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

Part 1: Vocabulary, symbols, technical specifications and requirements

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

Partie 1: Vocabulaire, symbols, spécifications techniques et exigences

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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).

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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 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 1:
Vocabulary, symbols, technical specifications and requirements

1 Scope

This document specifies the design, test conditions and methods for the determination of the cooling and heating capacity and control of radiant heating and cooling panels with an open air gap. This document applies to all types of prefabricated radiant panels that are part of the room periphery such as ceiling, walls and floor.

This document is applicable to water-based heating and cooling panel systems (free hanging) in residential, commercial and industrial buildings. The methods apply to systems mounted to the wall, floor or ceiling construction with an open air gap.

This document does not cover panels embedded into ceiling, wall or floor structures and hybrid (combined thermal radiation and forced-convection) ceiling panels.

This document specifies the definition, symbols, comfort criteria, technical specifications and requirements of ceiling mounted radiant panels.

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 18566-2, *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*

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 http://www.iso.org/obp

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

3.1
active length of the ceiling mounted radiant panel
length of the usable heating or cooling panel with identical cross section and without connection components and covers, which are bonded together with the water flow components

3.2
active surface of the ceiling mounted radiant panel
lower panel surface, of which the lateral edges are not included

3.3
asymmetric feature
difference between the plane radiant temperature of the two opposite sides of a small plane element

3.4
average unconditioned surface temperature
AUST
mean temperature value of the uncontrolled surfaces

3.5
breaking load
minimum breaking force, in kilonewtons, which is the lowest breaking strain of the rope when tested to destruction

3.6
building management system
BMS
computer-based system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as heating, cooling, ventilating, lighting, power, disaster prevention, and security systems

3.7
characteristic equation
equation that gives the thermal output and cooling capacity as a function of the temperature difference at constant water flow rate

3.8
connection component
any other component attached to the active length of the ceiling mounted radiant panel which is used for connecting to the distribution system or for venting and draining

3.9
construction dimension
dimension of ceiling mounted radiant panel after installation inside the test booth

3.10
construction length
length of the ceiling mounted radiant panel including the collectors/headers but excluding the connecting pieces to the heating pipe work

3.11
dedicated outdoor air system
DOAS
type of heating, ventilation and air-conditioning (HVAC) system that consists of two parallel systems: a dedicated outdoor air ventilation system that handles latent loads and a parallel system to handle sensible loads

3.12
dimensions of non-circular pipes
shape and all dimensions necessary to describe exactly the cross section of the pipe

3.13
direct heating or cooling surface
<wet surface> portion of the heating or cooling surface of the panel which is in contact with the water

3.14
distance between pipes
distance between the centre lines of two pipes in parallel

3.15
draught
unwanted local cooling of the body caused by air movement and air temperature

3.16
effective surface temperature
design panel surface temperature based on comfort criteria

3.17
emissivity
ratio of emissive power of a surface at a given temperature to that of the black body at the same temperature and with the same surroundings

3.18
factory test pressure
<leak test> pressure to which the panel is submitted during the manufacturing process

3.19
free hanging sail
element composed of one or more modules of a cooling installation which is additionally used for heating

Note 1 to entry: Depending on the use of the sails, they can be covered with thermal insulation or noise absorption material.

3.20
heated and chilled ceiling surfaces
radiant ceiling panel surfaces which have different compositions and installation methods by manufacturers

3.21
heating appliance
device to transfer heat in order to provide specific temperature conditions inside buildings

3.22
independent heating appliance
self-contained heating appliance which does not need to be connected to a remote heat source (e.g. a boiler) as it contains its own heat source

3.23
indirect heating or cooling surface
<dry surface> portion of the heating or cooling surface of the panel which is in contact with air only

EXAMPLE Radiant sheet between the pipes.

3.24
inlet water temperature
bulk temperature of the water entering the ceiling mounted radiant panel

3.25
length of radiant sheet
length of the heat or cold transferring sheets

Note 1 to entry: Generally identical with the active length according to ISO 18566-2.

3.26
maximum operating pressure
maximum system pressure to which the panel may be submitted as stated by the manufacturer

3.27
maximum surface temperature
maximum temperature permissible for physiological reasons or building fabrics, for calculation of the limit curves, which may occur at a point on the surface (floor, wall, ceiling) in the occupied or peripheral area depending on the particular usage at a temperature drop σ of the heating medium equal to 0

3.28
mean radiant temperature
MRT
uniform temperature of an imaginary enclosure in which the radiant heat transfer from the human body is equal to the radiant heat transfer in the actual non-uniform enclosure

3.29
mean radiant temperature of room
temperature in a defined point of the room resulting from the radiation of all surrounding surfaces and of the ceiling mounted radiant panel or heated ceiling surface

3.30
mean water temperature
arithmetical mean of inlet and outlet water temperature

3.31
minimum surface temperature
minimum temperature permissible for physiological reasons or building fabrics, for calculation of the limit curves, which may occur at a point on the surface (floor, wall, ceiling) in the occupied or peripheral area depending on the particular usage at a temperature drop σ of the heating medium equal to 0

3.32
model
ceiling mounted radiant panel or heated ceiling surface of defined construction, width and height

3.33
module
1 m of the active length of a ceiling mounted radiant panel, in relation to 1 m^2 active surface of a heated ceiling surface

3.34
nominal cooling capacity
cooling capacity at temperature difference of 8 K between room temperature and mean water temperature

3.35
nominal modular cooling capacity
cooling capacity of one module at temperature difference of 8 K between room temperature and mean water temperature

3.36
nominal temperature difference
temperature difference of 8 K between room temperature and mean water temperature

3.37
open or closed ceiling surface
open or closed active and non-active elements of chilled ceilings, which are additionally used for heating, which are part of suspended ceilings and generally constructed modular from industrially prefabricated elements

3.38
operative temperature
OT
uniform temperature of an enclosure in which an occupant would exchange the same amount of heat by radiation plus convection as in the actual non-uniform environment

3.39
outlet water temperature
bulk temperature of the water leaving the ceiling mounted radiant panel

3.40
outside diameter of circular pipe
nominal diameter according to standard pipe dimensions

3.41
predicted mean vote
PMV
index that predicts the mean value of the votes of a large group of persons on the 7-point thermal sensation scale (hot, warm, slightly warm, neutral, slightly cool, cool, cold), based on the heat balance of the human body

3.42
predicted percentage of dissatisfied
PPD
index that establishes a quantitative prediction of the percentage of thermally dissatisfied people who feel too cool or too warm

3.43
prefabricated ceiling mounted radiant panel
heat-transmitting device in the form of a heating or cooling element with width of 0,3 m up to 1,5 m fitted with connection components and designed to operate on water flow heating facilities and/or in cooling systems

3.44
radiant output
thermal output emitted downwards by radiation of the active length

3.45
radiant surface heating and cooling system
heating and cooling system that controls the temperature of indoor surfaces on the floor, walls, or ceiling

3.46
radiant asymmetry
difference between the plane radiant temperature of the two opposite sides of a small plane element

3.47
reference room temperature
temperature measured with a globe thermometer

3.48
suspended ceiling with integrated heating elements
single closed elements integrated in closed hanging ceilings and combined with non-active elements which are used for heating and are thermally insulated on the upper side

3.49
temperature difference
difference between mean water temperature and reference room temperature

3.50
thermal output
sum of the products of the heating or cooled surfaces of a space with the associated design heat flow densities

3.51
vertical air temperature difference
air temperature difference between head and ankles of a person

Note 1 to entry: 0,1 m and 1,1 m for sedentary and 0,1 m and 1,7 m above floor for standing.

3.52
water flow rate
volume of fluid passing through the ceiling mounted radiant panel per unit of time

4 Symbols

Symbol	Unit	Definition
A	m^2	surface area of the non-insulated walls
A_a	m^2	active surface of a heated ceiling surface module
A_i	m^2	installation surface area
A_{rp}	m^2	active surface area of the ceiling mounted radiant panel
c_p	J/kg K	specific heat capacity
D_i	m	inside diameter of the pipe
$D_{i/o}$	m	diameter for connection of inlet/outlet
D_o	m	outside diameter of pipe
d_{tub}	m	distance between pipes
h	J/kg	specific enthalpy
h_1	J/kg	inlet water enthalpy
h_2	J/kg	outlet water enthalpy
h_v	mm	height of the void including the height of the test sample
K	W/K^n	constant of the characteristic equation
K_{act}	$W/K^{n_{act}}$	constant of the characteristic equation of the active length/surface
K_{actM}	$W/(m^2K^{n_{actM}})$	constant of the characteristic equation of the module
K_{Cact}	$W/(m\,K^{n_{Cact}})$	constant of the characteristic equation of the active length
K_{comp}	$W/K^{n_{comp}}$	constant of the characteristic equation of the connection components
K_{rto}	$W/(m\,K^{n_{act}})$	constant of the characteristic equation of the module based on the rated thermal output
K_{tot}	$W/K^{n_{tot}}$	constant of the characteristic equation of the construction length/ surface
k_p	W/m·K	thermal conductivity of the panel material