



SLOVENSKI STANDARD

SIST EN 442-2:1997

01-avgust-1997

Ogrevala in konvektorji - 2. del: Preskusne metode in vrednotenje rezultatov

Radiators and convectors - Part 2: Test methods and rating

Radiatoren und Konvektoren - Teil 2: Prüfverfahren und Leistungsangabe

Radiateurs et convecteurs - Partie 2: Méthodes d'essai et d'évaluation

Ta slovenski standard je istoveten z: EN 442-2:1996

[SIST EN 442-2:1997](https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997)

<https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997>

ICS:

91.140.10	Sistemi centralnega ogrevanja	Central heating systems
-----------	-------------------------------	-------------------------

SIST EN 442-2:1997

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 442-2:1997](https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997)

<https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997>

EUROPEAN STANDARD

EN 442-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

July 1996

ICS 91.140.10

Descriptors: heaters, heat radiators, convectors, heating units, tests, calorific power, marking

English version

Radiators and convectors - Part 2: Test methods and rating

Radiateurs et convecteurs - Partie 2: Méthodes
d'essai et d'évaluationRadiatoren und Konvektoren - Teil 2:
Prüfverfahren und Leistungsangabe

ITeH STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 442-2:1997](https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997)<https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997>

This European Standard was approved by CEN on 1995-06-02. 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.

The European Standards exist 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

Contents

Foreword		3
0	Introduction	3
1	Scope	4
2	Normative references	4
3	Definitions	4
4	Symbols and units of measurement	8
5	Selection of heating appliances to be tested	9
6	Laboratory arrangements and test methods	11
7	Test report	34
Annex A (normative)	Master radiators dimensional verification	35
Annex B (normative)	Determination of pressure drop	42
Annex C (normative)	Least squares regression for a model	49
Annex D (normative)	Analysis of test results by the method of least squares multiple regression	50
Annex E (normative)	Specimen test report	52
Annex F (informative)	Apparatus and method of checking the bulk temperature- Measuring devices	56
Annex G (informative)	Examples of typical appliances according to Table 4	58

[SIST EN 442-2:1997](https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997)

<https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd01f5e3987d/sist-en-442-2-1997>

Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 130 "Space heating appliances without integral heat sources" of which the secretariat is held by UNI.

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 January 1997, and conflicting national standards shall be withdrawn at the latest by January 1997.

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

0 Introduction

This European Standard results from the recognition that the heating appliances falling into the field of application hereinafter stated are traded on the basis of their thermal output.

To evaluate and compare different appliances it is therefore necessary to refer to a single stipulated value, hereinafter called the standard thermal output.

The standard thermal output is a defined value taken from the characteristic equation.

The pre-requisites of the standard thermal output, as defined by this European standard, are the following :

- to be representative of the actual output of the appliance;
- to be reproducible within the tolerances defined by this European Standard, taking into account the state of measuring techniques;
- to be representative of the thermal output, obtainable under the same test conditions, of any identical sample taken out of the current production (within the tolerances defined by this European Standard taking into account the state of measuring techniques and methods of manufacture).

This European Standard of radiators and convectors consists of the following parts:

- Part 1: Technical specifications and requirements
- Part 2: Testing and rating methods
- Part 3: Evaluation of conformity

1 Scope

This European Standard defines procedures for determining the standard thermal output of the heating appliances fed with water or steam at temperatures below 120°C, supplied by a remote heat source.

This European Standard specifies the laboratory arrangements and testing methods to be adopted, the admissible tolerances, the criteria for selecting the samples to be tested and for verifying the conformity of the current production with the samples tested at the initial test.

This European Standard also defines the additional common data that the manufacturer shall provide to the trade in order to ensure the correct application of the products.

This European Standard does not apply to independent heating appliances.

2 Normative references

This European 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 European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 442-1	Radiators and convectors - Part 1: Technical specifications and requirements <small>SIST EN 442-2:1997</small>
EN 10088-1	Stainless steels - Part 1: List of stainless steels <small>https://standards.iteh.ai/catalog/standards/sist/9a5d62b6-c1a7-4699-9324-cd015e3987d/sist-en-442-2-1997</small>
EN 45001	General criteria for the operation of testing laboratories
EN 45002	General criteria for the assessment of testing laboratories
ISO 31-4	Quantities and units: Part 4: Heat
ISO 5725	Precision of test methods - Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 heating appliance: A device having the purpose of transferring heat in order to provide specific temperature conditions inside buildings.

3.2 independent heating appliance: A 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 (e.g. gas fired appliances, electric appliances, heat pump appliances).

3.3 radiator: A heating appliance which emits heat by free convection and radiation. Radiators can be produced with different materials (e.g. steel, aluminium, cast-iron) and with different designs (e.g. plate type, column type, tube type)

3.4 sectional heating appliances (mainly applied to radiators): A heating appliance manufactured in sections of identical design and traded in this form which can be joined together into modular assemblies so that the desired output can be obtained.

3.5 free convection heating appliance: A heating appliance which does not contain a fan or similar device to activate the air flow over heat emitter (see 3.6 and 3.7).

3.6 forced convection heating appliance: A heating appliance which requires the action of a fan or similar device to blow or draw air over the heat emitter.

3.7 convector: A heating appliance which emits heat almost entirely by free convection. A convector comprising at least a heat emitter and a casing which provides an unheated convective chimney of defined height.

3.8 fan-assisted radiator or convector: A radiator or a convector equipped with a fan to increase the convective heat emission, characterized by two thermal outputs, one with the fan off and the other with the fan in operation.

3.9 height of the unheated convective chimney : The vertical distance between the lowest edge of the convector and the bottom of the air outlet section.

It applies to convectors only, being a main factor influencing their thermal output.

3.10 wet heating surface; primary heating surface: The portion of the heat emitting surface which is always in contact with the primary fluid (water or steam).

3.11 dry heating surface; secondary heating surface: The portion of the heat emitting surface which is in contact with air only (e.g. fins projecting from the wet surface).

3.12 family of heating appliances: A group of heating appliances of similar design and construction and of identical material, positions of primary fluid connections and other related variables that particularly affect the conditions of flow of the primary fluid within the heating appliance.

3.13 type of heating appliances: A group of at least three heating appliances of similar design whose cross section remains unchanged while the height or length varies or which have a systematic variation of only one characteristic dimension of the dry heating surfaces providing that this does not affect the water side (e.g. the height of convector fins on panel radiator).

3.14 model: Heating appliance of defined height, length and depth within a type.

3.15 range of heights: Difference between the maximum and minimum height of the models in a type.

3.16 module of heating appliances: The reference length of the useful portion of a heating appliance. In the case of sectional heating appliances the module coincides with the section.

In the case of non-sectional heating appliances a length of 1m is assumed as the module. In the case of convectors, a length of 1 m of the heat emitter (not the casing) is assumed as the module.

The thermal output of any model can be obtained by multiplying the thermal output of the module by the number of sections or the length of the heating appliance in metres, as appropriate.

- 3.17 sample:** A heating appliance whose thermal output shall be determined or has been determined; its dimensions shall not deviate from the data indicated in the production drawings by more than the dimensional tolerances specified in this European Standard.
- 3.18 inlet water temperature:** The bulk temperature of the water entering the heating appliance.
- 3.19 outlet water temperature:** The bulk temperature of the water leaving the heating appliance.
- 3.20 temperature drop:** The difference between inlet and outlet water temperature.
- 3.21 mean water temperature:** The arithmetical mean of inlet and outlet water temperature.
- 3.22 reference air temperature:** The air temperature measured on the vertical line at the centre of the test booths, 0,75m above the floor level.
- 3.23 excess temperature:** Difference between mean water temperature and reference air temperature.
- 3.24 standard excess temperature:** The excess temperature of 50K as determined in the standard conditions (inlet water temperature of 75 °C, outlet water temperature of 65 °C and reference air temperature of 20 °C).
- 3.25 air pressure:** The air pressure measured at the test place.
- 3.26 standard air pressure:** It is defined as 101,325 kPa (1,01325 bar).
- 3.27 water flow rate:** The amount of water flowing through the heating appliance per unit of time.
- 3.28 standard water flow rate:** The water flow rate relating to standard test conditions.
- 3.29 standard thermal output:** The thermal output of a heating appliance defined for a standard reference air temperature of 20 °C, the standard air pressure, an inlet water temperature of 75 °C and an outlet water temperature of 65 °C.
- 3.30 characteristic equation:** The equation that gives the thermal output as a function of the excess temperature at constant water flow rate. The characteristic equation is a power function with a specific characteristic exponent.
- 3.31 standard characteristic equation:** The characteristic equation which is valid for standard water flow rate and from which the standard thermal output can be found for the standard excess temperature of 50 K.
- 3.32 regression equation of a type:** The equation which gives the standard thermal outputs and the characteristic exponent of all the models within a type as a function of one characteristic dimension. The regression equation for the determination of thermal outputs is a power function, in which the characteristic exponent is a linear function of the characteristic dimension.
- 3.33 standard thermal output of the module:** The standard thermal output of a model divided either by the number of sections or by the length in metres.

3.34 test pressure: Pressure to which the heating appliance is submitted during the manufacturing process (i.e. factory test pressure).

3.35 maximum operating pressure: The maximum system pressure to which the heating appliance may be submitted as stated by manufacturer.

3.36 maximum operating temperature: The maximum inlet water temperature allowed by the manufacturer.

3.37 test installation: The combination of:

- test booth and other related parts
- measuring instruments and related equipment.

3.38 test system: The combination of:

- test installation
- master radiators.

3.39 test systems circuit: A group of test systems convened to comply with the specifications and procedures of this European Standard and to a periodical comparison of test results.

3.40 repeatability of a test installation: Capability of one test installation to provide test results on one given master radiator within the tolerance specified by this European Standard (see 6.2.4).

3.41 reproducibility of a test installation: Capability of different test installation to provide test results on one given set of master radiators within the tolerance specified by this European Standard (see 6.2.4).

3.42 pressure drop: The difference of pressure between water inlet and water outlet of the heating appliance.

3.43 standard pressure drop: The drop in pressure between inlet and outlet of the appliance heat emitter on the primary fluid side, when the appliance is fed at the standard water flow rate.

4 Symbols and unit of measurement

Table 1 - Symbols, quantity and units of measurement

N.	Quantity	Symbol	Unit
4.1	Thermal output	Φ	W
4.2	Standard thermal output	Φ_S	W
4.3	Modular thermal output	Φ_L	W
4.4	Reference value for a master radiator	Φ_o	W
4.5	Reference value of a primary set of master radiator for interlaboratory comparisons	Φ_M	W
4.6	Electrical method heat losses	Φ_v	W
4.7	Electric power	P_{el}	W
4.8	Thermodynamic temperature	T	K
4.9	Temperature	t	°C
4.10	Inlet water temperature	t_1	°C
4.11	Outlet water temperature	t_2	°C
4.12	Temperature drop	$t_1 - t_2$	K
4.13	Mean water temperature	t_m	°C
4.14	Reference room air temperature	t_r	°C
4.15	Excess temperature	ΔT	K
4.16	Specific heat capacity	c_p	J/kg K
4.17	Specific enthalpy	h	J/kg
4.18	Inlet water enthalpy	h_1	J/kg
4.19	Outlet water enthalpy	h_2	J/kg
4.20	Water flow rate	q_m	kg/s
4.21	Standard water flow rate	q_{ms}	kg/s
4.22	Pressure	p	kPa
4.23	Maximum operating pressure	p_{max}	kPa

(continued)

N.	Quantity	Symbol	Unit
4.24	Pressure drop	Δp	kPa
4.25	Repeatability tolerance	S_o	
4.26	Reproducibility tolerance	S_m	
4.27	Overall height of the heating appliance	H	m
4.28	Range of heights	H_r	m
4.29	Overhall length of the heating appliance	L	m
4.30	Length of a section	L_s	m
4.31	Number of sections	N_s	-
4.32	Thermal resistance	R	m ² K/W
4.33	Time interval	τ	s

iTeh STANDARD PREVIEW (concluded)

5 Selection of heating appliances to be tested

5.1 Classification

SIST EN 442-2:1997

5.1.1 Heating appliances shall be grouped into families and types according to the definition in this European Standard. A family can include different types.

5.1.2 For the purposes of determining catalogue outputs, a family shall be divided into a number of separate types (in a family of radiators there may, for example, be single or double panels, with or without convector surfaces, using the same basic components).

5.2 Selection of models to be tested for determining the thermal outputs of a type

5.2.1 Selection of models to be tested when the variable characteristic dimension is the overall height and the cross section of the variable part is constant

5.2.1.1 When a type includes only models of height 300 mm and greater, the models to be tested within that type shall be selected in accordance with 5.2.1.2 to 5.2.1.5.

If the type also includes heights below 300 mm, the minimum height below 300 mm shall be tested in addition to the above models to be selected in accordance with 5.2.1.2 to 5.2.1.5.

For a type in which all heights are below 300 mm, only the minimum and the maximum height shall be tested.

5.2.1.2 The minimum number of models to be tested within a type is determined by the range of heights as shown in Table 2:

Table 2 - Minimum number of models to be tested

range of heights H_r m	number of heights
≤ 1	3
> 1	4

5.2.1.3 The minimum length of the models to be tested shall be 1 m or the closest to 1 m. In the case of sectional radiators the minimum number of sections shall be 10 and the minimum length 0,6m.

All the selected models of each type shall be of identical length, provided that the output of each model is not less than 700 W and not greater than 3500 W (the maximum output to be tested for determining the characteristic equation).

5.2.1.4 In the case of $H_r \leq 1$ m, the models to be tested shall be the minimum and maximum height of the range and an intermediate height so that H_{int} is equal to or the closest value greater than:

$$H_{max} = 1/2 \cdot H_r$$

(standards.iteh.ai)

Where H_{max} is the maximum height of the type.

5.2.1.5 In the case of $1 \text{ m} < H_r \leq 2,5 \text{ m}$, the models to be tested shall be the minimum and maximum height of the range and two intermediate heights so that H_{int1} and H_{int2} are the closest values respectively to:

$$H_{max} = 1/3 \cdot H_r$$

and

$$H_{max} = 2/3 \cdot H_r$$

5.2.2 Selection of models to be tested when the variable characteristic dimension is other than the overall height

The minimum number of models to be tested is three, having the same overall height and respectively, the minimum, intermediate and maximum value of the relevant characteristic dimension (see 5.2.1.4).

5.3 Testing samples submission and identification

5.3.1 On initial application for the testing of a family of heating appliances, or of a type within a family, heating appliances samples and product drawings shall be submitted to the testing laboratory.

Product drawings shall be submitted by the manufacturer.

5.3.2 The product drawings shall:

- show all dimensions and features having an influence on the heat emission, including the detail of welds or other assembly methods used;
- state the type of material and the nominal material thicknesses of all wet or dry surfaces, with the thickness tolerances, and type of paint.

5.3.3 Before proceeding with the thermal output testing, the laboratory shall identify the appliance against the drawing and shall note conformity of the sample with the drawing in respect of:

- dimensional tolerances given in Table 3;
- material thickness tolerances of convective surfaces, shown on the product drawings.

The laboratory shall also measure the mass and the water content of the sample models. The relevant values shall be reported in the test report.

The models for test shall be selected as specified in 5.2 of this European Standard.

5.3.4 Samples of heating appliances already in production shall be taken from the production line or manufacturer's stock by the laboratory or its authorized representative.

Samples of prototype appliances shall be submitted by the manufacturer.

6 Laboratory arrangements and test methods

6.1 Principle

The aim of the test is to determine the standard thermal output of the heating appliance using its standard characteristic equation, which is to be obtained according to 6.4.5.

6.2 Apparatus

6.2.1 Test System

For the purposes of this European Standard, a test system shall consist of:

- a) a test installation;
- b) a set of 3 master radiators built according to 6.2.3.

For the purposes of this European Standard, test installations are classified as reference and approved.

6.2.2 Reference test installation

The Reference test installation shall contain the following equipment:

- a) a closed unventilated booth comprising the test space within which the heating appliance under test is to be installed, equipped with water cooled surfaces to maintain specific thermal conditions independent of the external ambient, built according to 6.2.2.1;
- b) apparatus for cooling the water circulating in the walls of the closed booth;
- c) a primary heating circuit feeding the appliance under test built in accordance with 6.4;
- d) measuring and checking instruments complying with the requirements of 6.2.5 and 6.2.6.

6.2.2.1 Reference test booth

6.2.2.1.1. Test booth dimensions

The test booth shall have the following internal dimensions:

length : $(4 \pm 0,02)$ m
width : $(4 \pm 0,02)$ m
height : $(3 \pm 0,02)$ m

6.2.2.1.2 Test booth construction

The test booth shall be constructed with sandwich panels cooled by water (see Figure 1). The internal surface of the booth shall be smooth and made from flat sheets of steel. The sandwich panels (see Figures 1 and 2) are made up of:

- a steel panel water cooled;
- insulating foam injected between the steel panel and an external steel sheet, to form a single self supporting body;
- an external steel sheet 0,6 mm nominal thickness.

The steel water cooled panels (see Figure 3) are made up of two sheets welded together:

- one flat having 2 mm thickness;
- the other of 1 mm thickness having undulating shape to form water ways with a cross section approximately 150 mm².

The thickness of the insulating foam layer shall be 80 mm. The minimum overall thermal resistance of each wall, floor and ceiling shall be 2,5 m² K/W. The wall behind the appliance under test is made by the same sandwich panels but it is disconnected from the cooling system (the steel panels are empty). The inside surfaces of the test booth shall be covered with a dull paint having an emissivity of at least 0,9. The panels are assembled so that the structure of the test booth is self supporting, without thermal bridges (see Figure 4). The connection of the cooling panels to the circuit are made following a three-pipe circuit scheme (see Figure 5). The holes allowing water and electric connections with the outside of the test booth are provided with devices for air tightness.