
Prenosniki toplote - Preskusni postopki za ugotavljanje lastnosti naprav za prenos toplote zrak/zrak in dimni plini/zrak

Heat exchangers - Test procedures for establishing performance of air to air and flue gases heat recovery devices

Wärmetauscher - Prüfverfahren zur Bestimmung der Leistungskriterien von Luft-Luft-Wärmerückgewinnungs-komponenten

Echangeurs thermique - Procédures d'essai pour la détermination de la performance des recuperateurs de chaleur air/air

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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 and flue gases heat recovery devices

Echangeurs thermique - Procédures d'essai pour la détermination de la performance des recuperateurs de chaleur air/air

Wärmetauscher - Prüfverfahren zur Bestimmung der Leistungskriterien von Luft-Luft-Wärmerückgewinnungs-komponenten

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 110.

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European foreword

This document (prEN 308:2020) has been prepared by Technical Committee CEN/TC 110 “Heat exchangers”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede 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 ration (EATR) and outdoor air correction factor (OACF) are implemented.
- Correction of the sensible and latent efficiency due to leakages and bad heat balance are implemented.
- Several terms and definitions are changed, e.g. categories of heat recovery components.

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) 12353/2014 [6].

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	Examples for the application for precision class			
	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 of products — quality tests before market launch	— internal tests, e.g. for R&D	— special test points under extreme conditions — test of functionality	— not intended use
Test type B HRC installed in an AHU ^a Tested in laboratory	— test under ideal conditions with high-quality products	— certification of products — quality tests before market launch	— internal tests, e.g. for R&D — 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 with high-quality products and laboratory-like test equipment	— test under ideal conditions in real systems	— 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 units¹ 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.

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*

¹ Definition according Commission Regulation (EU) No 1253/2014 [6]

EN 13053:2019, *Ventilation for buildings - Air handling units - Rating and performance for units, components and sections*

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

3.1 Air categories

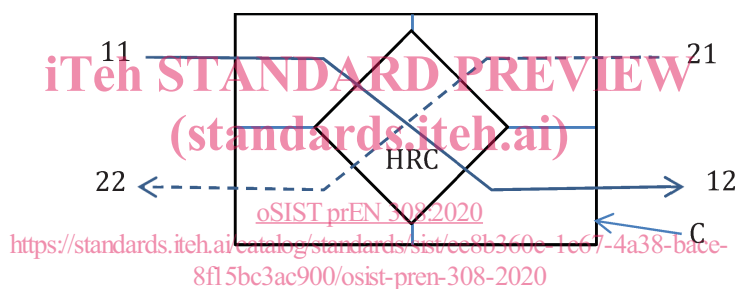
3.1.1

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: See Figure 1.



Key

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

NOTE Figure 1 shows the definition of the air flow categories in heat recovery components (HRC).

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: See Figure 1.

prEN 308:2020 (E)**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

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

Note 2 to entry: This term shall be used to describe the performance characteristic of a HRC for sensible heat.

Note 3 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 4 to entry: The temperature efficiency depends on the 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 temperature gross efficiency is calculated as in Formula (1).

$$\eta_{t,gro} = \frac{\theta_{22} - \theta_{21}}{\theta_{11} - \theta_{21}} \quad (1)$$

where

θ_{11} is temperature of exhaust air inlet, in °C;

θ_{21} is temperature of supply air inlet, in °C;

θ_{22} is temperature of supply air outlet, in °C.

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 [6], the same equation is used. There, the definition is called 'thermal efficiency of a non-residential HRS ($\eta_{t,nrvu}$)' 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. (standards.iteh.ai)

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 temperature net efficiency is calculated as in Formula (2).

$$\eta_{t,net} = \frac{\frac{\theta_{22} - \text{EATR} \cdot \theta_{11}}{1 - \text{EATR}} - \theta_{21}}{\theta_{11} - \theta_{21}} \quad (2)$$

where

EATR is exhaust air transfer ratio;

θ_{11} is temperature of exhaust air inlet, in °C;

θ_{21} is temperature of supply air inlet, in °C;

θ_{22} is temperature of supply air outlet, in °C.

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)

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3.2.4

temperature effectiveness

 $\eta_{t,efs}$

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 temperature effectiveness is calculated as in Formula (3).

$$\eta_{t,efs} = \frac{q_{m22} \cdot (\theta_{22} - \theta_{21})}{q_{m,min} \cdot (\theta_{11} - \theta_{21})} \quad (3)$$

where

q_{m22} is mass flow rate of supply air outlet, in kg/s

$q_{m,min}$ is minimum mass flow rate, either of supply air outlet or exhaust air inlet, in kg/s
 $q_{m,min} = \min(q_{m22}, q_{m11})$

θ_{11} is temperature of exhaust air inlet, in °C

θ_{21} is temperature of supply air inlet, in °C

θ_{22} is temperature of supply air outlet, in °C

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.

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 mass flow and on the mass flow ratio between the supply air flow and the exhaust air flow.

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3.2.6

humidity gross efficiency

η_x

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 humidity gross efficiency is calculated as in Formula (4).

$$\eta_{x,gro} = \frac{x_{22} - x_{21}}{x_{11} - x_{21}} \quad (4)$$

where

x_{11} is absolute humidity of exhaust air inlet, in g/kg;

x_{21} is absolute humidity of supply air inlet, in g/kg;

x_{22} is absolute humidity of supply air outlet, in g/kg.

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 humidity net efficiency is calculated as in Formula (5).

$$\eta_{x,net} = \frac{\frac{x_{22} - EATR \cdot x_{11}}{1 - EATR} - x_{21}}{x_{11} - x_{21}} \quad (5)$$

where

EATR is exhaust air transfer ratio;

x_{11} is absolute humidity of exhaust air inlet, in g/kg;

x_{21} is absolute humidity of supply air inlet, in g/kg;

x_{22} is absolute humidity of supply air outlet, in g/kg.

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

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3.2.8

humidity effectiveness

 $\eta_{x,efs}$

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 humidity effectiveness is calculated as in Formula (6).

$$\eta_{x,efs} = \frac{q_{m,dry22} \cdot (x_{22} - x_{21})}{q_{m,dry,min} \cdot (x_{11} - x_{21})} \quad (6)$$

where

$q_{m,dry22}$ is mass flow rate of dry supply air inlet, in kg/s;

$q_{m,dry,min}$ is minimum dry mass flow rate, either of supply air outlet or exhaust air inlet, in kg/s $q_{m,min} = \min(q_{m,dry22}, q_{m,dry11})$;

x_{11} is absolute humidity of exhaust air inlet, in g/kg;

x_{21} is absolute humidity of supply air inlet, in g/kg;

x_{22} is absolute humidity of supply air outlet, in g/kg.

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3.3 Leakage and mass flow

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3.3.1

nominal leakage rate

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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.

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