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RATING STANDARD
for the
CERTIFICATION
of
LIQUID CHILLING PACKAGES

RS 6/C/003-2017

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Nb	Modifications	Section	Page
1	The definition of Liquid chilling package is revised	III.1	4
2	Specifications for air-cooled units, ducted outdoor, both modes, tested in Participant Laboratory	IV.6.c.2	10
3	Airflow requirement for units with ducted condenser	V.1	12
4	Correction of tolerance for COP at Part Load A / TBiv	VII	17
5	Updating of the standard EN14825:2016	All the document	

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I. PURPOSE

The purpose of this Rating Standard is to establish definitions and specifications for the operation of the certification programme for Liquid Chilling Packages and Hydronic Heat Pumps.

II. SCOPE

The scope of the programme is defined in the relevant Operational Manual OM-3.

This standard describes the rating standards for cooling-only and reversible Liquid Chilling Packages or Heat-Pumps. Rating standards for heating-only Heat Pumps are given in RS 6/C/003A.

III. DEFINITIONS

III.1 General definitions

Eurovent Certita Certification Certified Published Ratings: A statement of the assigned values of those performance characteristics (*rating and part load* in cooling and heating mode) under stated rating conditions, by which a unit may be chosen to fit its application. These values apply to all units of nominal size and type produced by the same Participant.

The term "published rating" includes those shown on the unit, published in specifications, advertising computer selection programmes and other literature controlled by the Company. If the Participant publishes non-certified ratings they shall be clearly indicated.

Standard Ratings: A statement of performance characteristics based on tests performed at standard rating conditions as specified in this Rating Standard.

Application Ratings: A statement of performance characteristics based on other than standard test conditions.

Basic Model Groups (BMG): The basic models shall be defined by units which are essentially the same in terms of thermal performance *(capacities with not more than 10% difference)* and function and application. The same or comparable in terms of basic components, specifically fans, coils, compressors and motors. Single-phase and three-phase versions of one model belong to the same BMG.

Liquid Chilling Package:

A factory-made unit designed to cool liquid, using an evaporator, a refrigerant compressor, an integral or remote condenser and appropriate controls.

Note: It may have means for heating which can be reversing the refrigerating cycle, such as a heat pump.

Hydronic Heat Pump: A factory assembled unit of the self-contained type designed to heat liquid using a compressor, an evaporator and an integral condenser and appropriate controls.

Liquid Pressure Drop on Indoor side: Liquid internal pressure difference between outlet and inlet of unit on Indoor side (kPa).

Liquid Pressure Drop on Outdoor side: Liquid internal pressure difference between outlet and inlet of unit on Outdoor side (kPa).

A-weighed Sound Power Level: Sound power level radiated by the *unit* (Lw(A)) expressed in dB(A)

The following definitions are in accordance with EN14511-1:2013.

Total Cooling Capacity: Heat given off from the heat transfer medium to the unit-per unit time (kW).

Effective Power Input: Average electrical power input of the unit within the defined interval of time (kW) obtained from:

- the power input for operation of the compressor(s) and any power input for defrosting
- the power input of all control and safety devices of the unit
- proportional power input of the conveying devices (e.g. fans, pumps) for ensuring the transport of the heat transfer media inside the unit

Heating Capacity: Heat given off by the unit to the heat transfer medium per unit of time (kW)~~.~~

Energy Efficiency Ratio (EER): Ratio of the total cooling capacity to the effective power input of the unit (-).

Coefficient of Performance (COP): Ratio of the heating capacity to the effective power input of the unit (-).

Power input in stand-by mode (Psb*), in off mode (Poff), in thermostat-off mode (Pto), in crankcase heater modes (Pck):* as defined in EN 14825:*2016*.

LRcontmin: Load rate under which a unit with a variable speed compressor behaves as an ON/OFF unit. For staged capacity units it is the load rate of the smallest capacity step in full mode. For ON/OFF units LRcontmin equals 1.

$Ccp_{LRcontmin}$: Ratio of the COP (or EER) at LRcontmin and the COP (or EER) at full load.

III.2 Part Load, Load Rate, Cycling Coefficient, EER at part load condition and ESEER

Part Load: Operation at partial capacity.

Load Rate: Ratio of the cooling capacity at partial capacity and reduced condenser inlet water or air temperature to the cooling capacity at the part-load rating conditions (part-load rating conditions as defined in Table 6):

$$LR = \frac{\%\,\text{Part Load} * Pc_{\text{Full Load}}}{Pc_{\%\text{Part Load Conditions}}} \qquad \text{(eq. 1)}$$

Cycling coefficient: The cycling coefficient is defined by:

$$Cc = 1 - \frac{MSP}{Pe(c)} \qquad \text{(eq. 2)}$$

Where: MSP is Measured Sleep Power,
Pe(c) is effective power input of the cycling stage for given source temperatures.

A default value of 0.9 will be used for the cycling coefficient for all chillers.

<u>EER at part load condition</u>:

- When to reach a certain part load capacity (25%, 50% or 75%), cycling is necessary on the last stage, meaning that LR<1 or $\frac{Pc_{\%Part\,Load\,Conditions}}{Pc_{Full\,Load}} >$ $\%Part\,Load$, then EER at part load condition is defined by:

$$EER_{\%Part\,Load} = \left(\frac{Pc}{Pe(c)}\right)_{\%\,Part\,Load\,Conditions} x\,\frac{LR}{Cc\,x\,LR + (1 - Cc)} \qquad \text{(eq. 3)}$$

  It is automatically calculated by the Technical Datasheet.

- When to reach a certain part load capacity (25%, 50% or 75%) the unit has to cycle between two stages, i.e. $\frac{(Pc)_{Stage\,n-1}}{(Pc)_{Full\,Load}} > \%\,Part\,Load > \frac{(Pc)_{Stage\,n}}{(Pc)_{Full\,Load}}$, EER at part load condition is a combination between $\frac{(Pc)_{\%\,Stage\,n-1}}{(Pc)_{Full\,Load}}$ and $\frac{(Pc)_{Stage\,n}}{(Pc)_{Full\,Load}}$ automatically calculated by the Technical Datasheet.

<u>ESEER (only for the cooling mode of air conditioning chillers)</u>: The European Seasonal Energy Efficiency Ratio is a weighted formula enabling to take into account the variation of EER with the load rate and the variation of air or water inlet condenser temperature.

$$ESEER = A.EER_{100\%} + B.EER_{75\%} + C.EER_{50\%} + D.EER_{25\%} \qquad \text{(eq. 4)}$$

Table 1: Weighting coefficients A to D for calculation of ESEER

Load Rate (%)	**100**	**75**	**50**	**25**
Weighting coefficients	A = 0.03	B = 0.33	C = 0.41	D = 0.23

It is automatically calculated by the Technical Datasheet.

III.3 Energy Classification

Classification concerns EER and COP at *the standard rating conditions* as defined in section III.1.

The energy efficiency of chillers is designated by “Eurovent Certita Certification Class …” in catalogues and in the present ECP Website of Certified products. The following limits between classes have been defined (see

Table 2).

Table 2: Eurovent Certita Certification energy classification for chillers

Cooling Mode					
Air-cooled	**Air-cooled ducted**	**Air-cooled, Floor**	**Water-cooled**	**Water-cooled**	**EER Class**
LCP/A/../../N/...	LCP/A/../../D/…	LCP/A/../../N/..	LCP/W/../../N/..	LCP/W/../../N/..	
AC	AC	CHF	AC	CHF	
≥ 3.1	≥ 2.7	≥ 3.8	≥ 5.05	≥ 5.1	A
2.9≤EER<3.1	2.5≤EER<2.7	3.65≤EER<3.8	4.65≤EER<5.05	4.9≤EER<5.1	B
2.7≤EER<2.9	2.3≤EER<2.5	3.5≤EER<3.65	4.25≤EER<4.65	4.7≤EER<4.9	C
2.5≤EER<2.7	2.1≤EER<2.3	3.35≤EER<3.5	3.85≤EER<4.25	4.5≤EER<4.7	D
EER<2.5	EER<2.1	EER<3.35	EER<3.85	EER<4.5	E
Heating Mode					
Air-cooled	**Air-cooled ducted**	**Air-cooled, Floor**	**Water-cooled**	**Water-cooled**	**COP Class**
LCP/A/R/../N/..	LCP/A/R/../D/…	LCP/A/R/../N/..	LCP/A/R/../N/..	LCP/A/R/../N/..	
AC	AC	CHF	AC	CHF	
≥ 3.2	≥ 3.0	≥ 4.05	≥ 4.45	≥ 4.5	A
3.0≤COP<3.2	2.8≤COP<3.0	3.9≤COP<4.05	4.15≤COP<4.45	4.25≤COP<4.5	B
2.8≤COP<3.0	2.6≤COP<2.8	3.75≤COP<3.9	3.85≤COP<4.15	4≤COP<4.25	C
2.6≤COP<2.8	2.4≤COP<2.6	3.6≤COP<3.75	3.55≤COP<3.85	3.75≤COP<4	D
COP<2.6	COP<2.4	COP<3.6	COP<3.55	COP<3.75	E

Note: For air source units, COP classes are defined for COP at +7°C and not +2°C.

IV. TESTING REQUIREMENTS

All standard ratings shall be verified by tests conducted by an approved independent laboratory in accordance with the following standards, and shall be established at the Standard Rating Conditions specified in Section V.

IV.1 Cooling and heating capacity

Test method: **EN 14511-3:2013** “Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling- Part 3: Test methods”.

Test conditions: **EN 14825:*2016*** “Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling. Testing and rating at part load conditions and calculation of seasonal performance”.

IV.2 Power consumption during off mode, thermostat off mode, standby mode and crankcase heater mode.

EN 14825:*2016* "Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling. Testing and rating at part-load conditions and calculation of seasonal performance".

IV.3 Sound Power Level

Standard EN 12102:2013 shall be used in conjunction with:

- ISO 9614:2009 by sound intensity method (Part 1: Measurement by discrete points)
- ISO 3744:2012 (if ISO 9614 is no applicable) by free field method
  or:
- ISO 3741:2012, Precision methods for reverberation test rooms

For sound testing the following conditions shall be used:

- Test at *the standard rating condition* in cooling mode for the AC application
- With the pump running
- All fans running at nominal speed
- For ducted air cooled units the same airflow and ESP shall be kept as in cooling mode
- Inlet air temperature at the condenser between 30°C and 35°C for units with cooling capacity below 100 kW[1]
- Inlet air temperature at the condenser between 20°C and 35°C for units with cooling capacity above 100 kW
- For non-ducted air-cooled units, the sound power to be tested is the sound power radiated outdoor side
- For ducted air-cooled chillers the sound power to be tested is the discharge sound power level

<u>Case of reversible chillers:</u>

For air-cooled units with Pdesignh below 70 kW, the sound testing can be carried out also always Standard conditions (EN 14511:*2013*) but in heating mode (Air Temperature = +7°C) with a water temperature in accordance with Regulations: +35°C or +55°C

For water-cooled units, the sound testing can be carried out, as an option, at Standard conditions (EN 14511:*2013*) in heating mode with a water temperature in accordance with Regulations: +35°C or +55°C

IV.4 Part Load Testing of Air Conditioning Chillers

For air conditioning chillers, part load testing is done as indicated by the Participant to Eurovent Certita Certification in the Technical Datasheet.

[1] See minutes of meeting held on 15/01/2008.

The testing methodology provided by the Participant by filling the Technical Datasheet shall ensure the stable operation of the compression circuit (frequency for inverter driven compressors, slide valve position for slide valve screw chillers, and sequence of activated compressors for capacity staged chillers).

For air cooled chillers, the condenser fan(s) should be operated by the control of the chiller. Whenever cycling of the condenser fan(s) occurs, the test should be done as follows:

- An acquisition time period of 1 hour is required.
- Tolerance on leaving water temperature can exceed the maximum permissible deviation.
- If cycles exceed 1 minute, an entire number of periods shall be acquired.

IV.5 LRcontmin and $Ccp_{LRcontmin}$

A test shall be performed at LRcontmin under standard condition 7/12 in cooling mode (AC application) or 30/35 in heating mode (CHF application).

If the miniumum water flow rate of the unit doesn't allow to reach the required ΔT (7/12°C), the test has to be done, exemple for the cooling mode, at 7°C as leaving water temperature and the minimum flow is declared by the manufacturer.

IV.6 Testing in Participant's Laboratory

a. Introduction

All units with cooling capacity at Eurovent Certita Certification Standard Rating Conditions below the limits defined in the relevant Operational Manual shall be tested in an independent laboratory approved and under contract with Eurovent Certita Certification. The choice of the independent laboratory is made by Eurovent Certita Certification.

Units with higher capacity shall be tested either in an independent laboratory or in a Participant laboratory (approved by Eurovent Certita Certification) by an independent agency (selected by Eurovent Certita Certification) following the procedures specified in the Rating Standard.

The test agency is requested to install its own instruments and to carry out complete test under its own responsibility. The Participant's personnel are requested to help during the preparation and to operate the test installation during the measurement. The Participant may perform its own measurement in parallel, but only results obtained by the independent test agency are considered by Eurovent Certita Certification.

b. Basic outline of the procedure

The following procedure shall be applied:

- Approval of independent test agencies by Eurovent Certita Certification (based on technical capabilities and cost)
- Approval of Participant's laboratory by the independent agency selected by Eurovent Certita Certification (based on characteristics of test installation)
- Selection of unit to be tested by Eurovent Certita Certification
- Selection of test agency by Eurovent Certita Certification (based on availability, cost or other considerations)

- The Participant provides the selected test agency with all the required information concerning test installation
- The test agency notifies the Participant of its requirements to prepare adjustments for installation of measuring probes and instruments
- On the agreed date of test, the test agency installs its own instruments and performs the test; the Participant's personnel assures the correct operation of the installation
- Test report prepared by the test agency is sent to Eurovent Certita Certification

c. Detailed procedure

1. Approval of Independent Test Agencies

The Independent Test Agency shall have qualified personnel and adequate instruments in order to meet the requirements concerning maximum acceptable uncertainty of measurement as specified in EN 14511-*3:2013*.

The cooling and heating capacity at *the standard rating conditions* shall be determined within a maximum tolerance of 5% independent of the individual uncertainties of measurement, including the uncertainties on the properties of fluids.

Concerning the acquisition time period for the output measurement, it is necessary to record all the meaningful data continuously; in the case of recording instruments which operate on a cyclic basis, the sequence shall be adjusted such that a complete recording is effected at least once every 10 s.

The test agency shall have at least the following equipment:

- <u>Water flow rate</u> (uncertainty + 1%): Electromagnetic flow meter class 0.3 or Ultrasonic flow meter (only intrusion)
- <u>Temperatures</u> (uncertainty: Liquid + 0.1 K, Air + 0.5 K): 12 PT 100 probes with display giving 0.01°C resolution
- <u>Pressure drop</u> (uncertainty + 5%): 2 differential transducers up to 1 bar with display (class 0.5)
- <u>Electrical measurements</u> (uncertainty + 1%): Wattmeter (class 0.5) or Network analyser
- <u>Refrigerant pressure</u> (uncertainty + 1%): Manometer (class 0.5) or Pressure transducers with display (class 0.5)
- <u>Data acquisition system</u>

2. Approval of Participant Laboratory

The Participant shall send an application form to Eurovent Certita Certification. Essential characteristics of test installation shall be indicated. The test installation shall be able to satisfy the requirement of the EN 14511-3:2013 Standard concerning the maximum permissible deviations of measured values from set values.

The test installation shall be designed in such a way that requirement from test agencies concerning installation of measuring probes and instruments be satisfied. That concerns in particular the installation of a water flow meter for which the diameter and length of the connecting pipe are specified. In order to obtain a homogeneous water temperature, a mixing device shall be used on the leaving water.

For the ducted units (Indoor and/or outdoor), if a calibration certificate established by an accredited laboratory, of the complete measurement chain of the manufacturer is provided to Eurovent Certita Certification:

- *this certificate shall include the following elements in order to be accepted:*
  - *for each checking point: manufacturer airflow measurement, test agency airflow measurement, relative deviation, temperature, relative humidity, pressure drop across* ***the nozzles*** *measured by the manufacturer*[2]*.*
  - *for all checking points the relative deviation between the airflow rate measured by the manufacturer and the airflow rate measured by the test agency shall not exceed 5%* ***after correction by calibration coefficients*** *which is the maximum uncertainty of measurements defined in EN14511-3:2013.*
- *The manufacturer shall provide to the independent test agency the calibration certificates of all sensors included in the airflow measurement system (temperature, humidity and differential pressure).*

In case the test agency determines that the Participant laboratory does not fulfil the required specifications, the test shall not be carried out. The Participant shall then send his unit to the Independent Laboratory for testing.

3. Organisation of test

When the unit to be tested and the test agency have been selected by Eurovent Certita Certification, the direct contact between test agency and Participant shall be established. The test agency shall provide detailed request for preparation to be executed by Participants:

- Connection of water flow meter
- Adaptor for temperature probes
- Adaptor for pressure transducer

This preparation shall be carried out before the day of the test.

The test agency and Participant shall agree on the date of test. The test agency personnel shall inspect the test installation and connect measuring devices. The test is then performed under full responsibility of the test agency.

Eurovent Certita Certification shall receive the test report prepared by the test agency.

[2] For air-cooled units, ducted outdoor, both modes concerned

V. RATING REQUIREMENTS

V.1 General requirements

Tests with brine shall be carried out with the brine composition as specified in the table below.

Table 3: Brine composition

	Medium Brine	Low Brine
Applications concerned	MB,	LB
Brine type	Ethylene Glycol	
Brine composition	30% (weight)	50% (weight)

All tests shall be carried out with clean heat exchangers and that shall be specified in catalogues with published ratings.

For ducted air-cooled chillers tests for capacity shall be carried out at the air flow rate specified as nominal in the published ratings. A unit is considered as ducted if the measured ESP at the declared nominal airflow is higher than 30 Pa.

For units with ducted condenser, ESP must be between 30 Pa and 200 Pa.

V.2 Treatment of frosting of heat exchangers

The treatment of frosting shall be done according to EN 14511:2013.

V.3 Checking of refrigerant

a. Composition of refrigerant

For 10% of the total number of tests in a test campaign, randomly chosen by Eurovent Certita Certification, a sample of refrigerant is taken just after the end of the test for composition checking.[3]

b. Refrigerant charge

The lack of refrigerant is the main reason for failure on cooling capacity. A Participant can choose to send units already equipped with Pressure / Temperature gauges (one for suction, one for liquid, one for discharge). In that case, checking the values by simple reading is part of the unit installation instructions.[4]

As an option, a Participant can request that the laboratory provide information on suction and discharge pressures and sub-cooling and superheating temperatures. That may help Participants to explain the failure. If the laboratory detects a leak of refrigerant, the test shall be stopped and the leak repaired.

If the Participant requests to check the refrigerant charge before the test, it can be done and the extra cost will be invoiced accordingly. In this case, the laboratory cannot be held responsible in case of failure due to lack of refrigerant.

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[3] See minutes of meeting held on 25/04/2004
[4] See minutes of meeting held on 10/03/2008

V.4 Capacity Tests

For capacity tests the following Standard Rating Conditions Table 4 and Table 5 shall be used:

Table 4: Standard rating conditions for capacity tests in cooling mode

	Code	Evap	Cond
Cooling Floor	LCP/A . . /CHF	23 / 18	35 [a]
	LCP/W. . /CHF Water/Water	23 / 18	30 / 35
	LCP/W. . /CHF-MB Water/Water		
Air Conditioning	LCP/A . . /AC	12 / 7	35 [5]
	LCP/W . . /AC Water/Water	12 / 7	30 / 35
	LCP/W . . /AC-MB Water/Water		
Medium Brine	LCP/A . . /MB	-2 / -8	35 [a]
	LCP/W . . /MB Brine/Water	-2 / -8	30 / 35
Low Brine	LCP/A . . /LB	-19 / -25	35 [a]
	LCP/W . . /LB Brine/Water	-19 / -25	30 / 35

Table 5: Standard rating conditions for capacity tests in heating mode

	Code	Evap	Cond
Low Temperature (previously Heating Floor)	LCP/A . . /CHF	7 (6)	30 / 35
	LCP/W. . /CHF Water/Water	10 / 7	30 / 35
	LCP/W. . /CHF-MB Brine/Water	0 / -3	30 / 35
Intermediate Temperature (previously Air Conditioning)	LCP/A . . /AC	7 (6)	40 / 45
	LCP/W . . /AC Water/Water	10 / 7	40 / 45
	LCP/W . . /AC-MB Brine/Water	0 / -3	40 / 45

[5] Dry bulb

Medium Temperature (previously High Temperature)	LCP/A . . /HT	7 (6)	47 / 55
	LCP/W . . /HT Water/Water	10 / 7	47 / 55
	LCP/W . . /HT-MB Brine/Water	0 / -3	47 / 55
High Temperature (previously Very High Temperature)	LCP/A . . /VHT	7 (6)	55 / 65
	LCP/W . . /VHT Water/Water	10 / 7	55 / 65
	LCP/W . . /VHT-MB Brine/Water	0 / -3	55 / 65

V.5 Part Load Rating Conditions for ESEER (cooling mode of air conditioning chillers)

For Part load tests the following Standard Rating Conditions (Table 6) shall be used:

Table 6: Part load rating conditions

% Part Load		**100 %**	**75 %**	**50 %**	**25 %**
Air-cooled chillers	Air temperature at condenser inlet (°C)	35	30	25	20
Water-cooled chillers	Water temperature at condenser inlet (°C)	30	26	22	18

The following rating conditions are required:

- For air-cooled chillers
  - The leaving water temperature is set at 7°C (Air conditioning application)
  - The evaporator water-flow rate is equal to the standard rating water-flow rate
  - The air-flow rate is controlled by the chiller
- For water-cooled chillers
  - The leaving water temperature is set at 7°C (Air conditioning application)
  - The evaporator water-flow rates are equal to the standard rating water-flow rates
  - The condenser water flow rate is controlled by the chiller. If the chiller doesn’t control it, the condenser water flow rate will be equal to the standard rating water flow rate

V.6 Part Load Rating Conditions for SEER (cooling mode for comfort chillers)

For each application, units either allowing or not allowing a variation of the outlet water temperature with the outdoor temperature are considered. The part load conditions for determining the declared capacity and the declared energy efficiency ratio are given in the following table.
The variable outlet temperature ($T_{outlet\_average}$) shall only be applied when the control provides an outdoor air temperature dependant modification of the outlet temperature.

Table 7: Part load rating conditions for Air-cooled *& Water-cooled* units

Conditions	Part Load ratio %	Outdoor heat exchanger		Indoor heat exchanger	
		Air dry bulb temperature °C	*Inlet/outlet water temperatures*	Inlet/outler water temperature	
				Fixed outlet	Variable outlet
A	100	35	*30 / 35*	12 / 7	12 / 7
B	74	30	*26 / a*	a / 7	a / 8,5
C	47	25	*22 / a*	a / 7	a / 10
D	21	20	*18 / a*	a / 7	a / 11,5

[a] With the water flow rate as determined during “A” test for units with a fixed water flow rate or with a fixed delta T of 5 K for units with a variable water flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

V.7 Part Load Rating Conditions for SEPR (cooling mode high temperature process chillers)

The part load conditions for determining the declared capacity and the declared energy efficiency ratio are given in the following table.

Table 8: Part load rating conditions for Air-cooled *& Water-cooled* units

Conditions	Part Load ratio %	Outdoor heat exchanger		Indoor heat exchanger	
		Air dry bulb temperature °C	*Inlet/outlet water temperatures*	Inlet/outler water temperature	
				Fixed outlet	Variable outlet
A	100	35	*30 / 35*	12 / 7	12 / 7
B	93	25	*23 / a*	a / 7	a / 8,5
C	87	15	*16 / a*	a / 7	a / 10
D	80	5	*9 / a*	a / 7	a / 11,5

[a] With the water flow rate as determined during “A” test for units with a fixed water flow rate or with a fixed delta T of 5 K for units with a variable water. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

V.8 Part Load Rating Conditions for SEPR (cooling mode medium temperature process chillers)

The part load conditions for determining the declared capacity and the declared energy efficiency ratio are given in the following table.

Table 9: Part load rating conditions for Air-cooled units

Conditions	Part Load ratio %	Outdoor heat exchanger		Indoor heat exchanger
		Air dry bulb temperature °C	*Inlet/outlet water temperatures*	Inlet/outler water temperature Fixed outlet
A	100	35	*30 / 35*	-2 / -8
B	93	25	*23 / [a]*	[a] / -8
C	87	15	*16 / [a]*	[a] / -8
D	80	5	*9 / [a]*	[a] / -8

[a] With the water flow rate as determined during "A" test for units with a fixed water flow rate or with a fixed delta T of 6 K for units with a variable water. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

V.9 Part Load Rating Conditions for SEPR (cooling mode low temperature process chillers)

The part load conditions for determining the declared capacity and the declared energy efficiency ratio are given in the following table.

Table 10: Part load rating conditions for Air-cooled & Water-cooled units

Conditions	Part Load ratio %	Outdoor heat exchanger		Indoor heat exchanger
		Air dry bulb temperature °C	*Inlet/outlet water temperatures*	Inlet/outler water temperature Fixed outlet
A	100	35	*30 / 35*	-19 / -25
B	93	25	*23 / [a]*	[a] / -25
C	87	15	*16 / [a]*	[a] / -25
D	80	5	*9 / [a]*	[a] / -25

[a] With the water flow rate as determined during "A" test for units with a fixed water flow rate or with a fixed delta T of 6 K for units with a variable water. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

VI. CERTIFIED PERFORMANCES

The following performances at standard conditions shall be certified:

- Cooling capacity [kW]
- Energy efficiency Ratio (EER) [-]
- European Seasonal Energy Efficiency Ratio (ESEER) for air-conditioning application [-] until 31/12/2017
- Water pressure drop at Indoor side [kPa]
- Water pressure drop at Outdoor side for water-to-water units [kPa]
- Heating capacity for reverse cycle units [kW]
- Coefficient of Performance (COP) for reverse cycle units [-]
- A-weighted sound power level for Air Cooled Units in cooling mode [dB(A)]
- P_{sb}, LRcontmin and $Ccp_{LRcontmin}$ in cooling and heating

For relevant units (see OM § II.4.b)

- Capacity at Pdesignh [kW]
- Seasonal Efficiency in heating (SCOP & ηs) [-]
- *Poff, Pto, Pck*
- A-weighted sound power level for Air Cooled Units in heating mode [dB(A)]
- A-weighted sound power level for Water Cooled Units in heating mode [dB(A)] (Option)

From 1st July 2016 for Low Temperature and Medium Temperature Process Chillers:

- Cooling Capacity [kW]
- Seasonal Efficiency SEPR [-]

From 1st January 2018:

- Capacity at Pdesignc [kW]
- Seasonal Efficiency in cooling (SEER and/or SEPR) [-]
- Primary Seasonal Efficiency in cooling ($\eta_{s,c}$) [-]

All ratings refer to a fouling factor equal to zero.

The published literature or computer programme for all the products shall include all the certified performances.

VII. TOLERANCES

When tested by the laboratory selected by Eurovent Certita Certification, the performances obtained shall not differ from the claimed values by more than the tolerance (see Table). High deviation lead to penalty tests (see IV.4 Failure treatment in the relevant Operational Manual).

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Table 11: Table of tolerances, intermediate and high deviations

	Tolerance	Intermediate	High deviation
	Standard Point (EN 14511:2013)		
Cooling or heating capacity, EER or COP	< -5%	< -8%	< -10%
	ESEER		
EER on part load point if only one or two points are tested (%)	< -(2+3/%Part Load)	< -(3+4.5/%Part Load)	< -(4+6/%Part Load)
Part Load 75%	<-6%	<-9%	<-12%
Part Load 50%	<-8%	<-12%	<-16%
Part Load 25%	<-14%	<-21%	<-28%
ESEER if all points have been tested	<-9%	<-13%	<-17%
	Sound		
A-weighted sound power level rounded to the closest integer value (*) in heating mode for units ≤ 70 kW.	> +3 dB(A) > + 2 dB(A)*	> +5 dB(A)	> +7 dB(A)
	Other		
Water pressure drop	> + 15%		
LRcontmin	+/- 5% (point)		
CcpLRcontmin	< - 5% (point)		
	Auxiliaries		
P_{off}	> +10%		
P_{sb}	> +10%		
P_{to}	> +10%		
P_{ck}	> +10%		
	SCOP		
COP on part load point	< -(2+3/%Part Load)	< -(3+4.5/%Part Load)	< -(4+6/%Part Load)
Part Load A / Tbiv	<-7%	<-8%	<-11%
Part Load B	<-7.6%	<-11%	<-15%
Part Load C	<-10.6%	<-16%	<-21%
Part Load D	<-22%	<-33%	<-44%
P bivalent	*< -7%*	*< -8%*	*< -10%*

APPENDIX A. EXAMPLE OF ESEER CALCULATIONS

Figure 1: ESEER calculations, example of Load Rate and EER at part load condition

Capacity stage number:	3	Temperatures [°C]		FULL LOAD	Stage 2	Stage 3	
Cycling coefficient	0.9	30	Pc	100			
			Pe(c)	50			
Weighting coefficients		26	Pc	100	50		
25 % - 50 % - 75 % - 100 %			Pe(c)	50	25		
0.23 - 0.41 - 0.33 - 0 .03		22	Pc	100	50		
			Pe(c)	50	25		
		18	Pc			33	
ESEER:	**1.87**		Pe(c)			22	
Compute ESEER			**Part load**	**100%**	**75%**	**50%**	**25%**
			EER$_{PartLoad}$	**2.00**	**2.00**	**2.00**	**1.45**

$$LR = \frac{\%\,\text{Part Load} * Pc_{\text{Full Load}}}{Pc_{\%\,\text{Part Load Conditions}}} \qquad \text{(eq. 1)}$$

In this example, according to eq. 1, LR (25%) = 0.25 x 100 / 33, LR (50%) = 0.5 x 100 / 100 and LR (75%) = 0.75 x 100 / 100.

When cycling is necessary,

$$EER_{\%\text{Part Load}} = \left(\frac{Pc}{Pe(c)}\right)_{\%\,\text{Part Load Conditions}} \text{x} \frac{LR}{Cc \text{ x } LR + (1 - Cc)} \qquad \text{(eq. 3)}$$

In this example, since 33/100>0.25,

$$EER_{25\%} = \frac{33}{22} \text{ x } \frac{\frac{0.25x100}{33}}{0.9 \times \frac{0.25x100}{33} + (1 - 0.9)} = 1.45.$$

$$ESEER = A.EER_{100\%} + B.EER_{75\%} + C.EER_{50\%} + D.EER_{25\%} \qquad \text{(eq. 4)}$$

In this example, ESEER = 0.03 x 100 / 50 + 0.33 x 2 + 0.41 x 2 + 0.23 x 1.45

APPENDIX B. ESEER DECLARATION GUIDELINES

B.I. Certified characteristics

Only the European Seasonal Energy Efficiency Ratio (ESEER) will be published on the of Eurovent Certified Performance website. The declaration of part load data is mandatory for the selected units for test. If the Participant is unable to declare part load, Eurovent Certita Certification will ask the laboratory to test the unit for each load rate.

B.II. Part load declaration

For the unit selected for testing, Participants have to fill in the declaration form sent by Eurovent Certita Certification as follows:

- Participants have to give the number of stages. According to the number of stages of the selected chiller, the table corresponding to the number of stages is built automatically in the Excel sheet.
- Participants have to declare the cooling capacity (Pc) and the power input (Pe(c)) for the points necessary to calculate the ESEER. The proposed format and absolute cell position of the table have to be strictly respected.
- Participants have to press the button “Compute ESEER”, the macro associated to ESEER calculation will run as follows:
    - Calculate and display ESEER
    - Show the intermediary points that have been calculated at 25, 50 and 75% load in order to use the weighting coefficients derived for ESEER.

****

Figure 2: Example of a Scroll chiller, 1 compressor, part load control: ON/OFF

Capacity stage number:	**1**	Temperatures [°C]		**FULL LOAD**			
Cycling coefficient	0.9	30	**Pc**	10			
			Pe(c)	2.5			
Weighting coefficients		26	**Pc**	10.4			
25 % - 50 % - 75 % - 100 %			**Pe(c)**	2.2			
0.23 - 0.41 - 0.33 - 0 .03		22	**Pc**	10.8			
			Pe(c)	2			
		18	**Pc**	11.2			
ESEER:	**4.61**		**Pe(c)**	1.9			
Compute ESEER			**Part load**	**100%**	**75%**	**50%**	**25%**
			$EER_{PartLoad}$	**4.00**	**4.55**	**4.84**	**4.37**
			Load Rate	1	0.72	0.46	0.22
			$EER_{Full\ Load}$	4.00	4.73	5.40	5.89

In Figure 2:

a) Load Rate is calculated for each temperature using Load Rate definition (eq. 1, given in gray). $EER_{Full\ Load}$ is calculated for each Temperature as the ratio between Pc and Pe(c).

b) $EER_{Part\ Load}$ is calculated for each Temperature directly using the cycling formula (eq. 3)

c) ESEER is calculated using the ESEER definition (eq. 4).

****

Figure 3: Example of a Scroll chiller, 1 circuit, 2 compressors of the same size

Capacity stage number:	2	Temperatures [°C]		FULL LOAD	Stage 2		
Cycling coefficient	0.9	30	Pc	50			
			Pe(c)	12.5			
Weighting coefficients		26	Pc	52	27		
25 % - 50 % - 75 % - 100 %			Pe(c)	11.2	5.2		
0.23 - 0.41 - 0.33 - 0 .03		22	Pc		28.1		
			Pe(c)		4.7		
		18	Pc		29.1		
ESEER:	**5.49**		Pe(c)		4.4		
Compute ESEER			**Part load**	**100%**	**75%**	**50%**	**25%**
			$EER_{PartLoad}$	**4.00**	**4.86**	**5.91**	**5.84**

In Figure 3:

a. The full load cooling capacity is 50 kW.
b. The capacity at 75% is 0.75x50=37.5 kW. To obtain this capacity at 26°C, the chiller has to cycle on stage 1 and stage 2.
c. The capacity at 50% is 0.5x50=25 kW. To obtain this capacity at 22°C the chiller has to cycle on stage 2.
d. The capacity at 25% is 12.5 kW. To obtain this capacity at 18°C the chiller has to cycle on stage 2.

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Figure 4: Example of a Scroll chiller, 1 circuit, 2 compressors of different sizes (33 % / 66 %)

Capacity stage number:	3	Temperatures [°C]		FULL LOAD	Stage 2	Stage 3	
Cycling coefficient	0.9	30	Pc	100			
			Pe(c)	25			
Weighting coefficients		26	Pc	104	69.7		
25 % - 50 % - 75 % - 100 %			Pe(c)	22.4	13.4		
0.23 - 0.41 - 0.33 - 0 .03		22	Pc		72.4	37.8	
			Pe(c)		12.3	5.7	
		18	Pc			39.2	
ESEER:	**5.96**		Pe(c)			5.3	
Compute ESEER			**Part load**	**100%**	**75%**	**50%**	**25%**
			$EER_{PartLoad}$	**4.00**	**5.07**	**6.23**	**7.00**

In Figure 4:

a. The full load cooling capacity is 100 kW
b. The capacity at 75% is 0.75x100=75 kW. To obtain this capacity at 26°C, the chiller has to cycle on stage 1, the full load stage, and stage 2.
c. The capacity at 50% is 0.50x100=50 kW. To obtain this capacity at 22°C, the chiller has to cycle on stage 2 and stage 3.
d. The capacity at 25% is 0.25x100=25 kW. To obtain this capacity at 18 °C, the chiller has to cycle on stage 3 to obtain 25% capacity.

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Figure 5: Example of a Screw chiller, 2 circuits, 1 compressor by circuit with 50% unloading step for each compressor

Capacity stage number:	4	Temperatures [°C]		FULL LOAD	Stage 2	Stage 3	Stage 4
Cycling coefficient	0.9	30	Pc	200			
			Pe(c)	50			
Weighting coefficients		26	Pc		155.5	104	
25 % - 50 % - 75 % - 100 %			Pe(c)		35.3	22.4	
0.23 - 0.41 - 0.33 - 0.03		22	Pc			108	53.5
			Pe(c)			20.5	11.8
		18	Pc				55.4
ESEER:	**4.87**		Pe(c)				10.9
Compute ESEER			**Part load**	**100%**	**75%**	**50%**	**25%**
			$EER_{PartLoad}$	**4.00**	**4.42**	**5.20**	**5.03**

In Figure 5:

a. The full load cooling capacity is 200 kW
b. The capacity at 75% is 0.75x200=150 kW. To obtain this capacity at 26°C, the chiller has to cycle on stage 2 and stage 3.
c. The capacity at 50% is 0.50x200=100 kW. To obtain this capacity at 22°C the chiller has to cycle on stage 3 and stage 4.
d. The capacity at 25% is 0.25x200=50 kW. To obtain this capacity at 18°C the chiller has to cycle on stage 4.

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Screw chiller, 1 circuit, continuous control with slide valve, unloading from 100% to 15% capacity

The Participant has 2 options: supply only four points (Figure 6) or consider the unit as a ten steps chiller (Figure 7).

Figure 6: Example of a declaration of the chiller as a 4 steps chiller

Capacity stage number:	4	Temperatures [°C]		FULL LOAD	Stage 2	Stage 3	Stage 4
Cycling coefficient	0.9	30	Pc	200			
			Pe(c)	50			
Weighting coefficients		26	Pc		150		
25 % - 50 % - 75 % - 100 %			Pe(c)		32.9		
0.23 - 0.41 - 0.33 - 0.03		22	Pc			100	
			Pe(c)			21.9	
		18	Pc				50
ESEER:	**4.26**		Pe(c)				15
Compute ESEER			**Part load**	**100%**	**75%**	**50%**	**25%**
			$EER_{PartLoad}$	**4.00**	**4.56**	**4.57**	**3.33**

In Figure 6:

The Participant is able to supply four exact matching points at 25, 50, 75 and 100% for the condensing temperature indicated, 30, 26, 22 & 18°C for water cooled units and 35, 30, 25 & 20°C for air cooled units. In this case, the number of stages is 4.

If the Participant doesn't complete the table with the exact value for each load (25, 50 & 75%) to run the macro, the ESEER can't be calculated. For example if the full load capacity is 200 kW, at 25%, the cooling capacity has to be 50 kW.

Figure 7: Example of a declaration of the chiller as a 10 steps chiller

Capacity stage number:	**10**	Temperatures [°C]		**FULL LOAD**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**	**Stage 7**	**Stage 8**	**Stage 9**	**Stage 10**
Cycling coefficient	0.9	30	**Pc**	200	180	160	140	120	100	80	60	40	20
			Pe(c)	50	45	40	36	32	28	25	22	19	17
Weighting coefficients		26	**Pc**	208	187	166	146	125	104	83	62	42	21
25 % - 50 % - 75 % - 100 %			**Pe(c)**	45	40	36	32	28	25	22	20	17	15
0.23 - 0.41 - 0.33 - 0.03		22	**Pc**	216	194	173	151	130	108	86	65	43	22
			Pe(c)	41	37	33	29	26	23	20	18	16	14
		18	**Pc**	224	202	179	157	134	112	90	67	45	22
ESEER:	**4.24**		**Pe(c)**	38	34	31	27	24	21	19	17	15	13

Compute ESEER

Part load	**100%**	**75%**	**50%**	**25%**
$EER_{PartLoad}$	**4.00**	**4.57**	**4.56**	**3.24**

In Figure 7:

In this case, the Participant will calculate part load data every 10% load of the chiller.

In this example:

a. The full load cooling capacity is 200 kW
b. The capacity at 75% is 0.75x200=150 kW. To obtain this capacity at 26°C, the chiller has to cycle between 80% and 70% load.
c. The capacity at 50% is 0.50x200=100 kW. To obtain this capacity at 22°C the chiller has to cycle on 50% and 40% load.
d. The capacity at 25% is 0.25x200=50 kW. To obtain this capacity at 18°C the chiller has to cycle on 30% and 20% load.