SLOVENSKI STANDARD

SIST EN 1117:1999

01-december-1999

Prenosniki toplote ï Kondenzatorji hladiv, hlajeni s tekoļ ino ï Postopki preskuġanja za ugotavljanje tehniļ nih karakteristik

Heat exchangers - Liquid cooled refrigerant condensers - Test procedures for establishing the performance

Wärmeaustauscher - Flüssigkeitsgekühlte Kältemittelverflu(ssiger - Prüfverfahren zur Leistungsfeststellung

Echangeurs thermiques - Condenseurs a eau - Procédures d'essai pour la détermination des performances

Ta slovenski standard je istoveten z: EN 1117:1998

ICS:

27.060.30	Grelniki vode in prenosniki toplote	Boilers and heat exchangers
27.200	Hladilna tehnologija	Refrigerating technology

SIST EN 1117:1999 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1117

September 1998

ICS 27.060.30; 27.200

Descriptors: heat exchangers, condensers : liquefiers, water, definitions, classifications, calorific power, tests, measurements, characteristics, installation, computation

English version

Heat exchangers - Liquid cooled refrigerant condensers - Test procedures for establishing the performance

Echangeurs thermiques - Condenseurs à eau - Procédures d'essai pour la détermination des performances

Wärmeaustauscher - Flüssigkeitsgekühlte Kältemittelverflüssiger - Prüfverfahren zur Leistungsfeststellung

This European Standard was approved by CEN on 3 September 1998.

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.

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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1117:1998 E

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 110 "Heat exchangers", the secretariat of which is held by BSI.

This European Standard supersedes ENV 1117:1993.

The document was implemented previously as ENV 1117 in 1993 and no technical changes have been made.

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 March 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, 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.

1 Scope

1.1 This European Standard applies to series produced liquid cooled refrigerant condensers which operate with a (primary) refrigerant.

Its purpose is to establish uniform methods to test and ascertain the following:

- Product identification
- Capacity
- Liquid flow rate
- Liquid side pressure drop

This Standard does not cover technical safety aspects.

1.2 This standard deals with the following types of series produced liquid refrigerant condensers:

a) Shell and tube type;

b) Co-axial type with;

1) Refrigerant in annulus;
2) Refrigerant in the tube(s);

c) Plate type.

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

EN 45001 General criteria for the operation of testing laboratories

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 liquid cooled refrigerant condenser: Self contained refrigeration system component transferring heat from a condensing refrigerant to a cooling liquid. In the following the term "condenser" is used.

3.2 shell and tube type: Condenser consisting of a shell with a tube arrangement inside the shell.

3.3 co-axial type: Condenser consisting of an outer tube with one or more inner tubes, all arranged parallel to each other. The two fluids may flow either parallel or counter to each other.

3.4 plate type: Condenser consisting of parallel plates separating the two fluids.

3.5 working fluids

3.5.1 ***refrigerant (primary):*** Working fluid in a refrigeration system that absorbs heat by evaporation at a low temperature and rejects it by condensation at a higher temperature.

3.5.2 ***liquid:*** Working fluid, circulated through the refrigeration system and remaining in liquid phase during the absorption or rejection of heat.

3.6 capacity

3.6.1 ***capacity (refrigerant side):*** Product of the refrigerant mass flow rate and the difference between the specific enthalpies of the refrigerant vapour at the inlet connection and the subcooled refrigerant at the outlet connection.

3.6.2 ***capacity (liquid side):*** Product of the liquid mass flow rate and the difference between the specific enthalpies at the inlet and outlet connections.

3.7 temperatures

NOTE: All temperatures are average values ascertained over the measuring period.

3.7.1 ***liquid inlet temperature:*** Temperature of the liquid at the inlet connection, taking into consideration the local liquid velocities.

3.7.2 ***liquid outlet temperature:*** Temperature of the liquid at the outlet connection, taking into consideration the local liquid velocities.

3.7.3 ***ambient air temperature:*** Temperature of the air surrounding the condenser.

3.7.4 ***refrigerant temperatures***

3.7.4.1 *condensing temperature:* Saturation temperature corresponding to the absolute pressure of the refrigerant at the inlet connection.

3.7.4.2 *superheated vapour temperature:* Temperature of the refrigerant vapour at the inlet connection

3.7.4.3 *subcooled refrigerant temperature:* Subcooled refrigerant temperature is the temperature of the liquified refrigerant at the outlet connection.

3.8 liquid pressure

NOTE: All pressures are average values ascertained over the measuring period.

3.8.1 ***liquid inlet pressure:*** Average static pressure of the liquid at the inlet connection of the condenser.

3.8.2 ***liquid outlet pressure:*** Average static pressure of the liquid at the outlet connection of the condenser.

3.9 temperature differences

3.9.1 ***inlet temperature difference:*** Difference between the condensing temperature and the liquid inlet temperature.

3.9.2 ***superheating:*** Difference between the superheated vapour temperature and the condensing temperature.

3.9.3 ***subcooling:*** Difference between the saturation temperature corresponding to the absolute pressure of the refrigerant at the outlet connection and the subcooled refrigerant temperature.

3.9.4 ***liquid temperature difference:*** Difference between the liquid outlet and inlet temperature.

3.10 fouling resistance: Thermal resistance of a layer of unwanted deposit on the heat exchanger surface reducing it's heat transfer performance.

NOTE: 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 by the factory's cleaning process.

4 Symbols

For the purposes of this European Standard the following apply:

4.1 Letters

c_{pL}	specific heat capacity of the liquid	kJ/kg/K
h_{L1}	spec.enthalpy of liquid at the inlet connection	kJ/kg
h_{L2}	spec.enthalpy of liquid at the outlet connection	kJ/kg
h_{R1}	spec.enthalpy of refrigerant vapour at the inlet connection	kJ/kg
h_{R2}	spec.enthalpy of subcooled refrigerant at the outlet connection	kJ/kg
P_R	capacity (refrigerant side)	kW
P_L	capacity (liquid side/primary method)	kW
p_{atm}	atmospheric pressure	Pa
p_c	condensing pressure	bar
p_{R2}	refrigerant pressure at the condenser outlet	bar
p_{L1}	liquid pressure at the inlet connection	bar
p_{L2}	liquid pressure at the outlet connection	bar
q_R	refrigerant flow rate	--
q_L	liquid flow rate	--
t_{amb}	ambient air temperature	°C
t_{L1}	liquid inlet temperature	°C
t_{L2}	liquid outlet temperature	°C
t_{sup}	superheated vapour temperature	°C
t_{sub}	subcooled refrigerant temperature	°C
$t_{(pR2)}$	saturation temperature corresponding to p_{R2}	°C
t_c	condensing temperature	°C
t_{RM}	refrigerant temperature at the flow measuring point	°C
Δt_1	inlet temperature difference = t_c - t_{L1}	K
Δt_L	liquid temperature difference = t_{L2} - t_{L1}	K
Δt_{sup}	superheating = t_{sup} - t_c	K
Δt_{sub}	subcooling = $t_{(pR2)}$ - t_{sub}	K
$\Delta t_1^{(st)}$	standard inlet temperature difference	K
Δp_L	pressure drop on the liquid side = p_{L1} - p_{L2}	Pa
Z	Test duration	s
rd	relative deviation	%

4.2 Subscripts

m	mass
v	volume
numbers	Positions defined on the circuit diagram

4.3 Superscripts

(a,b)	test number referring to the test sequence
(st)	standard

5 Standard capacity

5.1 Basis for standard capacity data

The capacity of a condenser depends on:

a) The condensing temperature;

b) The temperature difference between the liquid and the refrigerant;

c) The mass flows of liquid and refrigerant;

d) The oil content;

e) The state of subcooling at the condenser outlet connection;

f) The state of superheating at the condenser inlet connection;

g) The type of refrigerant;

h) The fouling conditions.

Therefore the capacity of the condenser shall be specified for specific operating conditions.

5.2 Standard capacity conditions

The standard capacity shall be based on tests performed on a clean condenser under the conditions in table 1:

Table 1: "Standard capacity conditions"

Liquid type	Water
t_{L1}	20 °C
Δt_1	15 K
Δt_L	5 K or alternatively liquid flow as specified by the manufacturer
Δt_{sup}	35 K
Δt_{sub}	$\leq$ 3 K (if not specified differently)
oil content	< 1 % (by mass)

The quality of the liquid shall be such that it does not cause measurable fouling during the entire operation for establishing the test.

Δt_{sup} shall be the value that results when the refrigerant is subjected to isentropic compression from -10 °C evaporating and +10 °C vapour to +40 °C condensing temperatures.

For the following common refrigerants, Δt_{sup} is:

R-134a	25K
R-22	45K
NH_3	50K

6 Manufacturer's data

To identify the Liquid Cooled Condenser and allow its traceability the manufacturer or supplier shall supply to the test house the following minimum information for every condenser:

a) type;

b) capacity at standard conditions;

c) type of refrigerant;

d) correction factors for other refrigerants that may be used;

e) max. and min. allowable liquid flow rate; and

f) related liquid pressure drop through the condenser;

g) internal volume on condenser refrigerant side;

h) internal volume on condenser liquid side;

i) installation instructions;

j) overall and mounting dimensions;

k) connection sizes;

l) weight;

m) liquid refrigerant level in the condenser (where applicable);

n) number of liquid and refrigerant circuits;

o) oil type.