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Samostojne hladilne enote za male hladilnice - Razvrstitev, tehnične lastnosti in preskus porabe energije

Packaged refrigerating units for walk-in cold rooms - Classification, performance and energy consumption testing

Kälteaggregate für begehbare Kühlräume - Klassifikation, Prüfung der Leistung und des Energieverbrauchs

Groupes frigorifiques prêts à monter pour chambres froides - Classification, performance et essai de consommation d'énergie

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 17432:2021) has been prepared by Technical Committee CEN/TC 44 “Commercial and Professional Refrigerating Appliances and Systems, Performance and Energy Consumption”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by March 2022, and conflicting national standards shall be withdrawn at the latest by March 2022.

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.

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Introduction

This document was developed in order to provide a suitable method of performance testing of packaged refrigerating units for stationary cold room applications.

This is the first edition of this document. It includes testing only in so-called “dry conditions”. That means, the evaporator does not show any ice formation during the test. Although it is well-known, that such conditions do not represent the typical situation in the practical use of the packaged refrigerating units, this edition of the document focusses on the description of a test procedure providing reliable test results, which can be used to compare the performance of different models/types of packaged refrigerating unit.

In order to keep the test procedure in this document practically oriented, tests under so-called “wet conditions” as well as taking defrost periods into account will be a future Work Item of the responsible working group. The aim is to integrate such tests in a later revision of this document.

This document reflects the current market situation which shows that only refrigerating units without integrated pump for the heat transfer medium on the exterior heat exchanger are offered.

1 Scope

This document specifies classification criteria, test conditions and test procedures for performance testing of packaged refrigerating units for stationary cold room applications. This includes ductless units for cold storage applications at medium temperatures (MT) and low temperatures (LT) in either compact or split designs, fitted with electrically driven compressors, which work according to the vapour compression cycle.

2 Normative references

There are no normative references in this document.

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 https://www.electropedia.org/

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

3.1
packaged refrigerating unit
functional unit incorporating a complete factory-made refrigerating system, mounted in a suitable frame and/or enclosure, that is fabricated and transported complete, or in two or more sections and in which no refrigerant-containing parts are connected on site other than by isolation valves, such as companion valves, and by interconnecting piping as defined by the manufacturer

Note 1 to entry: A packaged refrigerating unit incorporates at least one refrigerant circuit, and can incorporate one or more heat transfer circuits.

Note 2 to entry: The terms “factory-made” and “refrigerating system” are defined in EN 378-1.

3.2
compact unit
packaged refrigerating unit, that has been assembled, filled ready for use, and is installed without the need for connecting any refrigerant-containing parts

3.3
split unit
packaged refrigerating unit, comprising one unit providing cooling to the cold room and one unit used for condensing the refrigerant

3.4
factory made
manufactured at a dedicated production location under control of a recognized quality system

Note 1 to entry: Assembling in this context means manufacturing.

[SOURCE: EN 378-1:2016, 3.8.5, modified — The present Note 1 to entry was added.]

3.5
interior heat exchanger
heat exchanger in which liquid refrigerant is vaporized by absorbing heat from the interior heat transfer medium

Note 1 to entry: For the applications regarded here, the interior heat exchanger is usually called “evaporator”.

3.6
exterior heat exchanger
heat exchanger in which the refrigerant is cooled down due to heat dissipation by the exterior heat transfer medium

Note 1 to entry: For the applications regarded here, the exterior heat exchanger is usually called “condenser”.

3.7
heat transfer medium
medium (water, air, etc.) which transfers heat without undergoing phase changes

3.8
dry bulb temperature
temperature of air measured by a thermometer exposed to the air but shielded from radiation and moisture

3.9
calorimeter room
insulated enclosure which houses a heating device and the interior heat exchanger

3.10
test chamber
room in which the ambient air can be conditioned and kept in a steady state condition and in which the exterior heat exchanger as well as the calorimeter room are located

Note 1 to entry: See 7.2 for further explanation.

3.11
cooling capacity
heat per unit of time transferred to the unit via heat transfer medium minus introduced heat of the fans installed at the interior heat exchanger

3.12
total power consumption
average electrical power consumption of the packaged refrigeration unit, including all electrical supplies needed for the cooling operation of the unit, over time

3.13
energy efficiency ratio
ratio of cooling capacity to total power consumption of the unit

3.14
operating limits
limitations in terms of maximum and minimum operating conditions (range of pressure, temperature, voltage, humidity, etc.)

Note 1 to entry: The unit shall work as intended within the operating limits specified by the manufacturer.

3.15
nominal conditions
conditions that define a standard which reveals if a packaged refrigerating unit is working within those defined limits

3.16
support cold
independently working refrigerating unit to compensate heat losses through the calorimeter room envelope

3.17
low temperature
LT
application, at which the packaged refrigerating unit is capable of delivering its nominal cooling capacity at the interior heat exchanger inlet temperature of −20 °C

3.18
medium temperature
MT
application, at which the packaged refrigerating unit is capable of delivering its nominal cooling capacity at the interior heat exchanger inlet temperature of 0 °C

4 Symbols and abbreviated terms

Table 1 — Symbols

Symbol	Quantity	Unit	Unit Symbol
$\dot{Q}_0$	Cooling capacity	Watt	W
P_E	Total power consumption	Watt	W
EER	Energy efficiency ratio	—	—
A	Length of the air inlet of the interior heat exchanger	millimetres	mm
B	Width/height of the air inlet of the interior heat exchanger	millimetres	mm
$q_{\text{Heat loss}}$	Heat loss of the calorimeter room	Watt per Kelvin	W/K
P_{Heater}	Electric power consumption of the heating device, all running fans and any other devices being placed inside the calorimeter room which are in use during calibration of the calorimeter room	Watt	W
T_{int}	Internal temperature of the calorimeter room	Kelvin	K
T_{out}	Ambient temperature of the test chamber	Kelvin	K
ΔT	Temperature difference	Kelvin	K
$T_{\text{out,w}}$	Temperature of the heat transfer medium at heat exchanger outlet	Degree Celsius	°C

Symbol	Quantity	Unit	Unit Symbol
$T_{\text{int, w}}$	Temperature of the heat transfer medium at heat exchanger inlet	Degree Celsius	°C
$\dot{m}$	Mass flow	kilogram per second	kg/s
V	Volume	cubic metre	m^3
ρ	Density	kilogram per cubic metre	kg/m^3
$\dot{Q}_{Heat}$	Heat capacity of the heat exchanger	kilowatt	kW
$\dot{V}$	Volume flow	cubic meters per second	m^3/s
Δp_i	Maximum measured external static pressure difference between water inlet and outlet	Pascal	Pa
ΔP	Static pressure difference	Pascal	Pa
$\dot{Q}_{Heat,i}$	Total heating capacity of the heating device	Watt	W
$\dot{Q}_{\text{support cold}}$	Cooling capacity of the support cold	Watt	W
ΔT_i	Temperature difference between interior of the calorimeter room and exterior of the calorimeter room	Kelvin	K

Table 2 — Constants

Symbol	Description	Value
c_p	Specific heat capacity of water	4,19 kJ/(kg · K)

5 Classification

Refrigerating units are labelled by listing their heat transfer mediums. The heat transfer medium of the exterior heat exchanger (condenser) is listed in the first column, the heat transfer medium of the interior heat exchanger (evaporator) is listed in the second column (see Table 3).

Table 3 — Labelling of refrigerating units

Heat transfer medium		Term
Exterior heat exchanger	Interior heat exchanger	
Air	Air	Air cooled refrigerating unit
Water	Air	Water cooled refrigerating unit
Liquid	Air	Liquid cooled refrigerating unit

6 Test conditions

6.1 General

The test procedures defined in this document provide methods for determining cooling capacities and electrical power consumption of packaged refrigerating units as well as for determining heat recovery capacities of water-cooled packaged refrigerating units. The tests can be performed under dry conditions inside a calorimeter room, which is placed in a test chamber.

6.2 Testing conditions

The following test procedures are to be conducted under the nominal conditions given in Tables 4, 5 and 6), unless stated otherwise.

Table 4 — Air-to-air refrigerating unit – Nominal dry conditions

Application	Exterior heat exchanger	Interior heat exchanger	
	Dry bulb temperature at inlet	Dry bulb temperature at inlet	Rel. humidity at inlet
LT	32 °C	−20 °C	a
MT	32 °C	0 °C	a
a As low, as to prevent icing on the heat exchanger surface.			

The manufacturer may choose the following additional testing conditions for air-to-air refrigerating units:

— for cold climate: 15 °C for dry bulb temperature at inlet of exterior heat exchanger;

— for hot climate: 43 °C for dry bulb temperature at inlet of exterior heat exchanger.

Table 5 — Water-to-air refrigerating unit – Nominal dry conditions

Application	Exterior heat exchanger[a]		Interior heat exchanger	
	Inlet temperature	Outlet temperature	Dry bulb temperature at inlet	Rel. humidity at inlet
LT	30 °C	35 °C	−20°C	b
MT	30 °C	35 °C	0°C	b
a The heat transfer medium on the exterior heat exchanger shall be water. b As low, as to prevent icing on the heat exchanger surface.				