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Liquid chilling packages and heat pumps with electrically driven compressors - Cooling mode - Definitions, testing and requirements

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Flüssigkeitskühlsätze und Wärmepumpen mit elektrisch angetriebenen Verdichtern - Kühlen - Definitionen, Prüfung und Anforderungen

Groupes refroidisseurs de liquide et pompes à chaleur avec compresseur entraîné par moteur électrique - Mode réfrigération - Définitions, essais et exigences

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English version

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 113 "Heat pumps and air conditioners", the secretariat of which is held by AENOR.

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of an identical text or by endorsement, at the latest by July 1998, and conflicting national standards shall be withdrawn at the latest by July 1998.

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.

1 Scope

This European Standard specifies methods for testing and reporting of the rating and operational requirements and it specifies requirements for marking of liquid chilling packages, water/water and air/water heat pumps with electrically driven compressors when used for cooling or for cooling and heat recovery. When these units are used for heating, then Parts 1 to 4 of EN 255 apply.

This standard applies to factory-made units with integral condensers or for use with remote condensers.

In the case of units consisting of several parts, the standard applies only to those designed and supplied as a complete package, except for units with remote condenser.

Units having two or more indoor sections connected to a single outdoor unit (multiple split system liquid chilling packages or heat pumps) are excluded from this standard.

This standard is primarily intended for water and brine chilling packages, but can be used for other liquid subject to agreement.

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 255 - 1	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 1 : Terms, definitions and designations
EN 255 - 2	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 2 : Testing and requirements for marking for space heating units

EN 255 - 3	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 3 : Testing and requirements for marking for sanitary hot water units
EN 255 - 4	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 4 : Requirements for space heating and sanitary hot water units
ENV 12102	Air conditioners, heat pumps and dehumidifiers with electrically driven compressors - Measurement of airborne noise - Determination of the sound power level
EN 60335-2-40	Safety of household and similar electrical appliances - Part 2 : Particular requirements for electrical heat pumps, air conditioners and dehumidifiers (IEC 335-2-40:1992, modified)
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1 : General requirements (IEC 204-1:1992, modified)

3 Definitions

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

3.1 liquid chilling package : A factory-made unit designed to cool liquid, using an evaporator, a vapour compressor, an integral or remote condenser and appropriate controls. It may have means for heating which can be reversing the refrigerating cycle, like a heat pump, see EN 255-1.

3.2 heat recovery: The use of the available heat from a unit whose primary control remains in the cooling mode, by means of an additional heat exchanger.

3.3 heat recovery liquid chilling package : A factory-made unit as defined in 3.1 designed for the purpose of chilling liquid and recovering of heat.

3.4 heat transfer medium : Any medium (water, air ...) used for the transfer of the heat without change of state ; it can be :

- the cooled liquid circulating in the evaporator ;
- the cooling medium circulating in the condenser ;
- the heat recovery medium circulating in the heat recovery heat exchanger.

3.5 evaporator : Heat exchanger assembly which is designed to remove heat from the liquid to be cooled by evaporation of a refrigerant.

NOTE: In the case of a heat pump operating in the cooling mode, this will be the indoor heat exchanger, see EN 255-1.

3.6 condenser : Heat exchanger assembly which is designed to transfer heat to the cooling medium by condensation of a refrigerant.

NOTE: In the case of a heat pump operating in the cooling mode, this will be the outdoor heat exchanger, see EN 255-1.

3.7 heat recovery heat exchanger : Heat exchanger assembly which is designed to transfer heat to the heat recovery medium.

3.8 cooling capacity (P_C): Heat given off from the liquid to the refrigerant per unit of time.

3.9 heat rejection capacity : Heat removed by the heat transfer medium of the condenser per unit of time.

3.10 heat recovery capacity : Heat removed by the heat transfer medium of the heat recovery heat exchanger, per unit of time.

3.11 effective power input (P_E) : Average electrical power input of the unit within the defined interval of time obtained from :

- the power input for operation of the compressor,

- the power input of all control and safety devices of the unit, including devices necessary for correct operation of the refrigerating circuit (e.g. oil pump, refrigerant pump) and,

- the proportional power input of the conveying devices (e.g. fan, pump) for ensuring the transport of the heat transfer media inside the unit.

3.12 total power input (P_T) : Power input of all components of the unit.

3.13 energy efficiency ratio (EER) : Ratio of the cooling capacity to the effective power input of the unit.

3.14 temperature of saturated vapour at the discharge of the compressor : Temperature of saturated vapour /dew point of the refrigerant corresponding to the discharge pressure of the compressor, measured at the compressor/piping connection.

3.15 temperature of the liquid refrigerant : Temperature of the refrigerant measured at the inlet of the expansion device.

3.16 glide : Difference between dew point temperature and bubble point temperature at a given pressure.

3.17 brine : Liquid that has a freezing point depressed relative to water.

3.18 sound power level (L_W) : Ten times the logarithm to the base 10 of the ratio of the given sound power to the reference sound power expressed in decibels. The reference sound power is 1pW (10^{-12} W).

4 Designations

4.1 Designation of temperatures of heat transfer media

The designation relating to the temperatures of heat transfer media is formed in such a way that the heat transfer media are indicated together with their temperatures (in °C), the values

indicated in the first place referring to the condenser and the values indicated in the second place to evaporator.

All air temperatures are inlet temperatures. Water and brine temperatures for the evaporator are outlet temperatures. Water temperatures for the condenser are inlet temperatures.

A short designation is formed in such a way that a characteristic letter is used for the heat transfer medium : A for air, W for water and B for brine. In the case of units for use with remote condenser, the letter R is used.

4.2 Denomination of units

The denomination of units normally depends on the heat transfer medium used to remove the heat from the condenser.

In the case where a unit reverses its refrigerating cycle for heating, the denomination may follow the same principles given in EN 255-1.

Table 1 presents the most common types of units.

Table 1 : Units denomination

Heat transfer medium condenser	Denomination
Air	air cooled liquid chilling package liquid chilling package for use with remote condenser air/water heat pump air/brine heat pump
Water 1)	water cooled liquid chilling package liquid chilling package for use with remote condenser water/water heat pump water/brine heat pump
1) For units not used during winter, brine can also be used instead of water at the condenser, but the test conditions will remain the same as for water.	

5 Rating test

5.1 Basic principles

All measured parameters, with exception of time measurement, shall be understood to be average values over the duration of the test period.

5.1.1 Cooling capacity and heat recovery capacity

The cooling capacity and heat recovery capacity shall be determined using the following formula :

$$P = q.\rho.c_p.\Delta t$$

where

P is the cooling/heat recovery capacity in Watts
q is the volume flow rate in cubic metres per second
ρ is the density in kilogrammes per cubic metre
c_p is the specific heat at constant pressure in joules per kilogramme kelvin
Δt is the difference between inlet and outlet temperatures in kelvins

The cooling capacity shall be corrected for the heat from the liquid pump :

- If the liquid pump at the evaporator is an integral part of the unit, the heat from this should not affect the cooling capacity greater than the declared value of uncertainty. If the heat is greater, then the same power (calculated in 5.1.3.1) which is excluded from the input is also added to the cooling capacity.

- If the liquid pump at the evaporator is not an integral part of the unit the heat from this should also not affect the cooling capacity greater than the declared value of uncertainty. If the heat is greater, then the same power (calculated in 5.1.3.2) which is included in the input is also substracted from the cooling capacity.

5.1.2 Power input of fans

5.1.2.1 Power input of fans for units without duct connection

In the case of units which are not designed for duct connection, i.e. which do not permit any external pressure differences, and which are equipped with an integral fan, the power absorbed by the fan shall be included in the effective power absorbed by the unit.

5.1.2.2 Power input of fans for units with duct connection

5.1.2.2.1 If a fan is an integral part of the unit, only a fraction of the input of the fan motor shall be included in the effective power absorbed by the unit. The fraction which is to be excluded from the total power absorbed by the unit shall be calculated using the following formula :

$$\frac{q.\Delta p_e}{\eta} \text{ in watts}$$

where

η is equal to 0,3 by convention
Δp_e is the available external static pressure difference in pascals
q is the nominal air flow rate in cubic metres per second

5.1.2.2.2 If no fan is provided with the unit, the proportional power input to be included in the effective power input absorbed by the unit is calculated using the following formula :

$$\frac{q.\Delta p_i}{\eta} \text{ in watts}$$

where

η is equal to 0,3 by convention
Δp_i is the measured internal static pressure difference in pascals

q is the nominal air flow rate in cubic metres per second

5.1.2.3 Units for use with remote condenser

For units for use with remote condenser, the auxiliary fan or liquid pump power input shall not be taken into account in the effective power input.

5.1.3 Power input of cooling medium pump and of liquid pump

5.1.3.1 If a pump is an integral part of the unit, only a fraction of the input to the pump motor shall be included in the effective power absorbed by the unit. The fraction which is to be excluded from the total power absorbed by the unit shall be calculated using the following formula :

$\frac{q.\Delta p_e}{\eta}$ in watts

where

η is equal to 0,3 by convention
Δp_e is the available external static pressure difference in pascals
q is the nominal water flow rate in cubic metres per second

5.1.3.2 If no pump is provided with the unit, the proportional power input to be included in the effective power input absorbed by the unit is calculated using the following formula :

$\frac{q.\Delta p_i}{\eta}$ in watts

where

η is equal to 0,3 by convention
Δp_i is the measured internal static pressure difference in pascals
q is the nominal water flow rate in cubic metres per second

5.2 Test installation

5.2.1 Arrangement of the test installation

5.2.1.1 General requirements

The test installation shall be designed in such a way that all requirements on adjustment of set values, steady state and uncertainties of measurement according to this European Standard can be fulfilled.

Ducted air systems shall be sufficiently air tight to ensure that the measured results are not significantly influenced by exchange of air with the surroundings.

5.2.1.2 Liquid chilling package for use with remote condenser

Units for use with remote condenser are tested by using a water cooled condenser the characteristics of which shall enable the intended operating conditions to be achieved.

5.2.1.3 Units with integral air cooled condenser

The unit is placed in a test room. The size of the test room shall be selected such that any resistance to air flow at the air inlet and air outlet orifices of the test object is avoided. The air flow through the room shall not be capable of initiating any short circuit between these two orifices, and therefore the velocity of the air flows through the room at these two locations shall not exceed 1,5 m/s when the test object is switched off. The air velocity in the room shall also not be greater than the mean velocity through the unit inlet. Unless otherwise stated by the manufacturer, the air inlet or air outlet orifices shall be not less than 1 m distant from the surfaces of the test room ; this also applies to any measuring ducts.

Any direct heat radiation by heating devices in the test room on to the unit or on to the temperature measuring points shall be avoided.

5.2.1.4 Setting of the external static pressure difference on the air side for appliances with duct connection

For appliances with duct connection, the maximum external static pressure difference available at the nominal flow rate specified by the manufacturer is preferably set on the air outlet side of the unit when the refrigerating system does not operate. The nominal air flow rate shall then be verified.

5.2.2 Installation and connection of the test object

The test object shall be installed and connected for the test as recommended by the manufacturer in his installation and operation manual.

For unit with open-type compressor the electric motor shall be supplied or specified by the manufacturer. The compressor shall be operated at the rotational speed specified by the manufacturer.

Temperature and pressure measuring points shall be arranged in order to obtain significant values.