SLOVENSKI STANDARD
SIST EN 306:1997

01-avgust-1997

Prenosniki toplote - Merilne metode in merilna točnost za ugotavljanje njihovih lastnosti

Heat exchangers - Methods of measuring the parameters necessary for establishing the performance

Wärmeaustauscher - Messungen und Meßgenauigkeit bei der Leistungsbestimmung

Echangeurs thermiques - Méthodes de mesurage des parametres nécessaires a l'évaluation des performances

Ta slovenski standard je istoveten z: EN 306:1997

ICS:

27.060.30	Grelniki vode in prenosniki toplote	Boilers and heat exchangers

SIST EN 306:1997 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 306

February 1997

Supersedes ENV 306:1990

ICS 27.060.30

Descriptors: heat transfer, heat exchangers, definitions, thermodynamic properties, measurements, flow measurements, pressure measurements, temperature measurements

English version

Heat exchangers - Methods of measuring the parameters necessary for establishing the performance

Echangeurs thermiques - Méthodes de mesurage des paramètres nécessaires à l'évaluation des performances

Wärmeaustauscher - Messungen und Meßgenauigkeit bei der Leistungsbestimmung

This European Standard was approved by CEN on 1997-01-10. 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

Ref. No. EN 306:1997 E

Contents **Page**

Foreword

This European Standard has been prepared by Technical Committee CEN/TC110 "Heat Exchangers", the secretariat of which is held by BSI.

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 August 1997, and conflicting national standards shall be withdrawn at the latest by August 1997.

The Document was implemented previously as a European Prestandard (ENV) in 1990 and no technical changes have been made.

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 and the United Kingdom.

Introduction

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

If a performance measurement of a heat exchanger is to be meaningful it is necessary to measure with well-known instruments, transducers and methods.

The standard deals with different instruments, transducers and methods for measuring temperatures, flow-rates, pressures and fluid quality for heat exchangers.

1 Scope

This European Standard specifies the methods and accuracy of measurement for temperature, pressure, fluid quality and massflow of different fluids and how to determine the pressure drops across a heat exchanger.

Measurements are restricted to those necessary for establishing the performance of heat exchangers classified in prEN 247 using the fluids listed in prEN 247.

This European Standard applies when reference by the various branch application standards. The specific application European Standards shall be the prime reference documents.

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 below. For dated references, any subsequent amendments or revisions to these publications only apply to this European Standard when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 247	Heat exchangers - Terminology
prEN 305	Heat exchangers - Definitions of performance of heat exchangers and the general test procedure for establishing performance of all heat exchangers
prEN 307	Heat exchangers - Guidelines to prepare instructions required to maintain the performance of each type of heat exchanger
EN ISO 9000	Quality management and quality assurance standards
ISO 2186	Fluid flow in closed circuits - Connections for pressure signal transmission between primary and secondary elements
ISO 5167-1	Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross conduits running full
ISO 5221	Air distribution and air diffusion - Rules to methods of measuring air flow rate in an air handling duct

3 Definitions

For the purposes of this European Standard, the following definitions apply:

3.1 Measurement of temperature

3.1.1 ***temperature:*** A measurement of the average kinetic energy of fluid particles due to their random motion in a fluid in thermodynamic equilibrium

3.1.2 ***total temperature:*** Fluid temperature including the temperature rise at a point of stagnation in a fluid flow.

3.1.3 ***inlet temperature:*** The average total temperature at the standard inlet point of a heat exchanger.

3.1.4 ***outlet temperature:*** The average total temperature at the standard outlet point of a heat exchanger.

3.1.5 ***working temperatures:*** The inlet temperature on the primary and secondary sides respectively.

3.2 Measurement of flow-rate

3.2.1 ***flow rate of a fluid through a cross-section of a conduit:*** The amount of fluid flowing through the cross-section of a conduit in unit time.

3.2.2 ***flowmeter:*** A device for measuring the flow rate.

3.2.3 ***straight length:*** A portion of a conduit whose axis is straight, and in which the cross-sectional area and cross-sectional shape are constant; the cross-sectional shape is usually circular.

3.2.4 ***fully-developed velocity distribution:*** A velocity distribution that does not change between two cross-sections of a flow. It is generally obtained after passing a sufficient straight length of a conduit.

3.2.5 ***regular velocity distribution:*** The distribution of velocities which sufficiently approaches that established in a long straight length of the closed conduit to permit an accurate measurement of the flow-rate to be made.

3.2.6 ***flow straightener:***

a) Device inserted in a conduit to eliminate or reduce circumferential velocity components which produce swirl (swirl remover).

b) Device inserted in a conduit to reduce the straight length required to achieve a regular velocity distribution (profile regulator).

3.2.7 ***steady flow:*** [1] Flow in which the flow-rate through a measuring section does not vary significantly with time.

3.2.8 ***pulsating flow of mean constant flow-rate:*** [2] Flow in which the flow-rate in a measuring section is a function of time but has a constant mean value when averaged over a sufficiently long period of time.

3.2.9 ***unsteady flow:*** [3] Flow in which the flow-rate in a measuring section fluctuates randomly with time.

3.2.10 ***hydraulic diameter:*** [4] Four times the wetted cross-sectional area divided by the wetted perimeter.

3.2.11 ***laminar flow:*** [5] Flow under conditions where forces due to viscosity are significant in comparison to the forces due to inertia.

3.2.12 ***turbulent flow:*** Flow under conditions where forces due to viscosity are small in comparison to the forces due to inertia.

---

[1] The steady flows observed in conduits are in practice flows in which quantities such as velocity, pressure, mass density and temperature vary in time about mean values independent of time; these are actually "statistically steady flows".

[2] Two types of pulsating flow are found:

- periodic pulsating flow
- random pulsating flow

[3] The time interval being considered is to be long enough to exclude from this definition the random components of the turbulent flow itself.

[4] For a circular conduit running full, the hydraulic diameter is equal to the diameter of the conduit.

[5] Laminar flow may be unsteady but is completely free from turbulent mixing. Poiseuille flow is an example of steady laminar flow in a circular conduit.

3.2.13 ***transition flow:*** [6] Flow lying between a laminar flow and a turbulent flow.

3.2.14 ***reynolds number:*** [7] A dimensionless parameter expressing the ratio between the inertia and viscous forces. It is given by the formula

$$R_e = \frac{u:l}{V}$$

where

u is the average spatial fluid velocity expressed in metre per second

l is a characteristic dimension of the system in which the flow occurs expressed in vetres

V is the kinematic viscosity of the fluid expressed in square metre per second

3.3 Measurement of pressure

3.3.1 ***pressure:*** Ratio of force and area.

3.3.2 ***static pressure:*** Pressure caused by the random motion of fluid particles. In fluid flows static pressure is determined in such a way that the flow does not affect the determination of static pressure.

3.3.3 ***dynamic pressure:*** Pressure caused by the systematic motion of fluid particles in a fluid flow.

3.3.4 ***total pressure:*** The sum of static pressure and dynamic pressure in a fluid flow (equivalent to the ratio of mechanical energy and volume).

3.3.5 ***stagnation pressure:*** Sum of the static pressure and the dynamic pressure. It characterizes the state of the fluid when its flow energy is completely transformed into pressure. For an element of fluid at rest, the static pressure and the stagnation pressure have the same numerical value.

---

[6] As a guide, the Reynolds number for the transition flow of a Newtonian fluid, when referred to the conduit diameter, is generally between a lower limit of 2 000 and upper limit which varies between 7 000 and 12 000 according to the conduit roughness and other factors.

[7] When specifying a Reynolds number, one should indicate the characteristic dimension on which it has been based (for example diameter of the conduit, diameter of the differential pressure device, diameter of a Pitot tube head, etc.)

3.3.6 ***effective (gauge) pressure:*** The difference between the local absolute pressure of the fluid and the atmospheric pressure at the place and time of the measurement.

3.3.7 ***pressure loss:*** The static pressure loss caused by the presence of a heat exchanger in the conduit.

3.3.8 ***piezometer ring:*** A pressure equalization enclosure linking together two or more pressure tappings installed on one cross-section, and to which a pressure transducer can be connected.

It can either lie outside or be integral with the conduit.

3.3.9 ***annular chamber:*** Piezometer ring integral with the conduit or the primary device. This implies the use of annular pressure tappings.

3.3.10 ***wall (pressure) tapping:*** Annular or circular hole drilled in the wall of a conduit in such a way that, its edge is flush with the internal surface of the conduit, the tapping being such that the pressure within the hole is the static pressure at that point in the conduit.

3.4 Measurement of fluid quality

3.4.1 ***fluid quality (x)***: Term describing multicomponent fluids or multi-phase fluids by the mass ratio of a particular component of fluid phase and the fluid mixture. For example:

x_v is the vapour ratio of humid air expressed as mass of vapour per mass of dry air.

x_R is the vapour ratio of refrigerants expressed as mass of vapour phase per total mass of refrigerant.

Measuring fluid quality also includes other quantities which can affect the performance of the heat exchanger.

3.5 General definitions

3.5.1 ***influence quantity:*** Quantity which is not the object of the measurement but which can affect the result of a measurement.

3.5.2 ***measurement:*** Procedure in order to determine the value of a given quantity.

3.5.3 ***inaccuracy of measurement:*** The inaccuracy expressed by the totality of the overall limiting errors of measurement including all the systematic errors as well as the limiting random errors.

3.5.4 ***repeatability of measurements:*** The closeness of the agreement between the results of successive measurements of the same quantity carried out by the same method, by the same observer, with the same measuring instruments, in the same laboratory, at quite short intervals of time.

3.5.5 ***reproducibility of measurements:*** The closeness of the agreement between the results of measurements of the same quantity, where the individual measurements are made:

- by different methods, with different measuring instruments;

- by different observers, in different laboratories;

- after quite long intervals of time compared with the duration of a single measurement under different normal conditions of use of the instruments employed.

3.5.6 ***error of measurement:*** The discrepancy between the result of the measurement and the true value of the quantity measured. This can be expressed as an absolute error,

$$E_a = M-T$$

or as a relative error

$$E_r = \frac{(M-T)}{T} \quad 100\ \%$$

Where

E_a is an absolute error of measurement

E_r is a relative error of measurement in percentage

M is the value as result of a measurement

T is the true or as true considered value.

3.5.7 ***measuring instrument:*** Technical device for measuring a quantity.

3.5.8 ***measuring transducer:*** Device which converts the value of one quantity to a value of another quantity or to a different value of the same quantity.

3.5.9 ***sensor:*** Part of a measuring instrument which receives information about a quantity. The sensor is the first element of a measuring transducer.

3.5.10 ***sensing element:*** Sensing part of sensor which is under direct influence of a quantity to be measured.

3.5.11 ***fluid:*** Liquid, gas or vapour. In this standard priority is given to water, air, steam or any fluid used for heat transfer.

3.5.12 ***primary fluid:*** Fluid acting as the heat source.

3.5.13 ***secondary fluid:*** Fluid acting as the heat sink.

3.5.14 ***single phase fluid:*** A fluid in single phase can be liquid or gas.

3.5.15 ***multi phase fluid:*** A fluid with two or more phases can be liquid and gas.

3.5.16 ***primary refrigerant:*** Fluid producing low temperature by absorbing heat during evaporation at low pressure and rejecting heat during condensation at a high pressure.

3.5.17 ***secondary refrigerant:*** Fluid conveying heat from the low temperature source to the evaporating primary refrigerant.

4 Sampling

4.1 Sampling frequency

The sampling frequency or the time between two consecutive readings shall be sufficient for the medium around the measuring points to have changed.

The following formula can be used as a guideline for the sampling period:

$$t_s = \frac{M}{10\, q_m}$$

where

t_s is the sampling period expressed in seconds

M is the total medium mass in the system expressed in killogrammes

q_m is the mass flow expressed in killogrammes per second