SLOVENSKI STANDARD
SIST EN 328:2014

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Nadomešča:

SIST EN 328:1999

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Prenosniki toplote - Hladilniki zraka s prisilno konvekcijo za hlajenje - Postopki preskušanja za ugotavljanje lastnosti

Heat exchangers - Forced convection unit air coolers for refrigeration - Test procedures for establishing the performance

Wärmeaustauscher - Prüfverfahren zur Bestimmung der Leistungskriterien von Ventilatorluftkühlern

Échangeurs thermiques - Procédures d'essai pour la détermination de la performance des aérofrigorifères à convection forcée

Ta slovenski standard je istoveten z: EN 328:2014

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EUROPEAN STANDARD

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English Version

Heat exchangers - Forced convection unit air coolers for refrigeration - Test procedures for establishing the performance

Echangeurs thermiques - Aérofrigorifères à convection forcée pour la réfrigération - Procédures d'essai pour la détermination de la performance

Wärmeübertrager - Ventilatorluftkühler - Prüfverfahren zur Leistungsfeststellung

This European Standard was approved by CEN on 22 May 2014.

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This European Standard exists 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 CEN-CENELEC Management Centre has the same status as the official versions.

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

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Foreword

This document (EN 328:2014) 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of an identical text or by endorsement, at the latest by February 2015, and conflicting national standards shall be withdrawn at the latest by February 2015.

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

This document supersedes EN 328:1999 and EN 328:1999/A1:2002.

The main changes with respect to the previous edition are listed below:

a) Clause 3 “Terms and definitions” is modified;

b) The revised standard takes into account the application of CO_2.

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

Introduction

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

1 Scope

This European Standard is applicable to non-ducted unit air coolers for refrigeration operating:

a) with direct dry expansion of a refrigerant;

b) with liquid overfeed by pump circulation of a refrigerant;

c) with a liquid.

This standard specifies uniform methods of performance assessment to test and ascertain the following:

— product identification;

— standard capacity;

— standard liquid pressure drop;

— standard refrigerant pressure drop (for operation with liquid overfeed by pump circulation only);

— nominal air flow rate;

— nominal fan power.

It does not cover evaluation of conformity.

It is not applicable to air coolers for duct mounting or with natural air convection.

This standard does not cover technical safety aspects.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025)*

EN 60034-1, *Rotating electrical machines - Part 1: Rating and performance (IEC 60034-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1
physical definitions
3.1.1
forced convection unit air cooler
refrigeration system component transferring heat from air to a refrigerant or liquid. The air is mechanically circulated over the heat transfer surface by integral fan(s) and fan drive(s)

Note 1 to entry: The heat transfer coil includes refrigerant distributing and collecting headers.

Note 2 to entry: In the following “forced convection unit air cooler” is referred to as “unit cooler”.

3.1.2
heat transfer surface (air side)
external surface of the cooling coil which is in contact with the air flow passing the cooling coil

3.1.3
internal volume
volume of the refrigerant containing parts of the unit cooler between its two connections

3.1.4
fouling resistance
thermal resistance of a layer of unwanted deposit on the heat exchanger surface reducing its heat transfer performance

Note 1 to entry: The fouling resistance for a clean surface is zero. Clean, in this context, means that all production residues have been removed from the heat transfer surface and the fan(s) by the factory's cleaning process.

3.2
refrigerant
working fluid in a cooling system, which absorbs heat at low pressure / temperature by evaporation and rejects heat at a higher pressure / temperature by condensation

3.3
liquid
working fluid remaining liquid during the absorption of heat

3.4
capacities
3.4.1
sensible air cooling capacity
heat flow rejected by the air resulting from a dry bulb temperature drop

3.4.2
latent cooling capacity
heat flow rejected by the air resulting from condensation of water vapour or frost formation including subcooling on the unit cooler surface

3.4.3
total cooling capacity
sum of the sensible and the latent capacities measured at the same time

3.4.4
gross cooling capacity
total heat flow absorbed by the refrigerant or liquid

3.4.5
net cooling capacity
cooling capacity available for cooling the air equal to the gross cooling capacity minus the fan power

3.4.6
standard capacity
gross cooling capacity at standard conditions and normal atmospheric pressure of 1013,25 hPa of a unit cooler with clean internal and external surfaces

3.4.7
fan power
electric power, absorbed by the fan motors at the electrical terminals of the motor(s)

3.4.8
nominal fan power
fan power measured during the air flow test and corrected to the normal atmospheric pressure of 1013,25 hPa

Note 1 to entry: The fan power will also differ with the temperature at which the fan runs. As the fan power is only a small proportion of the total cooling load, the deviations are considered to be negligible.

3.5
rotational speed of the fans
average rotational speeds of fans

3.6
pressures and pressure differences
for the purposes of this standard all pressures are average values ascertained over the test duration

3.6.1
evaporating pressure
absolute pressure of the refrigerant, at the outlet connection of the unit cooler

3.6.2
liquid inlet pressure
static pressure of the liquid at the inlet connection of the unit cooler

3.6.3
liquid outlet pressure
static pressure of the liquid at the outlet connection of the unit cooler

3.6.4
liquid pressure difference
difference between the liquid inlet pressure and the liquid outlet pressure

3.6.5
refrigerant inlet pressure
absolute pressure of the refrigerant, at the inlet connection of the unit cooler (see Annex F)

3.6.6
critical pressure
pressure at the critical point where the liquid and gaseous phases of the refrigerant have the same physical properties

3.7
temperatures
for the purposes of this standard all temperatures are average values ascertained over the test duration

3.7.1
air temperatures
3.7.1.1
air inlet temperature
average dry bulb temperature of the air at the unit cooler inlet, taking into consideration the local air velocities

3.7.1.2
air dew point temperature
dew point temperature of the air within the calorimeter room

3.7.1.3
inside temperature
air temperature inside the calorimeter room responsible for the heat exchange with the ambient

3.7.1.4
ambient temperature
temperature around the calorimeter room responsible for the heat exchange with the inside

3.7.2
refrigerant temperatures
3.7.2.1
evaporating temperature
dew point temperature of the refrigerant, corresponding to the evaporating pressure

3.7.2.2
superheating temperature
temperature of the refrigerant vapour at the outlet connection of the unit cooler, measured on the wall of the tube at the location recommended by the manufacturer for fixing the expansion valve sensing element or downstream of the liquid-suction heat exchanger where this is an integral part of the unit cooler

3.7.2.3
subcooled refrigerant temperature
temperature of the liquid refrigerant at the inlet connection to the expansion device (not necessarily part of the unit cooler)

3.7.2.4
bubble point temperature for cooler measurement
temperature calculated from the enthalpy based on the temperature and pressure at the inlet of the expansion valve

3.7.3
liquid temperatures
3.7.3.1
liquid inlet temperature
average temperature of the liquid at the inlet connection of the unit cooler taking into consideration the local liquid velocities

3.7.3.2
liquid outlet temperature
average temperature of the liquid at the outlet connection of the unit cooler taking into consideration the local liquid velocities

3.7.4
water temperatures
(applicable only where the balancing heat is supplied by water)

3.7.4.1
water inlet temperature
temperature of the water as it enters the calorimeter

3.7.4.2
water outlet temperature
temperature of the water as it leaves the calorimeter

3.7.5
vapour outlet temperature
temperature of the refrigerant vapour at the vapour outlet connection of the separator

3.8
temperature differences
3.8.1
temperature differences for refrigerants
3.8.1.1
inlet temperature difference
difference between the air inlet temperature and the evaporating temperature

3.8.1.2
superheating
difference between the superheating temperature and the evaporating temperature

3.8.1.3
degree of superheating
ratio of the superheating to the inlet temperature difference

3.8.1.4
subcooling
difference between the bubble point temperature corresponding to the absolute pressure of the refrigerant at the inlet connection to the expansion device and the subcooled refrigerant temperature

3.8.2
temperature differences for liquids
3.8.2.1
inlet temperature difference
difference between the air inlet temperature and the liquid inlet temperature

3.8.2.2
liquid temperature difference
difference between the liquid inlet and outlet temperatures

3.9
high glide
refrigerant where the difference between the condensing and bubble point temperatures at a condensing temperature of 40 °C is greater than 3K

3.10
operation with refrigerants
3.10.1
direct expansion operation
evaporation process in which the refrigerant enters the unit cooler via a direct expansion device as a liquid-vapour mixture and leaves it in superheated state (see system boundaries in Annex A)

3.10.2
operation with liquid overfeed by pump circulation
evaporation process in which the refrigerant leaves the unit cooler in partially evaporated state, the process being operated by a mechanical liquid pump and a separator being parts of a refrigerating machine

Note 1 to entry: The refrigerant is transported from the separator to the unit cooler by the mechanical pump (see Annex F).

3.10.3
supercritical operation
thermodynamic cycle in which the outlet pressure at the compressor is higher than the critical pressure of the refrigerant with a gas cooler being part of the refrigerator

3.11
refrigerant enthalpies
3.11.1
refrigerant inlet specific enthalpy
specific enthalpy of the refrigerant at the inlet connection of the unit cooler system. For capacity calculation it is defined as the specific enthalpy of the saturated liquid refrigerant at the inlet to the expansion device corresponding to the subcooled refrigerant temperature and for transcritical operation it is defined as the enthalpy corresponding to temperature and pressure

Note 1 to entry: For liquid overfeed by pump circulation the refrigerant inlet enthalpy cannot be defined by temperature and pressure measurement at the unit cooler's connections (see Annex E).

3.11.2
refrigerant outlet specific enthalpy
specific enthalpy of the refrigerant at the outlet connection of the unit cooler system. For capacity calculation it is defined as the specific enthalpy of the refrigerant corresponding to the evaporating pressure and the superheating temperature

Note 1 to entry: For liquid overfeed by pump circulation the refrigerant outlet enthalpy cannot be defined by temperature and pressure measurement at the unit cooler's connections (see Annex E).

3.11.3
specific vaporization enthalpy
enthalpy at the evaporating pressure without regard to the pressure drop across the unit cooler (see Annex F)

3.12
nominal air flow
air volume flow rate flowing through the unit cooler, when its air side is dry and clean

3.13
oil content
proportion of oil by mass in the refrigerant related to the pure refrigerant

3.14
refrigerant recirculation rate
ratio between the actual mass flow rate through the unit cooler and the mass flow rate necessary for the total evaporation of the refrigerant (see Annex F)

4 Symbols

For the purposes of this document, Table 1 applies: