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Enofazni prenosniki toplote tekočina-tekočina - Preskusni postopek za določanje zmogljivosti

Liquid-to-liquid single-phase heat exchangers - Test procedure for determining performance

Einphasen-flüssig/flüssig Wärmetauscher - Prüfverfahren zur Bestimmung der Leistungskriterien

Echangeurs monophasiques liquide/liquide - Procédure d'essai pour la détermination de la performance

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ICS:

27.060.30	Grelniki vode in prenosniki toplote	Boilers and heat exchangers

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 18208

October 2026

ICS 27.060.30

English Version

Liquid-to-liquid single-phase heat exchangers - Test procedure for determining performance

Echangeurs monophasiques liquide/liquide - Procédure d'essai pour la détermination de la performance

Einphasen-flüssig/flüssig Wärmetauscher - Prüfverfahren zur Bestimmung der Leistungskriterien

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European foreword

This document (EN 18208:2026) 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of an identical text or by endorsement, at the latest by April 2027, and conflicting national standards shall be withdrawn at the latest by April 2027.

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.

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.

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Introduction

This document is designed to support a series of European standards dedicated to heat exchangers.

This document provides manufacturers and users with the information needed to present the thermohydraulic performance characteristics of a heat exchanger. These characteristics form the basis for evaluating the state of a heat exchanger, whether it is new/a replacement, or already in operation.

This document also provides a performance-based acceptance test procedure for a liquid-to-liquid single-phase heat exchanger (sensor calibration, acknowledgement of uncertainties, standardization of physical properties of liquids) and the possible transpositions under various rated conditions.

The customer's technical specification, referred to in this document, defines or adapts the level of tolerance. It also defines thermal performance acceptance criteria. Examples are provided in Annex C.

Underlying assumption of this document is that the liquid is a Newtonian fluid in turbulent conditions. This document may be adapted for other liquids or conditions, as agreed by parties involved in the performance test.

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1 Scope

This document defines the general terms and the calculations used to determine the thermohydraulic performance of heat exchangers. It includes the general test procedure and related theories.

This document is intended to be used for acceptance-testing heat exchangers in test facilities such as laboratories, manufacturer test facilities and final installation site.

This document specifies three acceptance levels:

— level 1 for minimum tolerances;

— level 2 for nominal tolerances;

— level 3 for maximum tolerances;

This document constitutes an application-specific standard in line with EN 305 and EN 306.

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.

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EN 247, *Heat exchangers — Terminology*

EN 305, *Heat exchangers — Definitions of performance of heat exchangers and the general test procedure for establishing performance of all heat exchangers*

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EN 306, *Heat exchangers — Methods of measuring the parameters necessary for establishing the performance*

EN ISO 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full*

ISO/TR 12767, *Measurement of fluid flow by means of pressure differential devices — Guidelines on the effect of departure from the specifications and operating conditions given in ISO 5167*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 247 and the following apply.

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

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

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

3.1
liquid
any type of liquid, such as water, used to transfer thermal energy (heat)

Note 1 to entry: There can be a combination of two or more types of liquids, all in the same phase state (single-phase liquid).

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3.2
primary liquid
hottest liquid, which serves as a heat source

3.3
secondary liquid
coolest liquid, which serves as a heat sink

3.4
mixture
liquid with two or more elements, all in the same phase state

3.5
heat exchanger
device designed to transfer heat between two physically separated liquids

3.6
thermohydraulic performance of a heat exchanger
heat exchanger thermohydraulic performance that can be established by measuring, or can be calculated using measured parameters, and is expressed according to one or more of the following elements:

— temperature of primary/secondary liquid;

— flow rate of primary/secondary liquid;

— pressure of primary/secondary liquid;

— temperature difference;

— heat transfer coefficient;

— heat transfer rate transferred by primary liquid / captured by secondary liquid;

— pressure drops;

— fouling factors.

Note 1 to entry: These elements are identified per EN 305 and may be established by measuring per EN 306.

3.7
heat exchanger categories
classification of heat exchanger types based on design criteria, physical criteria, or a mix of the two

3.8
heating
temperature increase of a secondary liquid that does not change its phase state

3.9
cooling
temperature decrease of a primary liquid that does not change its phase state

3.10
fouling
deposit of a layer of unwanted materials entailing/causing resistance to the heat transfer

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3.11
plugging
obstruction of one or more openings/channels in a heat exchanger where no primary or secondary liquid can circulate, resulting in a decrease in the transfer surface and an increase in pressure drops

3.12
irreversible pressure drop
decrease of static pressure between inlet and outlet not including change of level

3.13
typical inlet
inlet considered the most representative of each heat exchanger, chosen by the manufacturer or in accordance with the installation conditions

3.14
typical outlet
outlet considered the most representative of each heat exchanger, chosen by the manufacturer or in accordance with the conditions of use

3.15
pinch temperature
minimum difference between the primary liquid and secondary liquid temperatures

3.16
customer
user
entity that purchases a good or service from a supplier

Note 1 to entry: For test of used heat exchangers, the user is responsible of the fouling of the heat exchanger. (i.e. for cleaning it or defining the fouling resistance)

3.17
maker
manufacturer
supplier
entity that supplies goods to a user and guarantees the performance of the heat exchanger (sourcing, manufacture, production inspection, packaging, storage, transport)

Note 1 to entry: For new heat exchangers, in the case of performance tests, they are also responsible for checking heat exchanger cleanliness (initial cleanliness report), preparing the heat exchanger and its immediate environment (e.g. anchoring, adapters, cradles, access scaffolding) and establishing the thermohydraulic criterion checking report (by transposition if the conditions differ from the reference conditions, per 6.3).

3.18
verifier
laboratory
entity that verifies the equipment performance through one or more tests and ensures the exchanger test measurements (calibration, test bench assembly, bench cleanliness check, sensor installation, liquid analysis report, acquisition chain, test bench/heat exchanger adapters connection, performance test, uncertainty calculations), including measurement uncertainties

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3.19
design state
reference conditions
heat exchanger operating parameters that will determine the minimum *k.A.F.* coefficient required to satisfy the customer's criterion

Note 1 to entry: This state is determined by the manufacturer based on the operating situations required by the customer (mass flow rates and liquid temperatures, heat transfer rate to be transferred, etc.)

3.20
steady state
condition where the average value of all main variables of the heat exchanger (temperature, pressure, flow rate) remains constant over time, and fluctuations are in the same order of magnitude of the measuring sensor, given that external conditions and inputs are unchanging

Note 1 to entry: Steady-state criteria are expressed in 6.1.3.

3.21
required
thermohydraulic rated conditions according to customer requirements

4 Symbols and abbreviations

For the purposes of this document, the symbols, abbreviations and subscripts given in Table 1 apply.

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Table 1 — Symbols, abbreviations, subscripts and units

Symbol	Denomination	Unit
A	Reference heat transfer surface area	m^2
C_{DP}	Hydraulic test factor	—
C_e	Thermal test factor	—
C_{foul}	Cleanliness factor	—
C_p	Constant pressure specific heat capacity	J/(kg °C)
F	LMTD correction factor	—
g	Acceleration of gravity	m/s^2
h	Specific enthalpy	J/kg
k	Overall heat transfer coefficient	$W/(m^2\ °C)$
$k{\cdot}A{\cdot}F$	Heat exchanger thermal performance	W/°C
LMTD	Log mean temperature difference	°C
NTU	Number of thermal transfer units	—
p	Pressure	Pa
q_m	Mass flow	kg/s
$q_m c_p$	Heat capacity flow rate	W/°C
R	Resistance (thermal)	$(m^2\ °C)/W$
S	Liquid flow section	m^2

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Symbol	Denomination	Unit
SM	Excess surface heat transfer coefficient	%
T	Celsius temperature	°C
U	Absolute uncertainty	—
v	Velocity	m/s
x	Overall heat transfer coefficient margin	%
y	Heat flow ratio	—
z	Height	m
α	Convective heat transfer coefficient	W/(m² °C)
ε	Thermal efficiency	—
ζ	Pressure drop coefficient	—
λ	Thermal conductivity	W/(m °C)
μ	Dynamic viscosity at liquid average temperature	kg/(m.s)
μ_w	Dynamic viscosity at temperature of wall in contact with liquid	kg/(m.s)
Φ	Heat transfer rate	W
ρ	Density	kg/m³
σ	Experimental standard deviation	—
Δ	Difference	—
$_{abs}$	Absolute	—
$_{clean}$	Clean	—
$_{foul}$	Fouled/fouling	—
$_{m}$	Mass	—
$_{max}$	Maximum	—
$_{mat}$	Material in contact with liquid	—
$_{min}$	Minimum	—
$_{num}$	Numerical	—
$_{op}$	Operational	—
$_{rel}$	Relative	—
$_{required}$	Design reference	—
$_{test}$	Test	—
$_{transpo}$	Transposed/transposition	—
$_{1}$	Primary side	—
$_{2}$	Secondary side	—
$_{11}$	Inlet conditions, primary side	—
$_{12}$	Outlet conditions, primary side	—

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Symbol	Denomination	Unit
21	Inlet conditions, secondary side	—
22	Outlet conditions, secondary side	—

NOTE The LMTD correction factor F depends on the type of heat exchanger and the flow configuration. This factor is equal to or less than 1 (5.3.5.2).

5 Performance of liquid-to-liquid heat exchangers

5.1 Typical quantities

5.1.1 Derived quantities

When this document serves as the basis for establishing performance characteristics, the parts contained in EN 305 shall be used (see Table 2).

Table 2 — Quantity used to establish performance characteristics

Quantity	Designation	Subclause
Fouling thermal resistance	R_{foul}	5.1.2.5
Excess surface heat transfer coefficient	SM	5.1.2.5
Cleanliness factor	C_{foul}	5.1.2.5
Pressure drops (hydraulic performance)	Δp	5.2
Heat transfer rate	Φ	5.3.2
Overall heat transfer coefficient	k	5.3.3
Heat transfer area	A	5.3.4
Logarithmic mean temperature difference	LMTD	5.3.5.2
Thermal performance	$k.A.F$	5.3.5.2.3
Number of thermal transfer units	NTU	5.3.5.2.4
Thermal efficiency	ε	5.3.5.3.2

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5.1.2 Rated conditions

5.1.2.1 General

The thermohydraulic performance of a heat exchanger shall be defined for rated conditions by:

— type of liquid;

— flow rate (primary and second liquid mass flow rate);

— temperature (at primary and secondary liquid inlet and/or outlet);

— total pressure (at primary and secondary liquid inlet and/or outlet);

— pressure drops (of primary and secondary liquids);

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