SLOVENSKI STANDARD
SIST EN 308:2022

01-junij-2022

Nadomešča:
SIST EN 308:1997

Prenosniki toplote - Preskusni postopki za ugotavljanje lastnosti komponent za rekuperacijo toplote zrak-zrak

Heat exchangers - Test procedures for establishing performance of air to air heat recovery components

Wärmeaustauscher - Prüfverfahren zur Bestimmung der Leistungskriterien von Luft/Luft-Wärmerückgewinnungsanlagen

Échangeurs thermiques - Procédures d'essai pour la détermination de la performance des composants de récupération de chaleur air/air

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ICS:

27.060.30	Grelniki vode in prenosniki toplote	Boilers and heat exchangers

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Heat exchangers - Test procedures for establishing performance of air to air heat recovery components

Échangeurs thermiques - Procédures d'essai pour la détermination de la performance des composants de récupération de chaleur air/air

Wärmeaustauscher - Prüfverfahren zur Bestimmung der Leistungskriterien von Luft/Luft-Wärmerückgewinnungsanlagen

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 308:2022) has been prepared by Technical Committee CEN/TC 110 “Heat exchangers”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by September 2022, and conflicting national standards shall be withdrawn at the latest by September 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 308:1997.

This edition includes the following significant technical changes with respect to EN 308:1997:

— Scope: flue gas heat recovery devices are no more included.

— In addition to laboratory tests of heat recovery components (HRC), laboratory tests for HRC fitted into air handling units and on-site tests of HRC are defined.

— Different precision classes for tests are defined.

— Leakage testing has been refined. Exhaust air transfer ratio (EATR) and outdoor air correction factor (OACF) are implemented.

— Differences of the sensible and latent efficiency can occur due to leakages and bad heat balance.

— Several terms and definitions are changed, e.g. categories of heat recovery components.

— Type A test is only on the heat exchanger and does not necessarily give a representative value when it is installed, corrections may be needed.

EN 13053 refers to EN 308 regarding the test setup and the test procedure. EN 13053 is a standard harmonized with the Commission Regulation (EU) 1253/2014 [5].

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document specifies methods for the performance testing of air-to-air heat recovery components (HRC) used in ventilation systems. This document does not contain any information on air handling units, ductwork and components of air distribution, which are covered by other European Standards. The document applies for laboratory and in on-site testing. Further it applies to different purposes of tests, which can be e.g. certification of products, acceptance of installed products, market surveillance or quality tests of manufacturers.

These different applications do not require the same precision of measurements results. Therefore, different precision classes are defined. Table 1 gives informative examples for the application of the different test types and precision classes. For low quality products, low quality installations and/or simplified testing, a 'not classified' precision class can occur for all test types.

Table 1 — Examples for the application of the different test types and precision classes

Test Type	Precision class P1 (high precision)	Precision class P2 (medium precision)	Precision class P3 (low precision)	not classified
Test type A HRC installed in a test casing or HRC-section Tested in laboratory	— certification or declaration of products — performance test	— test of functionality	— not intended use	— not intended use
Test type B HRC installed in an AHU[a] Tested in laboratory	— test under ideal conditions	— certification or declaration of products — performance test	— test of functionality	— not intended use
Test type C HRC installed in an AHU[a] or in duct work of an installed ventilation system Tested on-site	— not intended use, but possible under ideal conditions and laboratory-like test equipment	— test under ideal conditions in real systems — performance test	— typical test conditions in real systems	— test of functionality
[a] The HRC is installed in an AHU (air handling unit) by the manufacturer of the AHU.				

Customers and manufacturers are free to define the aspired precision class for testing of their products, but it will be taken into account that the available precision class depends on the test conditions, the HRC itself, the measurement equipment and the environment conditions.

This document is one of a series of European Standards dedicated to heat exchangers.

Note 1 Testing procedure of residential ventilation units, RVU's, is covered by EN 13141-7 and EN 13141-8.

Note 2 EN 13053 deals with non-residential ventilation units, NRVU's, specifically Air Handling Units (AHU's). For testing of the heat recovery, EN 13053 refers to EN 308.

1 Scope

This document specifies methods to be used for testing of air-to-air heat recovery components (HRC). The main purpose of the HRC is to exchange heat between exhaust air and supply air in order to save energy, which results in

— preheat or heat, and/or

— precool or cool

supply air in ventilation systems or air conditioning systems. Optionally HRC can exchange air humidity between exhaust and supply air. The HRC contains the heat exchangers and all necessary features and auxiliary devices for the exchange of sensible heat and (if available) air humidity between exhaust air and supply air. The HRC will be installed in casings or ducts. If fans are part of the test unit, the effect of the fan power on the measured values will be corrected.

This document specifies procedures and input criteria required for tests to determine the performance of a HRC at one or several test conditions, each of them with continuous and stationary air flows, air temperatures and humidities at both inlet sides. Three different test types are covered:

— Test type A, Laboratory testing of HRC installed in test casings (A1) or a HRC sections (A2);

— Test type B, Laboratory testing of HRC installed in non-residential ventilation units[1] in design configuration;

— Test type C, on-site (field) testing of HRC in non-residential ventilation units (C1) or a HRC sections (C2) in operation configuration.

This document is applicable to recuperators, regenerators, and HRC with intermediary heat transfer medium.

This document prescribes test methods for determining:

1) the temperature and humidity efficiency,

2) the pressure drop of exhaust air and supply air sides,

3) possible internal leakages; exhaust air transfer ratio (EATR) and outdoor air correction factor (OACF),

4) external leakages and

5) auxiliary energy used for the operation of the HRC.

HRC using heat pumps are not covered by this document.

1 Definition according Commission Regulation (EU) No 1253/2014 [5].

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.

EN 1886, *Ventilation for buildings — Air handling units — Mechanical performance*

EN 13053, *Ventilation for buildings — Air handling units — Rating and performance for units, components and sections*

JCGM 100, *Evaluation of measurement data — Guide to the expression of uncertainty in measurement*

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:

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

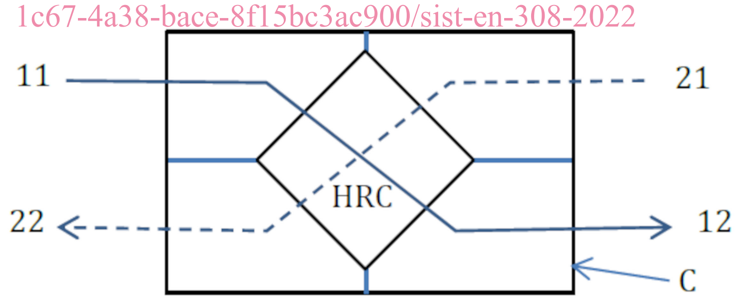
— ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Air categories

3.1.1
exhaust air inlet
air to be exhausted from the application, before entering the HRC

Note 1 to entry: In ventilation systems, this air is usually called extract air.

Note 2 to entry: Figure 1 shows the definition of the air flow categories in heat recovery components (HRC).



Key

11	Exhaust air inlet	22	Supply air outlet
12	Exhaust air outlet	HRC	Heat recovery component
21	Supply air inlet	C	Casing

Figure 1 — Air categories

3.1.2
exhaust air outlet
air in exhaust condition, intended to be blown back to the environment, after leaving the HRC

Note 1 to entry: In ventilation systems, this air is usually called exhaust air.

Note 2 to entry: See Figure 1.

3.1.3
supply air inlet
air intended for the application, before entering the HRC

Note 1 to entry: In ventilation systems, this air is usually called outdoor air. Sometimes this air does not come directly from outdoor (preheated space, ground heat exchanger, etc.)

Note 2 to entry: See Figure 1.

3.1.4
supply air outlet
air intended for the application, after leaving the HRC

Note 1 to entry: See Figure 1.

3.2 Thermal performance characteristics

3.2.1
temperature efficiency

$\eta_{t,efy}$

transfer of sensible heat from exhaust to supply air, with correction of the temperature increase of the supply air outlet caused by the EATR and a correction in case of a bad heat balance, to be used for the description of the performance characteristic of a HRC

Note 1 to entry: The determination is according to 6.1.6.

Note 2 to entry: No definitions of temperature efficiency on the exhaust-air side are included. If data on the exhaust-air side is required, conditions can be calculated by heat and mass balances, considering leakage and EATR.

Note 3 to entry: The temperature efficiency depends on the supply air mass flow and on the mass flow ratio between the supply air flow and the exhaust air flow.

3.2.2
temperature gross efficiency

$\eta_{t,gro}$

temperature difference on the supply air side divided by the temperature difference between exhaust air inlet and supply air inlet

Note 1 to entry: The determination is according to 6.1.6.

Note 2 to entry: The temperature gross efficiency does not regard internal or external leakages or heat flow through the casing. The temperatures θ_{11}, θ_{21} and θ_{22} can differ from measured values, see 6.1.6.2.

Note 3 to entry: In Regulation (EU) 1253/2014 [5], the same equation is used. There, the definition is called ‘thermal efficiency of a non-residential HRS (η_{t_nrvu})’ and shall be measured under dry reference conditions, with balanced mass flows, an indoor-outdoor air temperature difference of 20 K, excluding thermal heat gain from fan motors and from internal leakages.

3.2.3
temperature net efficiency

$\eta_{t,net}$

net transfer of sensible heat from exhaust to supply air, with correction of the temperature change of the supply air outlet caused by the EATR

Note 1 to entry: The determination is according to 6.1.6.

Note 2 to entry: The temperature net efficiency does not regard external leakages or heat flow through the casing. The temperatures θ_{11}, θ_{21} and θ_{22} can differ from measured values, see 6.1.6.2.

Note 3 to entry: Temperature net efficiency calculation is required if EATR is determined (see 5.5.2).

3.2.4
temperature effectiveness

ε_t

temperature gross efficiency, multiplied with the ratio of the mass flow rate of supply air outlet to the minimum mass flow rate of supply outlet or exhaust air inlet

Note 1 to entry: The determination is according to 6.1.7.

Note 2 to entry: The temperature effectiveness describes the ratio of the effective sensible heat transfer from the exhaust air side to the supply air side compared with the theoretical possible sensible heat transfer.

Note 3 to entry If the efficiency is very high, condensation occurs and the airflows are very unbalanced, the effectiveness value can be higher than 1.

3.2.5
humidity efficiency

$\eta_{x,efy}$

transfer of latent heat from exhaust to supply air, with correction of the humidity change of the supply air outlet caused by the EATR and a correction in case of a bad heat balance

Note 1 to entry: The humidity efficiency is determined according to 6.1.6.

Note 2 to entry: No definitions of humidity efficiency on the exhaust-air side are included. If data on the exhaust-air side is required, conditions can be calculated by heat and mass balances, considering leakage and EATR.

Note 3 to entry: The humidity efficiency depends on the supply air flow and on the mass flow ratio between the supply air flow and the exhaust air flow.

3.2.6
humidity gross efficiency

$\eta_{x,gro}$

absolute humidity difference on the supply air side divided by the absolute humidity difference between exhaust air inlet and supply air inlet

Note 1 to entry: The determination is according to 6.1.6.

Note 2 to entry: No definitions of efficiency on the exhaust-air side are included. If data on the exhaust-air side is required, conditions can be calculated by mass balances, considering leakages.

3.2.7
humidity net efficiency

$\eta_{x,\ net}$

net transfer of latent heat exhaust to supply air, with correction of the humidity change of the supply air outlet caused by the EATR

Note 1 to entry: The determination is according to 6.1.6.

Note 2 to entry: Humidity net efficiency calculation is required if EATR is determined (see 5.5.2).

3.2.8
humidity effectiveness

ε_x

humidity efficiency, multiplied with the ratio of the dry mass flow rate of supply air outlet to the minimum dry mass flow rate of supply outlet or exhaust air inlet

Note 1 to entry: The determination is according to 6.1.7.

3.3 Air flow and leakage

3.3.1
nominal leakage rate

ratio of the leakage (air volume flow) to the nominal air volume flow, at standard conditions

3.3.2
external leakage

q_{ve}

leakage from casing to or from the ambient air

Note 1 to entry: The external leakage is usually measured under static pressure difference. For calculations considering the impact of the external leakage on measurement uncertainty, the external leakage in operational mode has to be determined usually by calculation or estimation.

3.3.3
internal leakage

q_{vi}

umbrella term for the following definitions:

— test setup leakage;

— static internal leakage;

— dynamic internal leakage

3.3.4
test setup internal leakage

$q_{vi,setup}$

internal leakage of the test casing for Test Type A1, measured with static pressure difference

3.3.5
static internal leakage
$q_{vi,stat}$
internal leakage of the unit under test, measured with static pressure difference

Note 1 to entry: The static internal leakage is used as quality indicator for a HRC, where EATR and OACF are not determined. This concerns constructions with no or only minor leakages, such as plate heat exchangers.

Note 2 to entry: The unit under test is defined by the test type.

3.3.6
dynamic internal leakage
internal leakage of the HRC, measured in operation conditions with air flow on both sides

Note 1 to entry: The dynamic internal leakage is characterized by EATR and OACF. EATR and OACF shall be declared as a pair at identical conditions.

3.3.7
air flow
mass flow and volume flow of air

Note 1 to entry: If a clarification (mass or volume) is necessary the term is complemented with the applicable symbol.

Note 2 to entry: Used as an umbrella term.

3.3.8
exhaust air transfer ratio
EATR
transfer of exhaust air into the supply air side in HRC and which provides information on the ratio of exhaust air in the supply air

Note 1 to entry: The EATR can be measured with tracer gas. The determination is according to 6.1.2.

Note 2 to entry: The subscript shows how the EATR is determined or measured respectively:

— $EATR_{A1}$: According to Test Type A1

— $EATR_{A2}$: According to Test Type A2

— $EATR_{B}$: According to Test Type B

— $EATR_{C}$: According to Test Type C

Note 3 to entry: The EATR depends on pressure difference and airflows. Therefore, the test conditions at which EATR is determined always have to be declared.

Note 4 to entry: Procedures for the estimation of the EATR for test type C are described in Annex D.

Note 5 to entry: EATR replaces the old term Carry-Over.

3.3.9
outdoor air correction factor
OACF
ratio of the entering supply mass airflow rate and the leaving supply mass airflow rate, which provides information about the leakages between the air flows

Note 1 to entry: The determination is according to 6.1.2.

Note 2 to entry: The OACF depends on pressure difference and airflows. Therefore, the test conditions at which OACF is determined always have to be declared.

3.3.10
mass flow rate exhaust air inlet
q_{m11}
air mass flow on the exhaust air inlet side

Note 1 to entry: This is the mass flow that leaves the application side.

3.3.11
mass flow rate exhaust air outlet
q_{m12}
air mass flow on the exhaust air outlet side

3.3.12
mass flow rate supply air inlet
q_{m21}
air mass flow on the supply air inlet side

3.3.13
mass flow rate supply air outlet
q_{m22}
air mass flow on the supply air outlet side

Note 1 to entry: This is the mass flow that enters the application side.

3.3.14
nominal air mass flow rate
$q_{m,n}$
declared air mass flow rate as base for testing and test results

3.4 Pressure

3.4.1
pressure difference 22−11
Δp_{22-11}
difference in static pressure between the supply air outlet and the exhaust air inlet, measured in the casing or other connections with the same cross section area on both sides

Note to entry: The pressure difference is determined according 6.1.4.1.

3.4.2
pressure drop
Δp_{11-12}, Δp_{21-22}
loss in static pressure between the inlet and the outlet of a HRC, measured in the casing or other connections with the same cross section area on both sides

Note to entry: The pressure drop is determined according 6.1.4.2.

3.4.3
external static pressure difference
$\Delta p_{s,ext}$
difference between the static pressure at the outlet of the air handling unit and the static pressure at the inlet

[SOURCE: EN 13053]

3.4.4
static internal leakage mass flow rate
$q_{m,il,stat}$
leakage, caused by a static pressure difference between exhaust air side and supply air side

Note 1 to entry: Measured by blanking off and sealing all ducts of the HRC or HRC section.

3.5 General terms and definitions

3.5.1
standard air conditions
relating to air with a density of 1,20 kg/m^3, at a temperature of 20 °C, an atmospheric air pressure of 101 325 Pa and a relative humidity 40 %

3.5.2
face area
A_{f22}
orthographic projection of the supply air outlet side of the HRC, which is in contact with the supply air

Note 1 to entry: The face area of HRC depends on the HRC category and construction.

3.6 Categories of heat recovery components

3.6.1
heat recovery component
HRC
heat exchanger or combinations of heat exchangers which transfer heat and, in some cases humidity, between exhaust and supply air flow depending on the difference of temperature and humidity levels and which are generally installed in casings or air ducts

Note 1 to entry: In the following clauses the HRC are divided into three categories and additional sub-categories. Table 2 gives an overview.

Note 2 to entry: Used as an umbrella term.