RS 6/C/007- 2017

Published January 2017

RATING STANDARD
for the
CERTIFICATION
of
ROOFTOPS

RS 6/C/007- 2017

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Modifications as against latest version:

Nb	Modifications	Section	Page
1	Modifications of Rootops definition according to ErP regulation	III.1	4
2	Modifications of BMG definition	III.2	6
3	Air-cooled and Water-cooled replaced by Air-to-air and Water-to-air following the new definition of a rooftops	All the document	
4	Adding of Tolerances of Seasonal tests in Cooling	VII	12

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I. PURPOSE

The purpose of this Rating Standard is to prescribe testing and rating procedures for the operation of the Rooftops Certification Programme of Eurovent Certita Certification, as defined in the Operational Manual OM-13.

II. SCOPE

The scope of the programme is defined in the relevant Operational Manual OM-13.

III. DEFINITIONS

III.1 Rooftop

A rooftop unit is defined by the following features:

- *Air-to-air rooftop: Units covered by ErP regulation (Lot 21) will entry into force on 01/01/2018 and defined as a:*

Rooftop air conditioner *or* Rooftop heat pump

- *Water-to-air rooftop: Water-to-air heat pump/air conditioner (defined and covered by the regulation), driven by an electric compressor, of which the evaporateur, compressor and condenser are integrated into a single package.*

Features according definitions from ErP regulation:

- *Single packaged unit assembled in factory*
- *Common single frame*
- *Direct expansion system*
- *For Air-to-air unit, the outdoor side heat exchanger (condenser / evaporator) allows heat transfer with 100% outdoor (ambient) air.*

Additional features:

- *Designed to operate permanently outdoor*
- *The rooftop is designed to permanently handle 100% recycled air with the possibility of mixing partly the fresh air.*

- *The outdoor fan from an air-to-air rooftop could be ducted but for the certification tests, the unit must be not ducted.*

- *Rooftops could be equiped with 2 / 3 or 4 dampers depending on heat recovery system included or not.*

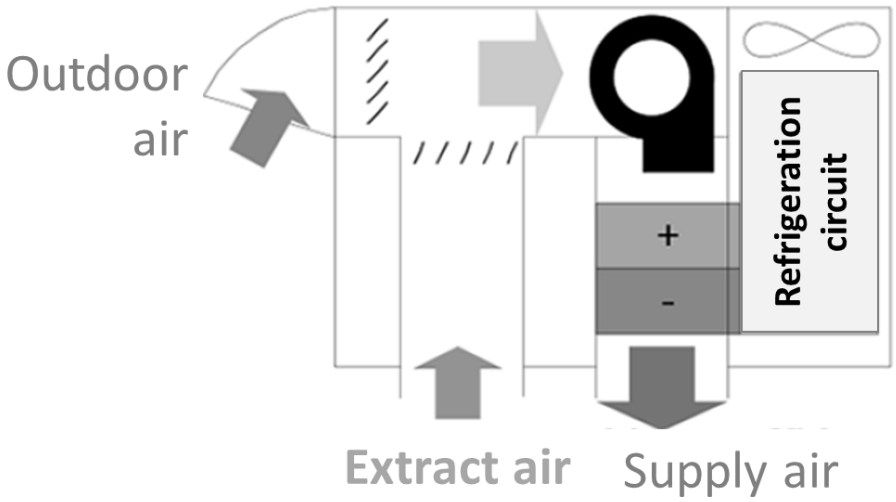
These types of rooftops shall be tested :

- *For the indoor heat exchanger with mixed air equal to 100% extract air and,*
- *For the ‘ outdoor ‘ heat exchanger with 100% outdoor air.*

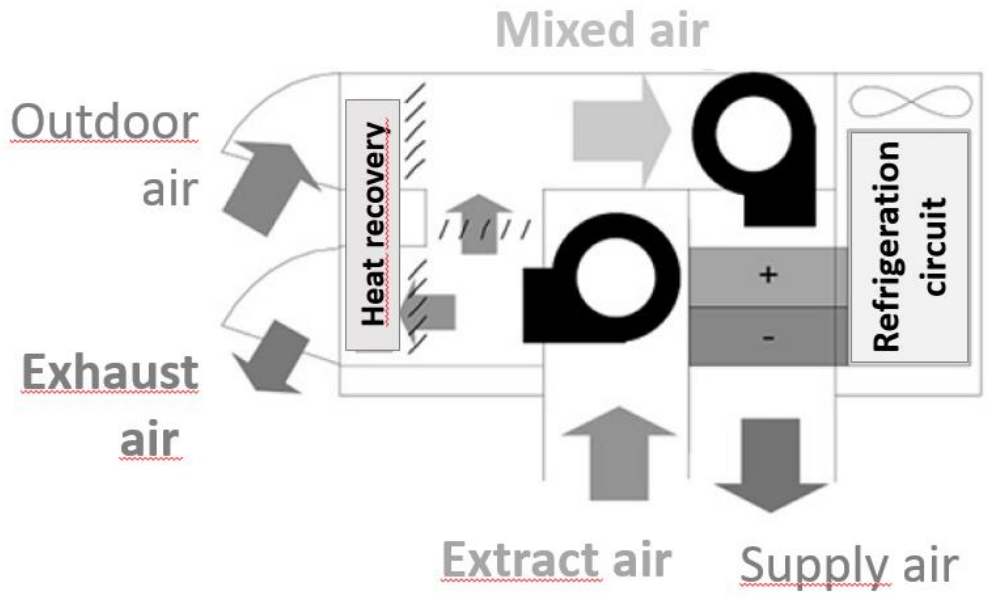
- *Other parameters in accordance with the standards EN 14511:2013 and EN 14825:2016.*

Some examples of rooftops:

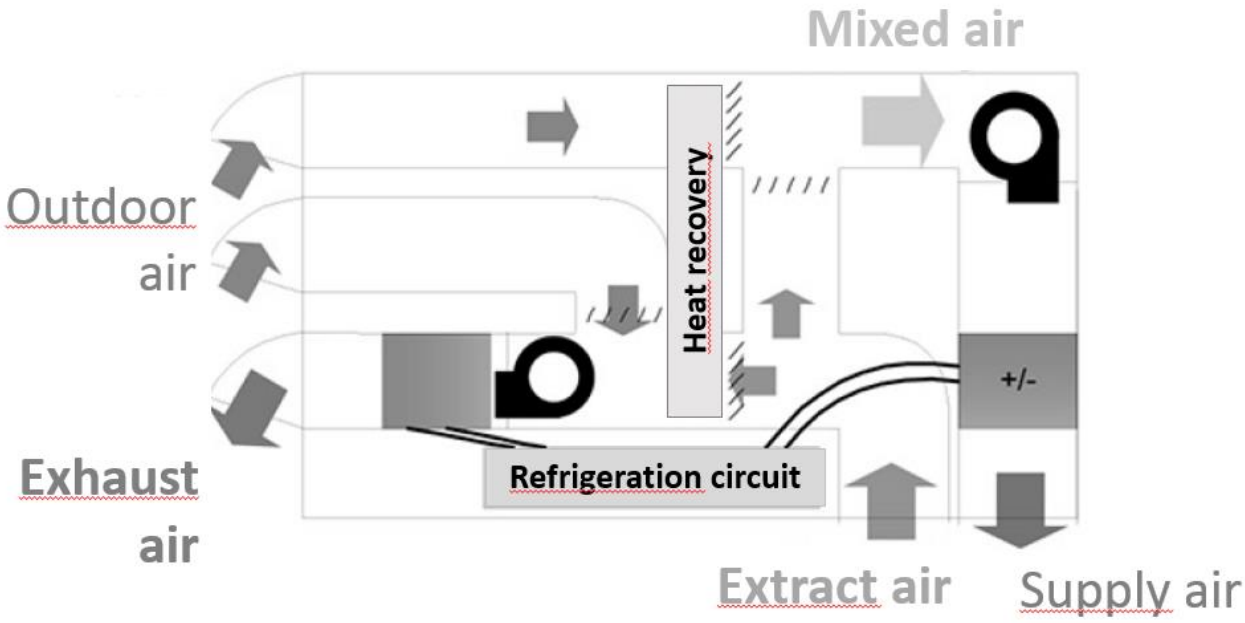
2 dampers rooftops:



3 dampers rooftops:



4 dampers rooftops :



III.2 Basic models groups (BMG)

A Basic Model Groups (BMG*) is a list of Rooftops models, part of a common commercial range sharing the same overall dimensions:*

- *Height (mm)*
- *Width (mm)*
- *Length (mm)*

with the same function and application (*For instance, reversible rooftops and* cooling only *rooftops are in two separate Basic Model Groups*)

with similar components (fans, coils, compressors and motors)

III.3 Measured and rated data

a. Definitions in accordance with EN 14511

The definitions of the following items, used in this RS, are given in EN 14511:2013.

- Cooling Capacity (Pc)
- Heating Capacity (Ph)
- Total Power Input (Pe(c) or Pe(h))
- EER, COP

b. Definitions in accordance with EN 14825

The definitions of the following items, used in this RS, are given in EN 14825:2016.

- Part Load ratio
- *Part Load conditions*
- SEER
- *SCOP*

c. Other definitions

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 full load and the COP (or EER) at LRcontmin.

The seasonal space cooling efficiency $\eta_{s,c}$ [%] is defined as:

$\eta_{s,c} = \frac{SEER}{CC} \times 100 - \Sigma F(i)$

where:

CC is the conversion coefficient, equal to 2,5

SEER is the Seasonal Energy Efficiency Ratio

ΣF(i) is the correction calculated equal to 3% for *air-to-air* rooftops.

***The seasonal space heating efficiency $\eta_{s,h}$** [%] is defined as:*

$\eta_{s,h} = \frac{SCOP}{CC} \times 100 - \Sigma F(i)$

where:

CC is the conversion coefficient, equal to 2,5

SCOP is the Seasonal Coefficient of Performance

ΣF(i) is the correction calculated equal to 3% for air-to-air rooftops.

IV. TESTING REQUIREMENTS

Standard ratings shall be established at the standard rating conditions specified in section V. All standard ratings shall be verified by tests conducted in accordance with the following standards:

IV.1 Performance testing

EN 14511:2013 “Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling”.

Used for:

- Standard rating points
- $LR_{contmin}$ and $Ccp_{LRcontmin}$

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”.

Used for:

- P_{sb}, P_{to}, P_{off}, P_{ck}
- Part Load Conditions in cooling mode
- *Part Load Conditions in heating mode*

IV.2 Acoustical testing

EN 12102:2013 "Air conditioners, liquid chilling packages, heat pumps and dehumidifiers with electrically driven compressors for space heating and cooling - Measurement of airbone noise - Determination of the sound power level".

IV.3 Testing in Participant's laboratory

Introduction and basic outline of the procedure are given in OM-13.

a. Detailed procedure

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 14511:2013 (see Table 3).

The cooling and heating capacity *at 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.

The test agency shall have at least the following equipment:

For test on water-*to-air* units:

- Water flow rate (uncertainty + 1%): flow meter class 0.3

For all tests:

- Temperatures (uncertainty: Liquid + 0.1 K, Air + 0.2 K): 12 PT 100 probes with display giving 0.01°C resolution
- Pressure drop (uncertainty + 5%): 2 differential transducers up to 500 Pa with display (class 0.5)
- Electrical measurements (uncertainty + 1%): Wattmeter (class 0.5) or Network analyser
- Mass measurement device (uncertainty + 1%)
- Data acquisition system

b. Approval of Participant Laboratory

The Participant shall send to Eurovent Certita Certification a calibration certificate of the airflow measuring devices used in the participant(s) test facilities with the following requirements:

- the certificate has to be issued by a laboratory accreditated by one of the full members of the European co-operation for Accreditation (for example COFRAC in France, see list on www.european-accreditation.org) for calibration of airflow or air velocity measurement systems according to EN17025:2005.
- all the necessary identification information of the calibrated airflow measuring device shall be provided in the certificate (e.g. serial

number, dimensions, type). The testing agency will check that the installed airflow measuring device correspond to the information provided in the certificate.

- the uncertainty of the calibration method shall be provided.
- the range of airflows for which the calibration is valid shall cover the airflow rate of the tested unit;
- the issuing date of the certificate shall not differ by more than 10 years from the date of the test.

If a calibration certificate 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.
  - 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 EN14511:2013.
- 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).

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 14511:2013 Standard concerning the maximum permissible deviations of measured values from set values (see Table 4).

The test installation shall be designed in such a way that requirement from test agencies concerning installation of measuring probes and instruments be satisfied.

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 if applicable.

c. 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. In particular the independant test agency will check that the casing and the ductwork of the installation is such as to minimize any air leakage.

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.

V. RATING REQUIREMENTS

Performance ratings claimed by manufacturers shall be verified by tests performed in one of Eurovent Certita Certification Independent Laboratories or in Participant Laboratory (see IV.3).. The following specifications will be used during the tests:

- Test unit shall be installed with vertical or horizontal airflow in accordance with the manufacturer's specifications
- No fresh air shall be used for rating, neither in cooling, nor in heating.
- The operating conditions shall be used following the Table 1.
- Allowable deviations from set values are given in EN 14511:2013.
- Testing shall be carried without mixing damper.
  The nominal airflow rate and the external static pressure (ESP) given by the manufacturer shall be measured.

a. Standard rating conditions

Table 1: Operating conditions for standard rating *(EN 14511:2013)*

	INDOOR SIDE		OUTDOOR SIDE			
	Air entering °C		Air entering °C		Water °C	
	Dry bulb	Wet bulb	Dry bulb	Wet bulb	In	Out
COOLING	27	19	35	24	30	35
HEATING	20	15 max	7	6	20*	
SOUND**	27	19 (+/-2)	20-35	-	30	35

* For units designated for cooling mode, the water flow rate obtained during the test at standard rating conditions in cooling is used.
** Same airflow and same available pressure as for the thermal test shall be used.

Indoor airflow shall be in relation with the cooling capacity and used also for the heating mode.

b. Part-load rating conditions for Cooling & *Heating* mode *(EN 14825:2016)*

For each part load conditions, it is possible to vary the air flow of the machine.
Only the damper setting cannot be changed.

VI. CERTIFIED CHARACTERISTICS

The following performance characteristics shall be certified and verified by tests:

a) Total Cooling Capacity
b) Heating Capacity
c) EER
d) COP
e) Eurovent Energy Efficiency class (cooling and heating)
f) Condenser water pressure drop (only for water cooled rooftops)
g) External static pressure (ESP)
h) Nominal airflow rate (Qv)
i) A-weighted Sound Power Level outside
j) A-weighted Sound Power Level in supply duct

From 1st January 2018:

k) Seasonal Efficiency in Cooling (SEER & ηsc)
l) Seasonal Efficiency in Heating (SCOP & ηsh)

VII. TOLERANCES

When tested in Laboratory, the characteristics obtained shall not differ from the values claimed by the participants by more than the tolerance given below. High deviations lead to penalty tests (see section IV.5.e of OM-13). Mean Value are used for the calculation of the Mean Value of Failure (MVF, see section IV.6 and Appendix D of OM-13).

Table 2: Table of tolerances, intermediate and high deviations

	Tolerance	Mean Value	High Value
Cooling or heating capacity	< -5%	< -8%	< -12%
EER or COP *at standard rating conditions*	< -8%	< -12%	< -15%
Seasonal Efficiency in cooling			
EER Condition B	*< -12.1%*	-	-
EER Condition C	*< -16.8%*	-	-
EER Condition D	*< -32.6%*	-	-
Sound			
A-weighted sound power levels	> +3 dB(A)	> +5 dB(A)	> +7 dB(A)
Others			
Water pressure drop	>+ 15%	-	-
P_{sb} / P_{to} / P_{off} / P_{ck}	> +10%	-	-
$LR_{contmin}$	+/- 5% (point)	-	-
$Ccp_{LRContmin}$	< - 5% (point)	-	-

APPENDIX A. EUROVENT CERTITA CERTIFICATION ENERGY CLASSES FOR ROOFTOPS

The purpose of Eurovent Certita Certification Energy Efficiency Classes is to simplify the selection of the best units for each type of Rooftops. The classification is entirely voluntary, not related to any European Directive. The energy efficiency of Rooftops is designated by “Eurovent Certita Certification Class A” or “Eurovent Certita Certification Class B” in catalogues and in the Eurovent Certita Certification Directory of Certified Products. Based on existing units presented to Eurovent Certita Certification the following limits between classes are defined:

Table 3: Eurovent Certita Certification Energy Classification of Air-*to-air* Rooftops - cooling mode

Eurovent Certita Certification Energy Efficiency Class	Rooftop units
A	3.00 < EER
B	3.00 ≥ EER > 2.80
C	2.80 ≥ EER > 2.60
D	2.60 ≥ EER > 2.40
E	2.40 ≥ EER

Table 4: Eurovent Certita Certification Energy Classification of Water-*to-air* Rooftops - cooling mode

Eurovent Certita Certification Energy Efficiency Class	Rooftop units
A	4.40 < EER
B	4.40 ≥ EER > 4.10
C	4.10 ≥ EER > 3.80
D	3.80 ≥ EER > 3.50
E	3.50 ≥ EER

Table 5: Eurovent Certita Certification Energy Classification of Air-*to-air* Rooftops - heating mode

Eurovent Certita Certification Energy Efficiency Class	Rooftop units
A	3.40 < COP
B	3.40 ≥ COP > 3.20
C	3.20 ≥ COP > 3.00
D	3.00 ≥ COP > 2.60
E	2.60 ≥ COP

Table 6: Eurovent Certita Certification Energy Classification of Water-*to-air* Rooftops - heating mode

Eurovent Certita Certification Energy Efficiency Class	Rooftop units
A	4.70 < COP
B	4.70 ≥ COP > 4.40
C	4.40 ≥ COP > 4.10
D	4.10 ≥ COP > 3.80
E	3.80 ≥ COP

APPENDIX B. TEMPLATE OF THERMAL TEST REPORT

Eurovent Certita Certification **Test-No.**

Test Report

Performance Test on an Air-*to-air* / Water-*to-air* Rooftop

Client	Eurovent Certita Certification 48-50 rue de la Victoire, 75009 Paris, France
Standards of test	RS 6/C/007, EN 14511 :2013.
Purchase order number	
Date of the purchase order .	
Content of order	
Testing object	Designation: Serial No.:
Manufacturer	
Eurovent Certita Certification Classification	
Arrival of the testing object ..	
Test period	

B.I. Testing Object and Test Set-up

Some important details of the testing object are given in Table 1. The test set-up in principle is shown in Figure 1. Photos of the unit installation are given in Figure 2.

Table 1: Data of the testing object

Refrigerant				
Number of refrigerant circuits				
Charge total system		[1)]		kg
Compressor (Manufacturer / type)				
Number of compressors / Model				
Expansion device	Location			
	Type			
Fans / Motors	number (indoor / outdoor)			
Fan type(s)	code (indoor / outdoor)			

[1)] Manufacturer's declaration.

The rooftop has been tested as shown in Figure 1.

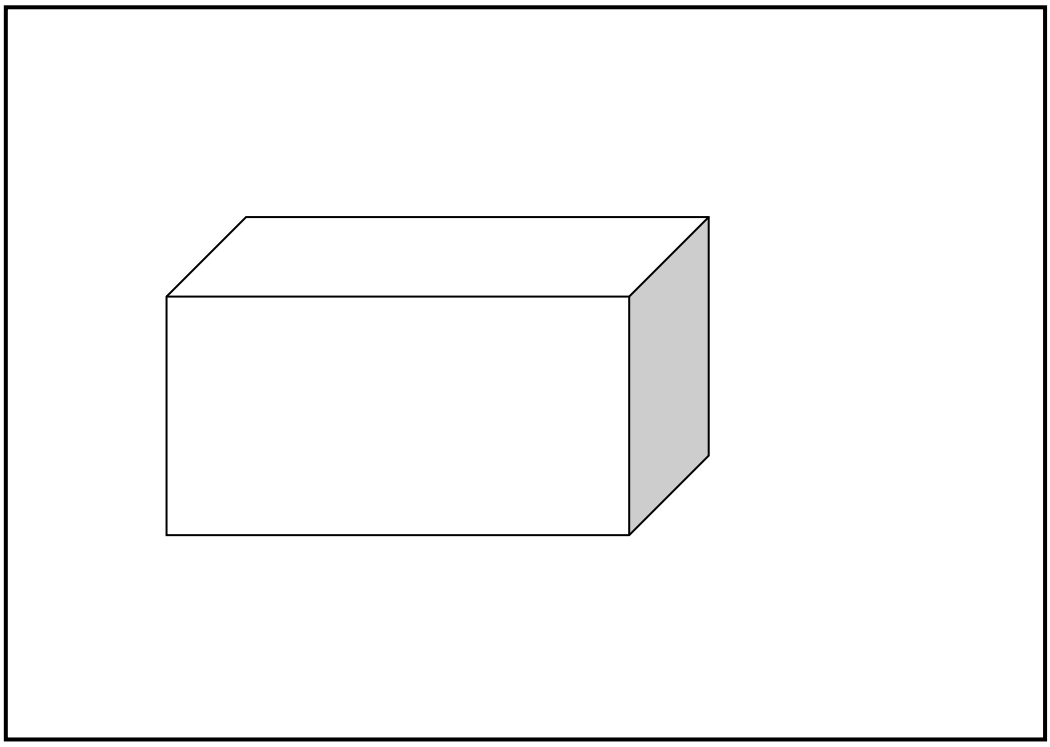


Figure 1: Test set-up in principle for the rooftop

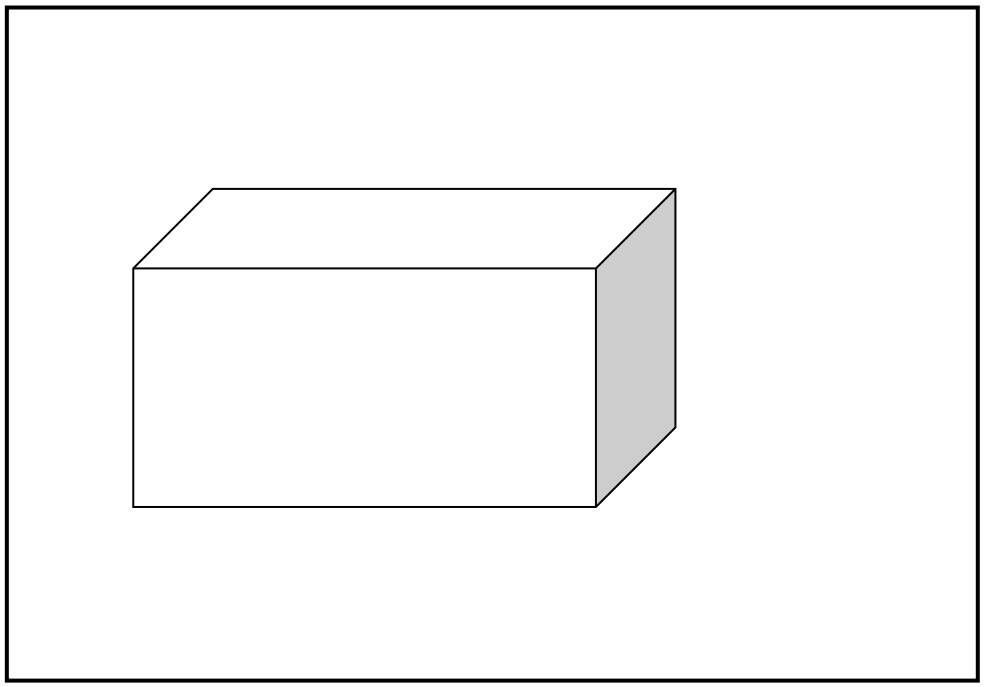


Figure 2: Photos of the unit installation

Comments:

B.II. Measuring Equipment

B.II.1. Measuring Devices

An overall view of the measuring equipment and devices can be seen in Tables 2 and 3.

Table 2: Measuring devices used

Measurements	Measuring device
Temperatures Air Water Dew point temperature	
Barometric pressure Air pressure difference Liquid pressure difference Refrigerant pressure	
Power, voltage, current	
Fan revolutions	
Water flow rate	
Mass	
Duration	

Table 3: Recording of measurements and calculation programs

Data logger	
Calculation and evaluation of performance tests	

B.II.2. Uncertainty of Measurements

The uncertainties of measurements are compared in Table 4 with the allowable uncertainties according to EN 14511:2013.

Table 4: Allowable uncertainties according to EN 14511 and uncertainties of the measuring devices used

Measurement	Max. allowable uncertainty	Uncertainty of the measuring devices used by the testing laboratory
Temperatures (air; water)	0,1 K	K
Wet bulb temperature	0,1 K	K *)
Water flow rate	2 %	%
Barometric pressure	0,1 %	%
Air pressure	1 Pa	Pa
Water pressure	1 %	%
Voltage	0,5 %	%
Current input	0,5 %	%
Power input	1 %	%
Duration	0,2 %	s
Mass	1 %	%
Number of revolutions	---	%

B.III. Test Results

The results of the air flow test are compared in Table 5 with the rated figures.

The results of the cooling test are compared with the rated figures in Tables 6 and 7.

Table 5: Results of air flow test on the indoor coil

		Rated	Measured
Barometric pressure	kPa		
Air inlet temperature:			
- Sensor 1	°C		
- Sensor 2	°C		
- …	°C		
- Mean	**°C**		
Fan revolutions	min^{-1}		
Air mass flow rate [3)]	**kg/s**		
Air density	kg/m^3		
Nominal air flow rate	**m^3/s**		
External static pressure (ESP)	**Pa**		
Requested minimum ESP	**Pa**		
Voltage	V		
Measured fan power input	**kW**		
Fan correction	kW		
Indoor fan power input	**kW**		

[1)] Allowable range acc. to EN 14511:*2013*
[2)] Deviation = $(X_{measured} - X_{rated}) / X_{rated}$
[3)] Rated air flow rate related to ρ_A = 1,2 kg/m³

Comments:

Table 6: Standard rating conditions and test results for cooling

		Rated	Measured		Uncertainty of measurements[3)]
Barometric pressure				kPa	
Inlet	- dry bulb temp.: - Sensor 1 - Sensor 2 - … - **Mean**			°C	
	- dew point temp. - density - specific humidity - specific enthalpy - air flow rate			°C kg/m³ g/kg kJ/kg m³/s	
Outlet	- dry bulb temp. - Sensor 1 - Sensor 2 - … - **Mean**			°C	
	- dew point temp. - density - specific humidity - specific enthalpy			°C kg/m³ g/kg kJ/k	
Air mass flow rate [2)] Dry air mass flow rate				kg/s kg/s	
Condensate flow rate - condensate 1 - condensate 2 **- Mean [1]**				 g/s g/s g/s	
Total capacity Sensible capacity **External Static Pressure** [2)] Fan correction				kW kW Pa kW	

[1)] Deviation = $(X_{measured} - X_{rated}) / X_{rated}$

[2)] Rated air flow rate related to ρ_A = 1,2 kg/m³

[3)] According to ISO/IEC Guide 98-3 “Uncertainty of measurement” (GUM)

Comments:

[1] The weight of the condensate is the reference method. The enthalpy method is used as a confirmation.

Table 7: Standard rating conditions and test results for cooling

		Rated	Measured		Uncertainty of measurements[3)]
Outdoor					
Inlet	- dry bulb temp.: - Sensor 1 - Sensor 2 - … - **Mean**			°C	
	- dew point temp.			°C	
	- density			kg/m³	
	- specific humidity			g/kg	
	- specific enthalpy			kJ/kg	
Outlet	- dry bulb temp.			°C	
External static pressure				Pa	
Air flow rate				m³/s	
Electric Power					
Voltage / Phase / Frequency				V/-/Hz	
Current				A	
Measured Total power input				kW	
Fan correction indoor				kW	
Indoor Fan power input				kW	
Cooling capacity				kW	
Total Power Input				kW	
EER				kW/kW	

[1)] Deviation = $(X_{measured} - X_{rated}) / X_{rated}$

[2)] Rated air flow rate related to ρ_A = 1,2 kg/m³

[3)] According to ISO/IEC Guide 98-3 “Uncertainty of measurement” (GUM)

Comments:

APPENDIX C. TEMPLATE OF ACOUSTIC TEST REPORT

Test Report

Acoustical Measurements on Air-*to-air* / Water-*to-air* Rooftops according to RS 6/C/007

Client Eurovent Certita Certification
48-50 rue de la Victoire,
75009 Paris, France

Order Number

Participant

Product Rooftop Unit
Reference:
Serial No.:

Results

	Sound power level L_{WA} [dB(A)]	
	Specified	Measured
Indoor side (in duct)		
Outdoor side (envelope)		

C.I. Product description

Reference:
Eurovent Certita Certification Classification:
Total Cooling Capacity: (Participant's declaration)
Voltage/Phase/Frequency:

C.II. Test set-up and test procedure

Operating conditions:

Air inlet temperature: °C

Air flow rate: m^3/s (kg/s)

Adjusted pressure: Pa

C.II.1. Indoor side (in duct)

Test method:

Measuring device:

a) <u>Installation</u>

The scheme of the unit installation shall include:

- Distances of the unit to the wall
- Position of sensors (distance between sensor and the units)
- Position of the ductwork

Figure 1: Test set-up in principle for the rooftop

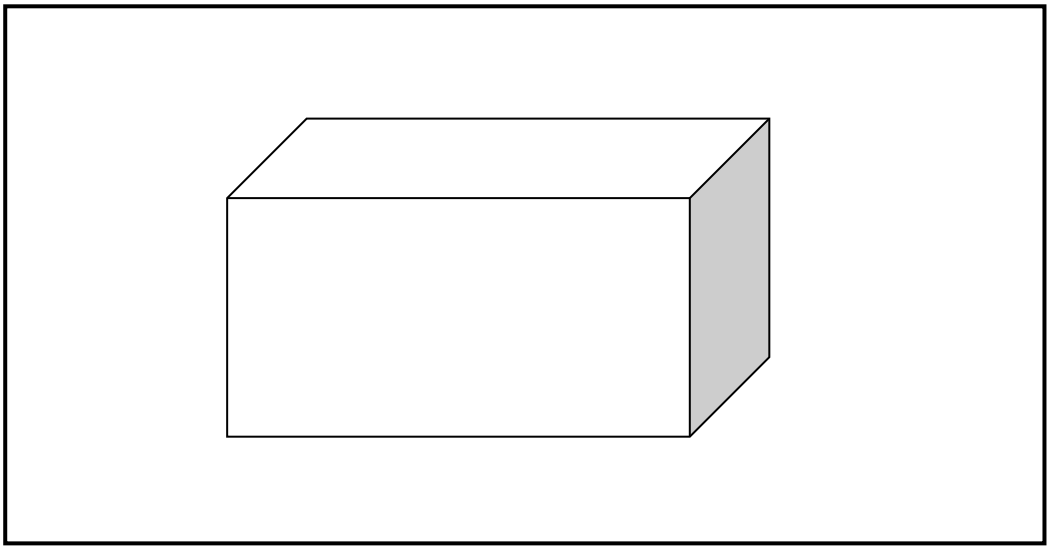


Figure 2: Photos of the unit installation

b) Measuring path

(Comments)

Measuring path:	Scanning the measurement surface in 1 m distance around the duct outlet
Measured values:	Sound intensity level per octave band 125 to 8.000 Hz as mean value over the measurement surface.

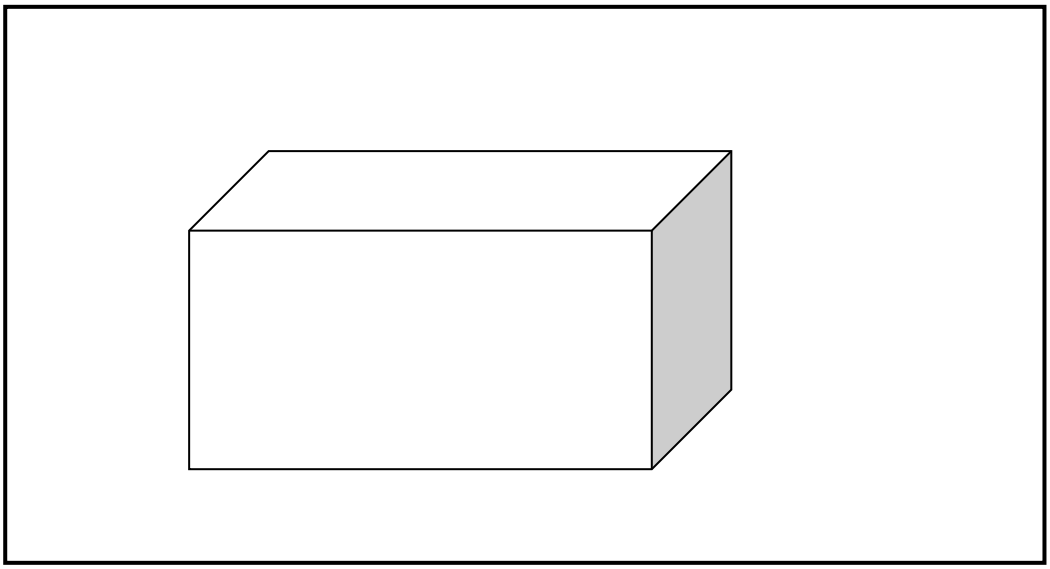


Figure 3: Scheme of the testing path around the unit

c) Background noise

The background noise is given in Figure 4 below (global and by octave band).

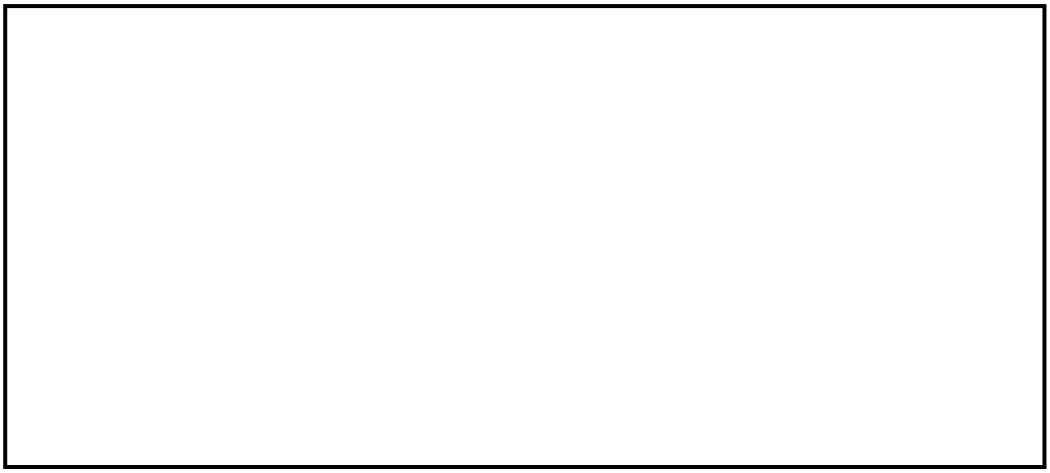


Figure 4: Background noise

C.II.2. Outdoor side (envelope)

(Comments)

C.III. Results

	L_{WA} [dB(A)]	Frequency spectrum	Fan rotation speed [min^{-1}]
Indoor side (in duct)		see Figure	
Outdoor side (envelope)			

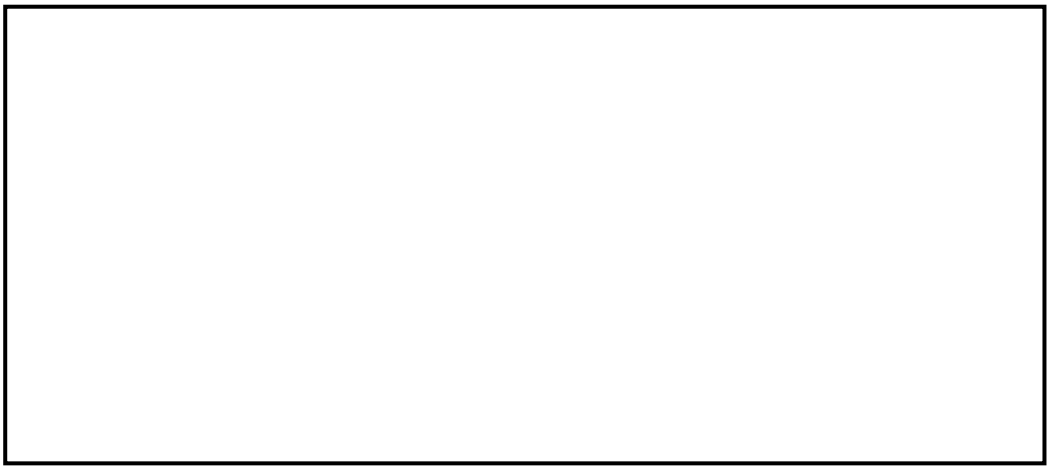


Figure 5: A-weighted sound power spectrum (third octave bands)