18566 series can be found on the ISO website.

Introduction

The radiant heating and cooling system consists of heat emitting/absorbing, heat supply, distribution, and control systems. Typical applications are low temperature radiant heating and high temperature radiant cooling. They are classified as embedded radiant heating and cooling systems and prefabricated radiant heating and cooling panel systems.

While ISO 11855 is for embedded radiant heating and cooling systems without an open air gap, ISO 18566 is for radiant heating and cooling panel systems with an open air gap. Because the system specifications for ISO 18566 are different from those of ISO 11855, it was necessary to develop separate ISO standards regarding the design and test methods of the cooling and heating capacity and control.

ISO 18566-1 specifies the comfort criteria, technical specifications and requirements which should be considered in the manufacturing and installation of radiant heating and cooling systems. ISO 18566-2 provides the test facility and test method for heating and cooling capacity of ceiling mounted radiant panels. ISO 18566-3 specifies the design considerations and design processes of ceiling mounted radiant panels. ISO 18566-4 addresses the control of ceiling mounted radiant heating and cooling panels to ensure the maximum performance which was intended in the design stage when the system is actually being operated in a building.

ISO 18566 does not cover the panels that are embedded into the ceiling, wall or floor structure.

This document deals with the determination of heating and cooling capacity of ceiling mounted radiant panels. In Clause 5, the boundary conditions for the heating and cooling capacity test are described. In Clause 6, the test chamber and the output from the test are defined.

This document is partly based on EN 14240, EN 14037 and ASNI/ASHRAE Standard 138.

Building environment design — Design, test methods and control of hydronic radiant heating and cooling panel systems —

Part 2: Determination of heating and cooling capacity of ceiling mounted radiant panels

1 Scope

This document defines technical specifications and requirements of free hanging (suspended) heating and dry cooling only surfaces with an air gap between construction and the emitter (not embedded) with or without an insulation fed with water at temperatures below 120 °C connected with a centralized heating and/or cooling supply source intended to be installed in buildings.

Ceiling mounted radiant panels covered by this document are limited to a width from 0,3 m up to 1,5 m.

This document also defines the additional common data that the manufacturer provides to the trade, in order to ensure the correct application of the products.

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/IEC 18566-1, *Building environment design — Design, test methods and control of hydronic radiant heating and cooling panel systems — Part 1: Definition, symbols, technical specifications and requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18566-1 apply.

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

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

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

4 Symbols

For the purposes of this document, the symbols in ISO 18566-1 apply.

5 Test booth

5.1 Radiant temperature asymmetry

The booth for testing ceiling mounted radiant panels shall be constructed in a way that all six surrounding surfaces can be chilled.

Walls, ceiling and floor shall have smooth inside surfaces covered with a coat of mat paint, having a degree of emissivity of minimum 0,9.

The test booth construction shall be sufficiently tight to prevent air infiltration.

Heating case

The cooling system is to be carried out in order that the temperature difference between the six surrounding inside surfaces of the test booth is not higher than 0,5 K. The temperature difference between inlet and outlet shall not be higher than 0,5 K. That condition shall be maintained at the tests for the determination of the characteristic equation.

Cooling case

For covering the cooling capacity, the test booth will be heated with a number of electrical heated cooling load simulators (see Annex B) which are positioned on the floor of the test booth (see Figures B.1 and B.2).

Differing from these definitions, the surfaces, floor and ceiling of the test booth shall be insulated in the way that the average heat flow in those surfaces is lower than 0,40 W/m^2 during the test. This heat flow shall be determined by preliminary calibration tests of the booth or by calculations.

The reference temperature during the measurement shall be 32 °C ± 0,5 K in the steady condition for a minimum of 30 min. The temperature(s) of inner surfaces of walls, floor and ceiling of the test booth (under the insulation) shall be controlled and be kept on a value, which is necessary to guarantee a maximum temperature difference between these surfaces and the reference temperature of less than 1,0 K.

The test booth will be heated with six electrical heated cooling load simulators, which are positioned on the floor of the test booth. The output of each simulator shall not exceed 180 W and shall be continuously adjustable, e.g. with an adjustable transformer or a thyristor. Each simulator shall have an identical heat output and the same number of bulbs.

The housing of the simulators consists of painted steel sheet. The emissivity of the inside and outside surface shall be at least 0,9. The active power of the simulators shall be measured with a measuring instrument of the accuracy class 1,0 % or better.

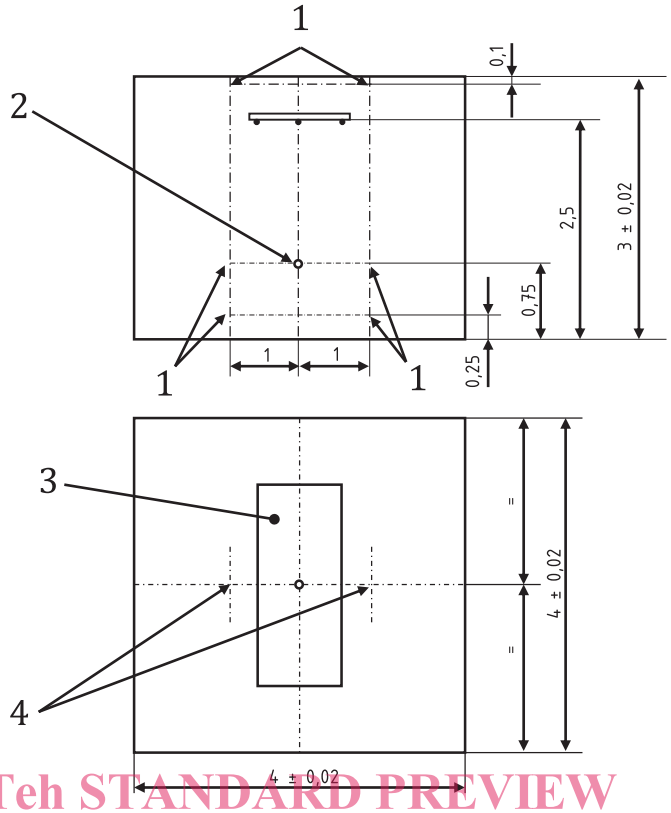
5.2 Temperature measuring points

Reference room temperature

The reference room temperature is measured at a height of 0,75 m above the floor of the test booth by means of a globe thermometer. The measuring point is situated on the vertical axis through the central point of the ceiling mounted radiant panel. A temperature sensor with blackened light metal sphere (diameter 150 mm, emissivity 0,9) is used. The measuring point is arranged in the centre of the sphere. The penetration of the temperature sensor through the surface of the sphere runs horizontally and is air tight. The hollow sphere is attached to the temperature sensor.

Air temperature

The air temperature is measured with sensors protected against radiation. The measuring points are situated on two vertical axes at three different heights as shown in Figure 1.



Key

1 air temperature measuring points

2 reference room temperature measuring point

3 ceiling mounted radiant panel

4 axes of air temperature measuring points

The dimension of the reference room should follow Figure 1, but national requirements should be also taken into account.

Figure 1 — Arrangement of measuring points for the reference room temperature and for air temperature

Surface temperature of the inside surfaces

The surface temperatures of the inside walls are calculated as average value of the inlet and outlet water temperature of each single surface wall.

5.3 Verification of test installation, repeatability and reproducibility

All test installations shall be verified for:

— **constructional conformity**: any statement concerning thermal outputs shall be accompanied by a statement indicating the test conditions in which the stated outputs have been obtained;

— **repeatability**: the repeatability precision shall be within an allowed tolerance s_0 when testing a single master panel in the same test installation at short or long intervals. The testing laboratory will use its own master panel (secondary set) to determine the repeatability tolerance s_0 of the test installation. Using this master panel, heat output tests shall be carried out. The latest test for repeatability shall not have taken place longer than 6 months before a thermal heat output test. The repeatability shall be tested every 12 months in minimum. To prove the repeatability precision of a test laboratory, the results of five consecutive tests at the start of the test installation shall be within a tolerance range s_0 = 20 W;

— **reproducibility**: the reproducibility shall be proved by using the primary set of master panels. The test results shall be within the tolerance s_m = ±20 W of the $\Phi_{M,s}$ value of each master panel.

The test laboratories have to prove the reproducibility in periodical tests.

6 Test

6.1 General

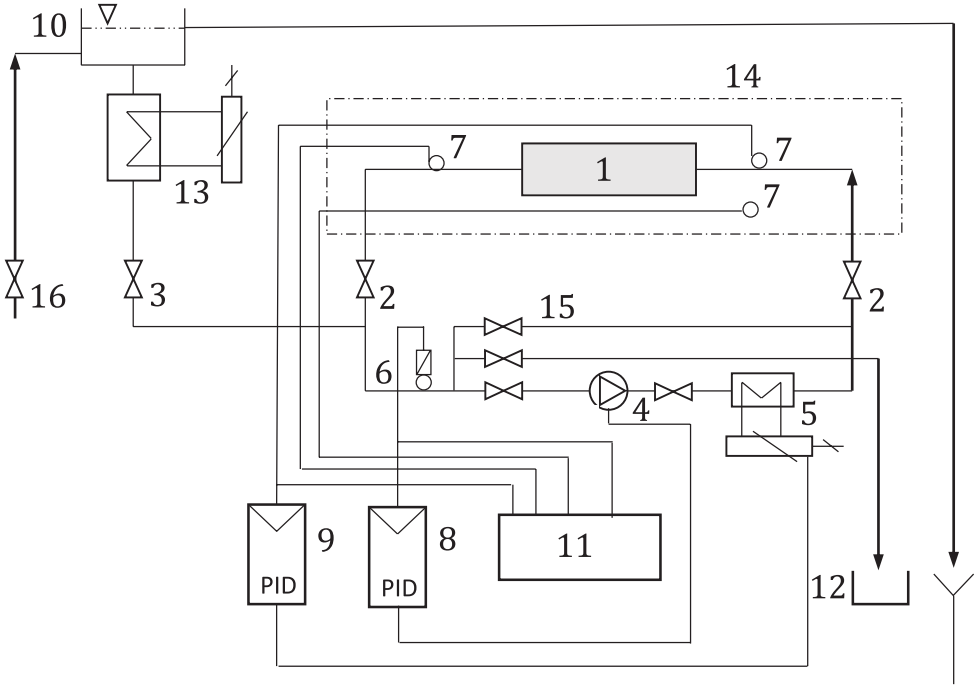
The aim of the thermal output test is to establish the standard characteristic equation of a ceiling mounted radiant panel by determining the related values of thermal output and cooling capacity and temperature difference. Neither of these quantities can be measured directly, but shall be calculated using the values of other measurable quantities, either directly or with additional information (calibration test, material properties table), by using mathematical relationships.

6.2 Test method

The thermal output Φ_{me} is calculated based on the water flow rate q_m and the measured temperatures h_1 and h_2 as shown in Formula (1). These temperatures are used to calculate the specific enthalpies as determined by the international steam tables at a reference water pressure of 120 kPa:

$$\Phi_{me} = q_m (h_1 - h_2) \quad (1)$$

The water flow rate is measured directly by a calibrated flow-meter in a closed water circuit or calculated using the mass of the water m, collected in a measuring vessel, and the relevant time interval τ.



Key

1	panel in the test booth	9	control unit for flow temperature
2	water circuit for measurement	10	container with overflow for calibration device
3	connection of the calibration device to the measuring circuit	11	recording and evaluating instruments
4	circulating pump in the measuring circuit (controlled)	12	collecting and draining installation for calibrating measurement
5	electric heating element in the measuring circuit for flow temperature control	13	heating device for calibrating measurement
6	mass flow measuring instrument	14	test booth
7	temperature measuring points	15	bypass
8	control unit for mass flow	16	water supply for calibration device

Figure 2 — Basic diagram of test installation with continuous measurement of the mass flow (weighing method) and with a device for calibrating the measuring instrumentation

The bulk temperature of the water at inlet and outlet shall be measured with a device which ensures a sufficient accuracy.

All temperatures which do not serve for the determination of the thermal output shall be measured with an accuracy of ±0,1 K.

The maximum uncertainty in measuring the thermal output shall not exceed ±10 W.

The air pressure is measured with a tolerance of ±2 hPa.

The natural convection inside the test booth shall not be influenced by additional means.

6.3 Dimension and construction of the test samples

The active length of the ceiling mounted radiant panels without the connection components shall be within the range of 2,9 m to 3,1 m. The width shall be within the range of 0,3 m to 1,5 m. The construction length including the connection components shall be a maximum of 3,5 m. No elements which could increase the heat output shall be added to the linkage between the active length and the collectors/headers.