TECHNICAL CERTIFICATION RULES OF THE EUROVENT CERTIFIED PERFORMANCE MARK

AIR HANDLING UNITS

Identification: ECP 05

Revision 01-2023 – February
(This version cancels and replaces any previous versions)

Approbation date: 20/02/2023

Comes into effect from: 10/03/2023

The purpose of this Technical Certification Rules is to prescribe procedures for the operation of the Eurovent Certified Performance (ECP) certification programme for Air Handling Unit (AHU), in accordance with the Certification Manual.

Modifications as against last version:

No.	Modifications	Section	Page
1	Removal of Summer Energy efficiency class transition period (now in force)	Appendix G	67
2	New planning for a penalty test	III.4.3	25
3	New requirement to send the feedback regarding the investigations following failure	III.4.3	26
4	Standard conditions precision for the HRS pressure drop	A.2.4	31
5	Specify of the recalculation for fan with adjustable speed	A.3.2	34
6	Clarification of the ESP acceptance criteria for fan with adjustable speed. Modification of the absorbed motor power (fixed and adjustable speed fans)	A.4	35
7	Introduction of the acceptance criteria for the $F_{s\text{-}Pref}$ value	E.1	56
8	Units with integrated heat pump and energy class	E.3.1	57
9	Precision on the displaying of the reference city on the printout	E.3.2	58
10	Introduction of decimal places for performances to calculate the fs-pref value	E.3.2	59
11	Precision of the unit of the temperature for the winter/summer energy efficiency class calculation	F.2 / G.1	60 / 66
12	Precision of the V1 and V2 values for the winter/summer energy efficiency class calculation	F.2 / G.1	60 / 66
13	Removal of the planning for the declaration of a new range manufactured in a non yet ECC audited factory	C.4	50
14	Removal of the planning for the declaration of a new range manufactured in an already ECC audited factory	C.4	50
15	Modification of the $P_{airside\text{-}ref}$ equation (summer/winter)	F.9 / G.9	65 / 79
16	Modification of the $f_{pe\text{-}DewP}$ equation (summer)	G.5.1.3	72
17	Removal of the classification of non-conformities		
18	Editorial update and miscellaneous clarifications	All	All

Published by Eurovent Certita Certification
48-50 rue de la Victoire
75009 Paris, FRANCE

Tel: + 33 1 75 44 71 71
E-mail: d.lambert@eurovent-certification.com

TABLE OF CONTENTS

I. GENERAL INFORMATION

I.1 Scope

I.1.1 General

The programme scope covers Air Handling Units (AHU) which can be selected in a software. Each declared range shall at least present one size with a rated air volume flow below 3 m^3/s. For each declared range, all Real Unit sizes available in the software and up to the maximum stated air flow and all Model Box.

configurations shall be declared.

The following units are specifically excluded from the scope:

- Units with special casing for only one project
- Units without any fans
- Units without ventilation functions
- Units belonging to a range which presents no size with a rated air volume flow below 3 m3/s
- Units with a rated air volume flow below 250 m^3/h
- Units with a rated air volume flow between 250 and 1000 m^3/h and which is exclusively intended for residential applications
- Units including only a fan and a non certified housing or casing (e.g. box fans, roof fans)
- Units which are exclusively specified as operating in a potentially explosive atmosphere as defined in Directive 94/9/EC (ATEX design)
- Units which are exclusively specified as operating for emergency use, for short periods of time,
- Units which are exclusively specified as operating:
  - where operating temperatures of the air being moved exceed 100 °C;
  - where the operating ambient temperature for the motor, if located outside the air stream, driving the fan exceeds 65 °C;
  - where the temperature of the air being moved or the operating ambient temperature for the motor, if located outside the air stream, are lower than – 40 °C;
  - where the supply voltage exceeds 1 000 V AC or 1 500 V DC;
  - in toxic, highly corrosive or flammable environments or in environments with abrasive substances;
- Flat packed units (i.e. not assembled casing and/or CKD (Complete Knocked Down)) unless, due to building limitations the unit cannot enter the buildings designated area in sections and the flat packed unit is being built on site, under the supervision of onsite direct employed personal of the AHU manufacturer.

I.1.2 Optional certification for Hygienic Air Handling Units

As an option of the Certification programme for Air Handling Units, an already certified range can also be certified as “hygienic”.

Dedicated process and specific requirements are described in the *Appendix H*.

I.1.3 Certify all principle

Whenever a company participates in the programme for AHU, all AHU within the scope of the programme and produced in the declared factory must be certified in accordance with these Technical Certification Rules. This rule is applicable for factories worldwide.

If one certified range is produced in different factories, these factories must be declared to ECC and will fall under the scope of the Certify All.

Example: a manufacturer has 3 factories all over the world: A, B and C. Factories A and B are both declared to ECC and C is not. Every ranges produced in A and B must be declared and certified, if C is fully independent and don't produce any ranges produced in A and B then it doesn't need to be declared and no further actions are required for C. However, if C produce one or several range(s) also produced in A and/or B then C must be declared and will fall under the scope of the Certify All, meaning that every ranges produced in C must be declared and certified.

List of exclusion: every unit falling under the list of exclusions below can be excluded from the certify all, the participant can decide to declare or not these units.

- Units with external pressure higher than 2000 Pa
- Units for cooling data centres with evaporative cooling
- Ceiling units with a height less than 0.6m
- Range with units with a heat pump integrated

I.2 Certified performances

I.2.1 Mechanical, thermal and acoustical performance

The following mechanical and acoustical performance in accordance with EN 1886:2007 shall be specified and verified by tests:

- **Casing air leakage (CAL)** class for one Real Unit size
- **Casing strength (CS)** class for one Real Unit size
- **Filter bypass leakage (FBL)** class for one Real Unit size

For each range and factory (except in the case of "sister factories") all variations (marked by a X) and worst cases are mandatory to be tested according to Table 1, and worst-case performances can be transferred from the tested Model Box (MB) to other constructions.

The Casing Air Leakage (CAL) shall be tested according to EN1886:2007, but the positive pressure shall be adapted according to this Technical Certification Rules.

To claim better class on one performance data, another MB with the construction parameter variation must be tested too.

Construction variation	Casing strength	Casing air leakage	Filter bypass leakage	Thermal transmittance	Thermal bridging	Acoustic insulation
Corner post	x	x	x	x	x	x
Mullion	x	x		x	x	x
Filter holding system (N/A in case of pre-filtration only)			x			
Type of access		Doors	Doors			Doors
Panel shape	x	x	x	x	x	x
Panel thickness	the thinnest	the thinnest		the thinnest	the thinnest	the thinnest
Sheet metal thickness	the thinnest			the thickest	the thickest	the thinnest
Insulation material (wool vs foam): - density out of - 25% - conductivity out of + 15%	x (density)			x (conductivity)	x (conductivity)	x (density)
Way of insulation mounting (fixed vs loose)	x					x
Metal sheet of panel (galvanized vs stainless steel)				worst case: galvanized	worst case: galvanized	
External finishing (galvanized vs coated)						
Doors handle, Hinge and /or latch		x		x		x
Gaskets (e.g. on doors, *casing*)		x	x			

Table 1: MB Construction variations

The following mechanical and acoustical performances in accordance with EN 1886:2007 shall be specified and verified by tests:

- **Casing strength class** for each variation of corner post, mullion, panel shape, for each variation of density of the insulation material out of -25 %, for each way of insulation mounting (fixed vs loose), for the thinnest panel and for the thinnest metal sheet.
- **Casing air leakage class** for each variation of corner post, mullion, panel shape, hinge and/or latch, gaskets, and for the thinnest panel.
- **Filter bypass leakage class** for each variation of corner post, filter construction and panel shape and gaskets.
- **Thermal transmittance class** for each variation of corner post, mullion, panel shape, hinge and/or latch, for each variation of conductivity of the insulation material out of +15 %, for galvanized sheet if available, for the thinnest panel and for the thickest metal sheet.
- **Thermal bridging factor class** for each variation of corner post, mullion, panel shape, for each variation of conductivity of the insulation material out of +15 %, for galvanized sheet if available, and for the thinnest panel and for the thickest metal sheet.
- **Acoustical insulation** for each variation of corner post, mullion, panel shape, hinge and/or latch, for each variation of density of the insulation material out of -25 %, for each way of insulation mounting (fixed vs loose), for the thinnest panel and for the thinnest metal sheet.

I.2.2 Other performances

On each Real Unit, the following performances shall be specified and verified by tests:

- **Air flow rate**, external static pressure, power input at 3 conditions + 1 “secret” operating point.
- **Octave band in-duct sound power level**, at the inlet and outlet, with only supply air fan running

- **Airborne sound power level**, only with supply air fan running
- **Heating capacity** at 2 conditions, if standard feature of the range
- **Cooling capacity** at 2 conditions, if standard feature of the range
- **Heat recovery dry efficiency** at one condition, at equal mass flow rates
- Heat recovery pressure drop on both air sides
- For run-around coils, **fluid side pressure drop**, glycol percentage and absorbed motor power of the circulation pump (if pump rated in output)
- **Pressure drop on water side** at two conditions for cooling coil and heating coil
- Calculated Eurovent AHU Energy Efficiency Class (see Appendix D)

I.2.3 Performance items not covered by the programme

The following performances shall not be considered: Filtration efficiency, Humidification, Heating/Cooling by other means than water coils, Sound attenuator characteristics, Vibration level, Hygienic aspects, Weather protection, Mixing efficiency, Drain facilities.

I.3 Definitions

In addition to the definitions specified in the Certification Manual, the following definitions apply:

Air Handling Unit: A factory made encased assembly or flat-packaged unit that consists of a fan or fans and other necessary equipment to perform one or more of the following functions: circulating, filtration, heating, cooling, heat recovery, humidifying, dehumidifying and mixing of air. The unit should be suitable to be used with ductwork.

Range: A family of Air Handling Units of different sizes grouped under the same designation and using the same selection procedure.

Model Box: Construction envelope built according to specifications presented in manufacturer's literature, used to establish mechanical, thermal and acoustical performance according to the relevant EN standards.

Sub-range: Part of a range using the same Model Box(es) and grouped under the same designation.

Real Unit: Unit from the range of a specific size, used to establish complete performance for all the available functions of the Air Handing Unit range, according to the relevant EN standards.

Deflection [mm/m]: The largest deformation of the sides of the unit under pressure, positive or negative, given as a difference in distance from a reference plane outside the unit to the external unit surface with and without test pressure. The deflection, related to the span, defines the casing strength.

Air leakage factor [l.s^{-1}.m^{-2}]: The air leakage in volume per unit of time, related to the external casing area.

Thermal transmittance [W.m^{-2}.K^{-1}]: The heat flow per area and temperature difference through the casing of the air handling unit.

Thermal bridging factor [-]: The ratio between the lowest temperature difference between any point on the external surface and the mean internal air temperature and the mean air-to-air temperature difference.

Filter bypass leakage [%]: Air bypass around filter cells as a percentage of rated air volume flow.

Acoustical insulation [dB]: Sound insertion loss value of the Air Handling Unit.

Heating capacity [kW]: Thermal energy supplied into the air per unit of time.

Cooling capacity [kW]: Thermal energy removed from the air per unit of time.

Heat recovery [%]: Heat transferred from exhaust air into supply air or reverse.

In-duct sound power level [dB]: Sound power level per octave band, radiated in the duct.

Airborne sound power level [dB(A)]: Sound power level radiated through the envelope of the Air Handling Unit.

Critical non-conformity: A non-conformity is classified as critical when based on objective evidence:

- there is a significant risk to the product's conformity to specified requirements, or

- there is a significant risk on management system's ability to control the product's conformity to specified requirements, or
- there is systematic or repeated non-conformity to a specified requirement.

Non-critical non-conformity: A non-conformity is classified as non-critical when based on objective evidence:

- there is no significant risk to the product's conformity to specified requirements, or
- there is no significant risk on management system's ability to control the product's conformity to specified requirements, or
- there is no systematic or repeated non-conformity to a specified requirement.

I.4 Contributors

The lists of contributors are given for information and may be modified by EUROVENT CERTITA CERTIFICATION whenever necessary.

I.4.1 Audit body

The audit functions are performed by the following body(ies), called audit body:

EUROVENT CERTITA CERTIFICATION SAS
48/50 rue de la Victoire
FR- 75009 PARIS
Tel : + 33 1 75 44 71 71
www.eurovent-certification.com

AENOR
Génova, 6
ES- 28004 MADRID

TÜV NORD Systems GMBH & Co. KG
Buildings Testing, Am TÜV 1
DE- 45307 – ESSEN

I.4.2 Independent laboratory / test body

When the checks carried out involve product tests, these are performed at the request of EUROVENT CERTITA CERTIFICATION by the following laboratories, known as Independent laboratory:

TÜV NORD Systems GMBH & Co. KG
Buildings Testing, Am TÜV 1
DE- 45307 – ESSEN

DTI - DANISH TECHNOLOGICAL INSTITUTE
Gregersenvej
DK- 2630, TAASTRUP

TÜV SÜD Industrie Service GmbH
Klima- und Lufttechnik - IS-TAK03-MUC, Geiselbullacherstraße 2
DE- 82140, OLCHING

II. REQUIREMENTS OF THE REFERENCE DOCUMENT

II.1 Reference documents

II.1.1 Product and test standards

The test procedure is detailed in the technical appendix and in the product and test standards.

The applicable standards are as follow (non-exhaustive list):

- EN 1886:2007: “Ventilation for buildings – Air Handling Units – Mechanical performance
- EN 13053:2019: Ventilation for buildings – Air Handling Units – Rating and performance for unit’s components and sections.

II.1.2 Specific technical requirements

II.1.2.1 Software

An English version of the software selection is necessary. Each quotation of a certified AHU shall include the date/code/number of the software version used for the selection of the unit. From the version code-key it shall be possible to check what the latest technical software version is by splitting up the code in more characters. An example of a suitable code is given below:

Version: XY / Z

Z: characters indicating a version serial number, not affecting the selection results

XY: characters to indicate the technical version serial number

The participant is obliged to send the most recent technical software version to Eurovent Certita Certification.

The selection software shall be operative as an entity with all unit components integrated in one software. Components in an AHU that are selected with different software or any other means of selection cannot be certified. The units of the applied range shall be built with components specified in the selection software. If some components not present in the certified software performing a certified performance item are included in the technical specification of a particular order, the following statement shall be provided in the quotation: “This component is not included in the software Eurovent certified”. This statement is not required for components serving for non-certified performance items.

At least four sections must be included: fan, filter, heating and cooling. When a heat recovery section is available, it shall be declared and included in the selected unit for test for certification.

Consistency of the software shall be verified by the auditor appointed by Eurovent Certita Certification. In case inconsistency of the software is observed, failure treatment shall be applied.

Anytime, Eurovent Certita Certification has the right to collect data directly from customer and perform extra checking of software.

Additional requirements for the Hygienic option:

The selection software shall be designed in order to propose the hygienic option as well as the selection of the required level.

According to the level selected the software shall be designed in such a way that it doesn’t allow the selection of non-applicable components (e.g. If level 3 is selected the supply side shall include at least an ePM 1 70% filter) and alert the user if the arrangement of the AHU is not in accordance with the hygienic requirements (e.g. alert the user if the dehumidifier is arranged before filters or silencers).

II.1.2.2 Consistency check of heat recovery

General

In case the selection is performed at a temperature lower than the lowest temperature allowed by a given Heat Recovery System (HRS) software, the comparison check has to be done at the lowest temperature available in the HRS software.

Manufacturer uses Eurovent Certified Performance certified HRS

The software shall always deliver the latest certified performances of the HRS standalone software. Should a new version of the HRS supplier's software get approved by Eurovent Certita Certification, the AHU manufacturer shall update its own selection software within 3 months. *Any discrepancy (as described below) between the dll and the HRS standalone software found after this 3 months period is considered as a critical NC (for any discrepancy between the dll and the software on the certified performances). The dll version and date shall be documented, otherwise it is considered as a critical NC.*

The efficiency and pressure drop data in the AHU quotation or software shall be compared with the results obtained from the current stand-alone certified software from the HRS supplier. AHU manufacturer can never claim higher efficiencies and/or lower pressure drops than the values received from the stand-alone software.

If possible one quotation with a rotor and one quotation with a plate heat exchanger must be checked.

This check only occurs if there is no Real Unit (RU) selection during the audit.

Manufacturer does not use Eurovent Certified Performance certified HRS

Additional testing of non-certified HRS are requested in the laboratory of the regular certification campaign, of the different models, one every year. Surveillance would only be necessary in case of change of the structure of the HRS. When a HRS is tested in the RU one year, this additional testing is not necessary for that year.

Compare the efficiency and pressure drop data in the AHU quotation or software with results obtained from the test result. Deviation shall be equal or lower than the acceptable acceptance criteria defined in the certification programme for the HRS (ECP-08-2020 for Air-to-Air Plates and Tubes Heat Exchangers, ECP-10-2020 for Air-to-Air Regenerative Heat Exchangers). In case a RU is tested every year, this additional testing is not necessary.

For certified and non-certified rotors

Observations of rotor arrangements in the AHUs shall be made during the annual factory inspection. If it appears that (sometimes) parts of the actual heat exchanger surface of the rotor are blanked/obstructed it shall be verified in manufacturer's software if this unfavourable assembly has been considered. The software shall predict (small) reduction in efficiency and (substantial) pressure drop increase, compared to a selection with completely open rotor surface.

II.1.2.3 Consistency check on small and large coils

General

During the factory audit, the auditor will check the consistency of the performances between small and large coils. This check shall only be performed when there is no Real Unit selection.

Should the consistency check not meet the acceptance criteria described in the methodology below, the manufacturer shall be able to explain this deviation. The auditor shall be entitled to finally make the decision.

Heat recovery coils are excluded from this consistency checks.

Methodology

The methodology is described in Appendix D.1.

II.2 Specific requirements and quality management

II.2.1 Ranges produced in several production places

When a manufacturer presents several production places, each place will be considered independently so each factory must be audited every year by the auditor appointed by Eurovent Certita Certification (selection or annual on-site checking). Assembly places shall be considered exactly the same way as manufacturing places.

Regarding the selection of units to be tested, the production places for an identical product – identical software, identical components (designation) and suppliers, same casing (same drawings and

materials), same assembly – must be considered as one collective production place. In that case each time a different production location will be randomly chosen for the selection of the unit to be tested. The different production places are thus called “sister production places”.

In case several manufacturing places have a different ISO 9001 certification status (one is certified and the other is not), the timetables described in Table 2: RU selection for factories with different ISO9001 certification status and Table 3: MB selection for factories with different ISO9001 certification status shall be applied:

Campaign year	ISO9001	Not ISO9001
Y	Selection	AOC
Y+1	AOC	Selection
Y+2	AOC	Selection
Y+3	Selection	AOC
Y+4	AOC	Selection
Y+5	AOC	Selection
Y+6	Selection	AOC
And so on…		

Table 2: RU selection for factories with different ISO9001 certification status

Campaign year	ISO9001	Not ISO9001
Y	Selection	
Y+3		Selection
Y+6	Selection	
Y+9		Selection
Y+12	Selection	

Table 3: MB selection for factories with different ISO9001 certification status

During the annual on-site checking, if there is any suspicion that the production place cannot ensure the same performances as its sister production places, then the auditor may ask that a Real Unit and/or Model Box be tested.

II.2.2 Management of non-certified ranges

When a manufacturer also produces units out of scope, they shall have a significantly different range name from the certified ranges. If the range out of scope can be selected in the same selection tool, it shall be clear that this range is not certified.

For a certified model it is forbidden to provide different performances than the performances given to an identical model (same casing, fans, coils, heat recovery system, filter…) which is not certified.

II.2.3 Special complaint procedure

The general complaint procedure is described in Certification Manual.

In addition, if a Participant obtains doubtful data from a competitor quotation he may present a complaint request. The Participant who complains will pay 1000 € as fee. Eurovent Certita Certification auditor will examine complaint within 6 weeks and complaint data will be also used during annual on-site checking.

If checking results show that the obtained data are different – meaning that other software had been used or quotation data manipulated – this is considered as a non-respect of procedures (see Certification Manual). The 1000 € fee will then be sent back to the plaintiff and it will be invoiced to the Participant who failed.

II.2.4 Brand Name

This covers the case of models submitted by a company presenting on the market units, under its own brand, manufactured by a certified company. When Company A doesn’t produce his own range but distributes under its own brand ranges already certified by Participant B, no additional test is required

for A. Nevertheless, A has to declare to Eurovent Certita Certification a place (“office”) where the orders to the customers can be accessed to and the software can be annually verified by an Eurovent Certita Certification auditor, during the same quarter as the verification of software hold by B. A’s office is often B’s factory. If a range or a production place of B doesn’t fulfil the requirements and B’s certificate is suspended and/or withrdrawed from the programme, A is also automatically suspended. If B quits certification, A is offered the possibility to cover test expenses for B’s products.

The Brand of the A company must be shown on the output.

A is fully responsible of his software and any non-compliance may have a consequence on A certification, even if B is the software provider.

The city(ies) and country(ies) of the production site(s) of company B shall be displayed on Eurovent Certified Performance website next to company A units and on company A certificate.

II.2.5 Traceability

To ensure the traceability of the products each certified product shall be marked to ensure traceability with respect to the plant (e.g. serial number).

II.3 Marking

It is highly recommended that the participating company indicates participation in the EUROVENT CERTIFIED PERFORMANCE (ECP) programme for Air Handling Unit by the following means.

II.3.1 Eurovent Certified performance mark and Energy Efficiency Label

II.3.1.1 Eurovent Certified Performance mark (ECP)

See relevant specifications in Certification Manual.

In addition, the mark shall also include the name of the certified range and the certificate number provided by Eurovent Certita Certification when certification is granted.

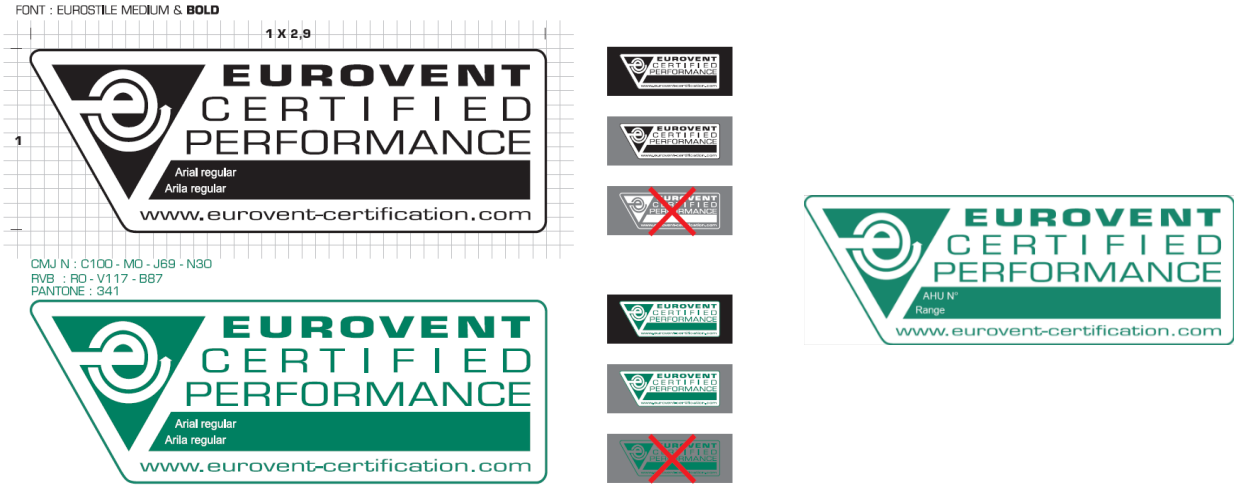


Figure 1: Eurovent Certified Performance mark specifications and Eurovent Certified Performance mark for Air Handling Units

II.3.1.2 Eurovent Certified Performance energy efficiency label

Rules for the use of Eurovent Certified Performance energy label are given in the Certification Manual.

It is not mandatory to use Eurovent Certified Performance energy labels however it is highly recommended to do so. If an energy label is used by the participant, it is mandatory to use the layout described on our website.

High resolution files of these labels, as well as specifications for the layout are available on the website in the manufacturer’s restricted area.

https://www.eurovent-certification.com/en/third-party-certification/certification-programs/ahu-air-handler-unit

For units (eventually on printouts)

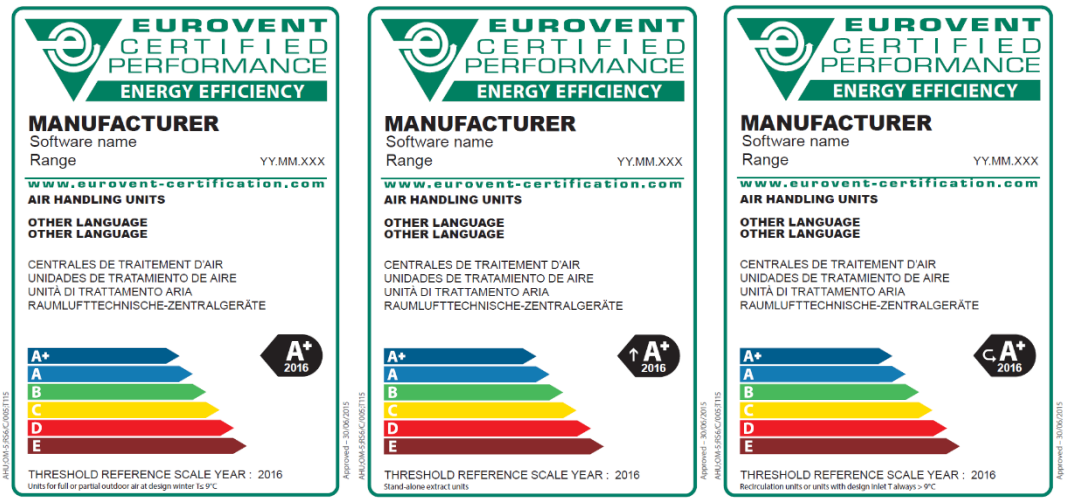


Figure 2: Examples for Eurovent Certified Performance Energy Efficiency Label – for units

For printouts

The label shall be at least 40 mm wide and 40 mm high. The diploma number shall be displayed on the label.

Conditions of use: can only be used in printed/web document:

- if the product shown is certified
- if no other product is shown
- if all certified performances of the product are displayed next to the label (in the same technical specification).

Files can be found on the restricted part of the Eurovent Certified Performance website

https://www.eurovent-certification.com/en/third-party-certification/certification-programs/ahu-air-handler-unit

Figure 3: Eurovent Certified Performance Energy Efficiency Label – for printouts

II.3.2 By Eurovent Certita Certification

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

The following information shall be published for each certified range on the Eurovent Certified Performance website www.eurovent-certification.com:

- Name of Company
- Trade or brand name
- Certificate number (format: YY.MM.NNN)
- Designation(s) of the range
- Software name and version
- List of certified characteristics and performance items
- Designation of certified sizes of the real units

- Heights and widths of the real units
- Designation of certified model boxes
- The certified mechanical, thermal and acoustical performance data of the model boxes: casing strength (deflection) identified with a “(M)”, casing air leakage at -400 Pa and +700 Pa identified with a “(M)”, filter bypass leakage identified with a “(M)”, thermal transmittance, thermal bridging factor and sound level at different frequencies
- Production sites (city, country)

II.3.3 By the Participant

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

II.3.3.1 Display of Eurovent Certified Performance logo on production units

The provisions of the Certification Manual apply.

Each Participant is entitled to display the Eurovent Certified Performance mark on units of ranges which have been certified:

- By using the relevant Eurovent Certified Performance mark
- By application of the relevant Eurovent Certified Performance mark directly on the nameplate
- By using the relevant Eurovent Certified Performance energy efficiency label if applicable. In case the Participant has chosen to display the Eurovent Certified Performance Energy Efficiency label on units, each unit shall be marked, even the one with class E.

II.3.3.2 Display of Eurovent Certified Performance logo on technical documentation

The provisions of the Certification Manual apply.

Participants are obliged to display the Eurovent energy efficiency class on the printouts of certified ranges by the means of class on first page (statement, small or large label). If possible, the graphical energy efficiency label shall be displayed. Otherwise statement shall be: “Eurovent energy efficiency class X (20XX)”. The following shall be applied:

Heat recovery systems: Plate and Rotary Heat Exchangers

Component in Euroventcertified software AHU	Component not in Eurovent certified software AHU but Eurovent certified component	Component not in Eurovent certified software AHU and no Eurovent certified component
AHU energy efficiency label mandatory	AHU energy efficiency label mandatory	AHU energy efficiency label not allowed
Specify at least dry efficiency at equal mass flow and design pressure drops for extract and supply air	Component identification shall be enabled Specify brand and type (product key) of component Specify at least dry efficiency at equal mass flow and design pressure drops	Specify at least dry efficiency at equal mass flow and design pressure drops for extract and supply air

Fan and electric motor

Component in Eurovent certified software AHU	Component not in Eurovent certified software AHU
AHU energy efficiency label mandatory :ify at least all data, required to check the energy efficiency class (as described in “Requirements for quotations / technical specifications”)	AHU energy efficiency label not allowed if fan out AHU energy efficiency label mandatory if motor out only Fan and motor identification shall be enabled Specify brand and type (product key) of components (fan and/or motor) that are not in the certified software Specify at least fan and motor date, required to check energy label: -for the fan: volume flow, fan speed and useful static pressure -for the motor: rated shaft power, synchronic speed, absorbed power

Standard plate and rotary heat exchangers, as well as standard fans and motors shall be obvious in the software and label is mandatory (first column).

In case of a special project and a heat recovery component is not included in the AHU software but ECP certified or covered by II.1.2.2, or if the motor is out only, label is mandatory.

In case of special projects and if displaying the energy label is not allowed (third column), the following statement shall be written instead: “Heat recovery component and/or fan selection beyond certified software does not comply with the Eurovent Certified Performance rules for label designation.”

III. CERTIFICATION PROCESS

III.1 Admission procedure

III.1.1 Declaration of data

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

The Applicant, after signing the Certification Agreement, shall send to EUROVENT CERTITA CERTIFICATION all information required for the qualification: software name and version, the software itself, declaration file and relevant literature.

III.1.1.1 Rated performance data

All characteristics shall be expressed in SI Units as a minimum. The manufacturer is authorized to display data from the selection software in non-SI units as an option.

III.1.1.2 Certification forms

Submittal of certification of models shall be completed and sent to Eurovent Certita Certification as .xlsx files. Copies of these forms are part of this manual (see Appendix B).

Original Equipment Manufacturer (OEM): Form AHU-1A for Real Units and Form AHU-1B for Model Boxes will be used.

Brand Name: For models submitted by a company presenting on the market units, under its own brand, manufactured by a certified company, forms AHU-2A and AHU-2B will be used to identify the corresponding model number of the OEM.

Technical forms: For models selected for test, Forms AHU-3A and AHU-3B must be completed with technical description of all components along with characteristics and performance data.

Evaluation of test result: For models tested, Forms AHU-4A is added to the test report and AHU-4B is sent by Eurovent Certita Certification, showing the deviations between claimed and measured data.

III.1.2 Admissibility of the application

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

After the certification agreement is signed between the company and Eurovent Certita Certification, the qualifying procedure shall be completed.

The company shall first submit to Eurovent Certita Certification the name(s) of the range(s) and complete a list of names and versions of the corresponding selection tools (selection softwares) for verification by an auditor appointed by Eurovent Certita Certification. If the software fulfils all preliminary requirements, the company shall submit to Eurovent Certita Certification the complete list of factories where the range is produced for verification by an auditor appointed by Eurovent Certita Certification. If the software and the factory fulfil all the preliminary requirements, the applicant shall submit to Eurovent Certita Certification the declaration list with all Real Unit (RU) sizes and Model Box (MB) configurations with all the required characteristics and performance data as required by this.

The following number of units per factory producing the range (except the case of “sister factories”, see II.2.1) are then required for test in an independent laboratory selected by Eurovent Certita Certification:

- The minimum number of Model Boxes to cover all worst configurations of the mechanical, thermal and acoustical performance. If several ranges use the same construction, the corresponding unit will be tested only once.
- One complete Air Handing Unit, being one size from the range, for all performance. The Real Unit is selected during the factory audit by the auditor appointed by Eurovent Certita Certification.

For units above the stated air flow rate of 3 m^3/s, the software shall be checked for consistency. If the tests show conformity with Appendix A and consistency is verified, certification is granted until 6 months after next period of annual on-site checking of software.

III.1.2.1 General Procedure

During the application procedure, the auditor appointed by Eurovent Certita Certification shall first verify that the software fulfils minimum requirements (no certification shall be accepted without appropriate selection software). If yes, he shall audit the factory, verify that AHUs are really manufactured there and selected with the software, and send a report of his audit to Eurovent Certita Certification. If the report shows that rules are not followed, the non-confomities (NC) shall be corrected and a NC resolution report shall be issued by the auditor before the application procedure can be resumed.

III.1.2.2 Procedure for Brand Name companies

When a company applies as a Brand Name of an already certified company, the application procedure shall consist in a pre-check of the selection software.

The software shall be a version not already used by the Brand Name manufacturer, but already including the Eurovent Certified Performance mark. The pre-check shall include at least two comparisons between selections made with the OEM's software and the Brand Name company's software.

If the technical requirements are fulfilled and the comparisons show no differences between the calculation results, the applicant can be certified. The certificate will be valid for 6 months following its delivery date.

Once the certification is granted, an audit of the applicant's office shall be carried out no later than 3 months after the delivery of the certificate. Once the result of this audit is passed, the certificate shall be extended to its normal validity date.

III.1.3 Qualifying campaign procedure

For a company ("Brand name") presenting on the market units, under its own brand, manufactured by a certified company, only on-site checking of software shall be conducted at the place ("office") where the customers' orders can be accessed. This place is often the factory of the certified manufacturer.

For manufacturers, Real Units taken from the production line shall be selected by the auditor appointed by Eurovent Certita Certification during a factory audit, using the selection software. Models Boxes will be directly selected by Eurovent Certita Certification from the declaration list, to cover all worst configurations of the mechanical, thermal and acoustical performance.

Selected units shall be sent to the independent laboratory within maximum 6 months. If this deadline is not fulfilled, another on-site checking with selection shall be scheduled within maximum one year from the previous on-site checking.

Units are then tested and the obtained performances compared with the values calculated using the software. The test on the Real Unit of a range can be carried out after the test results on the Model Box(es) is/are available.

Assembly places of flat-package units shall be considered exactly the same way as manufacturing places. When a manufacturer presents several manufacturing places, each place shall be considered independently.

If all the test results are within the acceptance criteria and calculation model appears consistent, Eurovent Certita Certification shall grant the certification. If not, failure treatment shall be applied.

When certified, the range is published on the Eurovent Certified Performance website with a certificate number, associated characteristics and performance, name and version of the last software verified by Eurovent Certita Certification, and production places. The participant is then entitled to use the certification mark for this range in literature and on products. It shall be obvious for which products the certification is granted (see also APPENDIX B and Certification Manual).

Additional requirements for the Hygienic option:

For the hygienic option the manufacturer will have to validate 100% of the requirements listed in the *Appendix H* through a documentation audit and an audit. Additionally, it is required that at least 40% of the requirements be visually checked (on an actual unit, component. model box, etc. and not on a document nor on a software) by the auditor during the factory audit.

For the documentation audit the manufacturer will have to fill the document checklist provided by Eurovent Certita Certification and issue it to Eurovent Certitia Certification. This list will have to be completed carefully and accurately in order to assist Eurovent Certita Certification during its work. The reference of the document as well as the relevant paragraph or the location of the information shall be clearly indicated in this document checklist.

III.1.4 Pre-check of selection software

A pre-check of the selection software must be conducted by the auditor for each applicant. The selection software must meet all the requirements listed in Appendix E. Once passed, the admission audit can be scheduled and carried out.

III.1.5 Initial admission audit

Once the pre-check of the selection software is passed, an initial admission audit including the selection of the Real Unit for testing must be scheduled and carried out.

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

Before each audit the auditor appointed by Eurovent Certita Certification shall collect and study the construction details and claimed performance of the relevant AHU range in order to make a proper selection of suitable unit(s) for testing.

Anytime, Eurovent Certita Certification has the right to ask an auditor to conduct a surprise audit to participants' factory as well as to collect data directly from customer and perform extra checking of software.

During each audit, the appointed auditor shall verify that the factory makes all necessary arrangements for the recording and investigation of complaints regarding certified performances.

During selection audits, a selection of a Real Unit will be performed by the auditor with the technical expert for each declared range via the selection software. The manufacturer will then be asked to build and ship the unit to the allocated independent laboratory.

The entire composition and technical specifications of the selected units shall then be checked onsite. Manufacturer's technical expert shall fully inform the auditor by submitting all relevant assembly drawings, specifications and technical data sheets of the selected units. Agreement shall be reached between manufacturer and the auditor on final selection of Real Unit for testing.

At least one unit shall be verified with the methodologies detailed in the following paragraphs

The following points will be checked during the audit:

Consistency check of heat recovery systems

The auditor will check the consistency of the performance of heat recovery components by comparing the results of the printout with the output of the standalone software of the Heat Recovery System supplier (applicable only in case of certified supplier, for further details refer to section II.1.2.2.)

Consistency check of small and large coils

The auditor will check the consistency of the results between a small and a large coil. Refer to section II.1.2.3.

Pressure drop consistency

The auditor will proceed to a check of the total static pressure of the fans (supply and extract) by doing the sum of every pressure drop of each component section.

Fan acoustic performance consistency check

The auditor will proceed to a check of the acoustic performance of a standalone fan "Alpha" with the acoustic performance of several fans "Alpha" for the same duty point of the single fan. The radiated noise and the sound noise of the opening cannot be the same between the standalone fan Alpha and several fans Alpha.Checking of the face air velocity

The auditor will check that the face air velocity (filter section, or fan section if no filter section) is properly calculated. Cf section A.3.1 for further details.

In case of force majeure (e.g. accidents, labour disputes, natural events, acts of war) which would not allow Eurovent Certita Certification to perform a factory audit Eurovent Certita Certification can decide to replace it by another mean of verification, to postpone it within a reasonable deadline or to cancel it. The Programme Committee will be made informed regarding these cases.

The audit is considered as passed if no Critical non-conformities have been found by the auditor. The following penalties can be applied during the audit:

- Any Non-critical non-conformity identified during an on-site checking will be escalated to Critical non-conformity if not solved prior or during the next follow-up audit.
- Any Critical non-conformity identified during an on-site checking shall be solved within 30 days after the factory audit (or within the deadline defined by the auditor during the audit). Non-resolution of a Critical non-conformity after this deadline can lead to an immediate suspension until the non-compliance is solved.

The classification of non-conformities is performed by the auditor (audit team leader in agreement with the members of the audit team when applicable).

Each certified range shall be allocated of 15 audit points (after first delivery of certificate). Each critical non-conformity related to a range (independently of the manufacturing place), shall remove 2 points to the account of the range. Should the same critical non-conformity be found in two different manufacturing places before the delay for correction has expired, it will not lead to an additional loss of points.

Any critical non-conformity linked to the Participant itself as per the Certification Manual (CM) table 1 Art.193 (refer to CM §3.4 latest version in force) and not to a specific range (including non-conformity to the certify all) will be evaluated according to the table 1 Art.193 of the CM latest version in force.

If a range reaches 0 point, Participant shall be notified for immediate suspension for one year (even if another certified range still have points). The amount of points of each range is reset to 15 once the participant is unsuspended. This modification of the rule will be in force from the 1st of January 2022.

Two consecutive audits without critical non-conformity resets the account to the initial level.

If the same range is produced in different sister factories, 3 additional points per sister factory will be allocated to the range.

Use of components not in the certified software shall remain exceptional. Energy class calculation shall be consistent with the unit delivered to the customer. Eurovent Certita Certification is entitled to ask a manufacturer to include a component in the software if it is observed that this component is used very often.

Handling of several ranges

Case 1: 2 ranges with different names, Range A is certified, Range B is not certified

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
YES	NO	Energy efficiency label for A	ECP mark and Eurovent Energy Efficiency label for B	Range A and B shall have significantly different names.

Case 2: 2 ranges with different names, Range A is certified, Range B is not certified

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
NO	YES	Energy efficiency label for A	ECP mark and Eurovent Energy Efficiency label for B	Range A and B shall have significantly different names. MB shall have different names

Case 3: 2 ranges with different names, Range A is certified, Range B is not certified

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
YES	YES	Energy efficiency label for A	ECP mark and Eurovent Energy Efficiency label for B	Range A and B shall have significantly different names.

Case 4: 2 products A and B from the same Eurovent certified range: they include only components available in the certified software except product B includes a Eurovent certified HRS not included in the certified software.

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
YES except Eurovent certified HRS	YES	Energy efficiency label for A and B		

Case 5: 2 products A and B from the same Eurovent certified range: they include only components available in the certified software except product B includes a non-Eurovent certified HRS not included in the certified software.

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
YES except non-Eurovent certified HRS	YES	Energy efficiency label for A and ECP mark for B	Energy efficiency class and label for B	

Case 6: 2 products A and B from the same Eurovent certified range: they include only components available in the certified software except product B includes a fan (or fans) not included in the software.

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
YES except fan(s)	YES	Energy efficiency label for A and ECP mark for B	Energy efficiency class and label for B	

Case 7: 2 products A and B from the same Eurovent certified range: they include only components available in the certified software except product B includes a motor (or motors) not included in the software.

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
YES except motor(s)	YES	Energy efficiency label for A and B		

Case 8: 2 products A and B from the same Eurovent certified range: they include only components available in the certified software except product B has a mechanical construction not included in the software.

ARE ENERGY COMPONENTS THE SAME?	IS MECHANICAL CONSTRUCTION THE SAME?	MANDATORY	FORBIDDEN	COMMENTS
YES	NO	This case is not allowed as all mechanical constructions for a certified range shall be certified and available in the certified software. Product with non certified mechanical construction shall carry a significantly different range name from the certified range name		

Regarding the Energy Efficiency Label the graphical energy efficiency label shall be displayed. Otherwise the statement: “Eurovent energy efficiency class X”, must be announced. If the graphical energy efficiency label is not used the Eurovent Certified Performance mark shall be displayed

Additional requirements for the Hygienic option:

For the hygienic option a documentation audit will be carried out in a first place to validate the requirements listed in the *Appendix H* (applicable only for the qualifying campaign). Once the documentation audit done the auditor will perform an additional audit (one day long) focused on the quality of the hygienic range. The primary objective of this audit is to visually check the requirements listed in the *Appendix H.* These checking can be completed by an audit of the quality management system:

As stated in the audit rules if no order has been received by the manufacturer for a hygienic product and if the auditor cannot check all the requirements listed in the *Appendix H* the auditor will perform a review of the quality management system to check that:

- The suppliers are regularly evaluated and that the corresponding evaluations are recorded;
- The raw material or incoming goods conformity with the bill of material (BOM) specifications is regularly evaluated and that the corresponding evaluations are recorded;
- The manufacturing process key steps are submitted to a validation check which results are recorded.
- The factory personnel is qualified to perform the specific tasks if any;
- Every product traceability is ensured, it includes the AHU system and its components;
- Calibration of measuring devices is performed on a regular basis; production non-conformities are recorded and corrective actions initiated; customer complaints are registered and treated (OEM and BN).

III.1.6 Selection of units to be tested

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

Regarding **Model Boxes**, Eurovent Certita Certification shall select the minimum number of units to cover the construction variations available on the software and catalogue.

If a model box is partly tested (not on all mechanical characteristics); it shall have the same dimensions as the already tested model box (on other characteristics) from which not tested characteristics will be adapted to declare all claimed model box values.

Selection of one **Real Unit** suitable for testing shall be made during selection audits as described above. Size of the units, air volume performance, heating and cooling capacity, shall be within the limits of the measuring facilities of the laboratory. An up-scaled or down-scaled unit can be selected if no suitable size is available. In case no unit with heat recovery or cooling/heating coils can be provided by the factory, these components and the associated performance shall be non-certified. Because it is a significant parameter for the energy efficiency classification, in case the software proposes heat recovery, then the selected unit shall include heat recovery.

For the sake of the recalculation, and in the case of a release of a new software version before the recalculation, the manufacturer shall keep an archived version of the software on which the selection

has been made for at least 1 year or make sure that every component remains selectable in the new software for 1 year.

III.1.7 Tests at the independent laboratory

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

Before testing, the laboratory shall check the product against the information declared in the technical datasheet to ensure that the unit corresponds to the selection.

The laboratory shall not perform the test and contact EUROVENT CERTITA CERTIFICATION when:

- one of the information is not compliant with the technical datasheet (see technical appendix),
- one of the units appears damaged

EUROVENT CERTITA CERTIFICATION will contact the applicant to give instructions regarding further actions.

III.2 Time limitation of acquisition and recovery of units

The provisions of the Certification Manual apply.

Model Box(es) for test shall be supplied to the laboratory within 6 weeks for factories in Europe and within 8 weeks for factories outside Europe.

Real Unit for test shall be supplied to the laboratory within 10 weeks for factories in Europe and within 14 weeks for factories outside Europe upon receipt of testing notification from Eurovent Certita Certification.

When the manufacturer does not meet the corresponding time limits for the supply of units this will be considered as a non-application of procedures and 3 points are removed from the contract. The manufacturer shall inform the laboratory and the Eurovent Certita Certification team (preferably before the test) if he wants the unit to be scrapped after the test results are available.

III.3 Test conditions

III.3.1 General

Only the independent laboratory personnel shall be permitted to handle test units. The manufacturer's installation and handling instructions shall be followed. The laboratory shall be responsible for uncrating, handling, testing and recrating the unit for shipment. The laboratory personnel shall make repairs to the test unit only in agreement with the manufacturer. No manufacturer's personnel shall be present in the test facility during the test.

III.3.2 Test conditions

The units shall be tested at the conditions as stated in Appendix A.

Thermal tests will be performed at 2 conditions in the heating mode and 2 conditions in the cooling mode (one condition at manufacturer’s rated design and one condition selected by Eurovent Certita Certification within the scope of the selection software). Independent laboratory shall test units at the conditions as close as possible to the selected rating conditions.

Aerodynamic tests (air flow - pressure - power input) shall be performed in accordance with the test standard ISO 5801:2007, in an operating range of +/-5% around the selected rating point.

Testing for heat recovery shall be carried out with at least 20 K difference, under dry conditions (supply air temperature should not be below +5°C).

Low frequencies shall be corrected according to *EN 13053:2019* duct end corrections.

III.3.3 Test report and tests results

For each unit, upon completion of all the measurements, the laboratory will render a test report (pdf) to Eurovent Certita Certification with tested data compared to original selection data. If at least one performance measurement is out of the acceptance criteria, the client manager shall conduct a “test check”, i.e. the selection software will be used to recalculate the performance at conditions used for test: test data will be compared to recalculation data. Eurovent Certita Certification will transmit a copy of the report together with results of test check (Forms AHU-4, see Appendix B).

Manufacturer must collect its products one month after receiving the test report. After this delay, the laboratory will destroy the units if not collected and the manufacturer will be invoiced through Eurovent Certita Certification.

If the results are out of the allowable acceptance criteria, or the calculation model appears inconsistent, failure treatment shall be applied.

III.4 Failure treatment

The tests shall be conducted at the conditions stated in Appendix A.

When a unit fails to comply with the requirements of the Appendix A, failure treatment shall be applied.

For each test, a performance item fails when the difference between the declared value and the measurement is not within the allowable acceptance criteria (see Appendix A). A test fails when one or more performance(s) fail. In case of failure, Eurovent Certita Certification shall promptly notify the applicant/participant. The applicant/participant shall examine the reason(s) of the failure.

III.4.1 Initial test failure

Is considered as an initial test failure any situation where:

- the unit to be tested cannot be operated, or
- any functional component of the unit to be tested is out of order
- the unit to be tested, or any of its components is damaged, e.g. due to transportation.

In case of an initial test failure the unit may be repaired (under the responsibility of the manufacturer) or replaced by a new one of the same model within 4 weeks, which shall be tested then, according to normal schedule of the laboratory.

If, in the course of testing the unit, the whole testing programme cannot be implemented because the specified testing conditions cannot be reached, then the test will be considered as failed and manufacturer has to restart the test procedure. In this case the applicant/participant shall examine the reasons of the failure.

III.4.2 Unit failure on a real unit

If the failure is established after the recalculation, the manufacturer shall rerate his data by adapting the software to the test results within 6 weeks. If the software is then in accordance with all measurements, certification is granted or renewed with the re-rated data.

After reverification (“test recheck”), if the software is still not in accordance with the test results, manufacturer will have two additional weeks for final adjustment of the software. In case of new failure, no adjustment of software will be accepted, and manufacturer must restart the test procedure.

For the following performances failures will be recorded as high failures and will lead to penalty tests:

- Heat recovery efficiency
- Heat recovery pressure drop (supply and/or exhaust)
- Available ESP (fan)
- Absorbed powed (fan)

Thresholds of deviation leading to a high failure can be found in Appendix A.

In case of two repetitive high failures (i.e. a high failure on surveillance test followed by a high failure on the associated penalty test), the Participant is immediately suspended for a period of 2 years. A new Real Unit selection will follow straight after the unsuspension of the Participant and the 3 years cycle of surveillance will restart from this Real Unit test.

III.4.3 Penalty test

In case of high failure on one of the following performances: Heat recovery Efficiency, Heat recovery pressure drop (supply and/or exhaust), Available ESP (fan) or absorbed power (fan) a penalty test will be added *and shall be done during the current* campaign of the participant, *the selection shall be done within one month after the treatment of the test (it could be done remotely)*.

The penalty test will consist of a full test except for acoustics and coils performances.

The participant shall inform ECC on the feedback regarding the investigations following high failure result with the sharing of a detailed report (with reasons of the high failures and actions taken).

III.4.4 Leakage classes reached during RU tests

In case of failure on RU tests not reaching any Filter By-pass Leakage (FBL) class or not in accordance with the highest filter class of the filters installed in the RU[1], it is considered as Initial test failure (immediate stop of the test) and complete retest is mandatory. In case retest is failed, manufacturer is suspended from the programme for 1 campaign.

In case of failure on RU tests not reaching any Casing Air Leakage (CAL) class, it is considered as Initial test failure (immediate stop of the test) and complete retest is mandatory. In case retest is failed, manufacturer is suspended from the programme for 1 campaign.

III.4.5 Test results on a Model Box

Manufacturer has four weeks after reception of result to select one of the following alternatives:

- Accept measured values. (Uprate is allowed.)
- Ask for a second test on the same unit. In this case, the manufacturer can choose to re-test only the performances which are not accepted
- Ask for a second test on another unit of the same model selected by Eurovent Certita Certification. In this case the delivery shall be done within 8 weeks from the date of the test report and all measurements are to be re-tested.

III.4.6 Failure in case of multiple production places

When a range is tested for different production places, if one surveillance test fails, all production places will have to re-rate their data and the software shall be re-rated according to the worst test results for each performance item.

III.4.7 Irregularities in production places

Irregularities found in a factory can be a reason for retesting or suspension of certification of the factory or the complete range. In case several factories produce the same range, if one factory is suspended, the Participant has one year to align it. After this delay, if the factory is still not in accordance with the requirements, the complete range is suspended from certification for one year.

III.5 Surveillance procedure

The provisions of the Certification Manual apply.

For mechanical, thermal and acoustical testing, Model Boxes shall be tested every six years for ISO 9001 certified factories, every three years otherwise. For performance testing, a Real Unit from recent regular production shall be tested, every three years for ISO 9001 certified factories, every year otherwise. If several factories produce exactly the same range with the same components, suppliers and methods, one unit is sufficient instead of one per factory. In addition, annual onsite checking of software shall be carried out every year. When the surveillance procedure is passed certification is renewed for another campaign.

III.5.1 Implementation of surveillance operations

For manufacturers, Participant's quality control shall be appropriate to maintain the performance within the acceptance criteria. A quality system according to ISO 9001 (covering the production quality systems) is acknowledged by a reduction in the frequency of surveillance tests. The manufacturer shall then annually provide a valid ISO 9001 certificate to Eurovent Certita Certification. In addition, annual on-site checking shall be performed in each Participant's factory(ies). Assembly places of units shall be considered the same way as manufacturing places.

Additional requirements for the Hygienic option:

Every participant will have to re-validate 100% of the requirements listed in the *Appendix H* (RS) for a period of 3 years through annual audits. The audit consists of visual checking of the unit/components available during the audit of the factory, review of the software and technical documents with the manufacturer.

During an annual audit (except the last year of a cycle) if some requirements haven't been validated this will be postponed for the following year, the validation of the remaining requirements will be the priority of the auditor.

If a manufacturer didn't receive any order for a hygienic unit and it is not possible to validate any of the requirements listed in the *Appendix H* for 1 year then the follow-up audit won't be focused on the checking of the requirements listed in the *Appendix H* but on the capability of the manufacturer to produce units in accordance with the requirements specified in the Appendix H.

After 3 years and if all the requirements have been validated a new cycle of 3 years will restart.

If after 3 years a manufacturer still didn't receive any order for a hygienic unit and cannot validate the requirements listed in the *Appendix H* then the Hygienic option will be suspended from the certificate. In order to be granted again for the Hygienic option the admission process must be done again.

If after 3 years it is not possible to validate 100% of the requirements listed in the *Appendix H*, the Hygienic option is suspended from the certificate. In order to be granted again for the Hygienic option the admission process must be done again.

In case of modification of the design of a declared range and if this modification has an impact on the quality and more specifically on one of the requirements listed in the *Appendix H*, the manufacturer shall inform Eurovent Certita Certification. The manufacturer will be asked to issue the relevant documents, and this will be followed by a documentation audit of the modification and a checking of the requirements impacted by the new design.

An additional cost for the documentation audit will be applied based on the nature of the modification.

III.5.2 Surveillance audit

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

The audit process detailed in the initial audit section (cf. III.1.5) is applicable for the surveillance audit.

During annual on-site checking of software, the same procedure than the initial audit (cf. III.1.5) shall be applied, without selection of unit for testing so without the restrictions for measuring facilities. This implies that any size may be selected. No precheck of the selection software must be performed before the surveillance audit.

The expected performance shall be recalculated based on components reselected with the software provided to Eurovent Certita Certification. The composition and technical specifications and performance from recalculation shall be the same as the one specified and announced to the customer. If in the meantime the Participant has officially launched a new software version and recalculation is made with this version, deviations should be traceable in the software update record sheet. Deviations on performance above acceptance criteria can lead to additional test. If it appears that different software had been used, this shall be considered as a non-application of procedures (see relevant chapter in Certification Manual).

In addition, mechanical construction (all the parameters) of one production unit shall be verified by the auditor, to compare certified characteristics of production with the tested Model Box(es). If it appears that different construction had been used, additional Model Box test shall be required by the auditor.

Specificity of the check software in case of sister factory:

In case of sister factories, the Participant has the possibility on request to perform only one software check per range and per year remotely. If so, then only the re-selection of **at least one project** per range will be done during the audit on site. The HRS consistency check, the energy efficiency class check, the checking of the information to be found on the printout and the coil consistency check will not be done during the audit on site.

The following check will be performed during the remote software check once a year on one or several random selection(s):

- HRS consistency (of all HRS supplier, for plate and rotary only)
- Energy efficiency class
- Coil consistency check (of all coil supplier)
- Information to be found on the printout.

The onsite audit of each sister factory is then reduced to a 5h work (7h in case of RU selection).
The remote software check (valid for all the sister factories) consists of a minimum 4h work (for one HRS supplier and one coil supplier) + 1 additional hour per additional HRS and Coil supplier.

In case of additional range during the onsite audit, 2 additional hours will be performed (instead of 4h).

III.5.2.1 Selection of units to be tested

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

Eurovent Certita Certification shall select one (1) unit per range for testing. If possible, a configuration different from that previously tested shall be selected, with a different Heat Recovery System from one year to another for example.

III.5.2.2 Surveillance tests

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

Every year, upon receipt of the audit's notification, the participant shall submit to Eurovent Certita Certification an updated version of its declaration list with all the required characteristics and performance data as required by this TCR.

For each certified range and factory, surveillance tests in the independent laboratory selected by Eurovent Certita Certification shall be required:

- Every six years for mechanical, thermal and acoustical performance on Model Boxes for participants holding valid ISO 9001 (every three years otherwise)
- Every three years for performance on Real Unit for participants holding valid ISO 9001 (every year otherwise)

Eurovent Certita Certification shall select the units for surveillance using the same procedure as for selection of units for the admission test. If possible, a RU size different from those previously tested shall be selected.

The certification is renewed for another period once all audits are passed, all tests are ordered, and the previous campaign is finished.

For a company ("Brand name") presenting on the market units, under its own brand, manufactured by a certified company, only on-site checking of software shall be conducted annually at the place ("office") where the customers' orders can be accessed.

III.6 Declaration of modifications

The provisions of the Certification Manual apply.

III.6.1 Changes concerning the certified range

The Participant shall inform Eurovent Certita Certification and the auditor of any modification to the range and/or software, using Form AHU-4C. A new software version without impact on performance does not have to be sent. If new components (fans, coils etc) are implemented in standard production, manufacturer shall inform Eurovent Certita Certification and provide new software to the auditor. For next test new components shall be selected.

Non-compliance is considered as a non-respect of procedures.

Anytime, Eurovent Certita Certification has the right to perform extra checking of software. Eurovent Certita Certification decides whether the modification is significant for the certified performance data or not. In the case of significant modifications Eurovent Certita Certification is entitled to demand adequate tests to verify the influence on performance data. This test shall not be considered as a surveillance one.

Ranges to be taken out of production

Running a test on a unit from a range/model (Real Unit or Model Box) which is going to disappear from the market can represent a useless cost for the Participants. If a test is necessary on a unit from a range/model (Real Unit or Model Box) which is going to disappear from the market, the Participant may send an official letter to Eurovent Certita Certification stating that the range/model (Real Unit or Model Box) will disappear between the date of the scheduled test and the date + one year. The range/model (Real Unit or Model Box) remains then certified for maximum one year. If the Participant changes his mind or if it appears that the range is still available after that time, it is considered as a major breach of the rules, and the Participant will have to pay a penalty fee of 15 000 €. In addition, the unit will have to be tested and the following test will have to follow normal schedule.

If the concerned range or model has been already selected for the sake of a surveillance campaign this process cannot be applied in accordance with the Certification Manual (latest version in force).

III.6.2 Changes concerning the certified product

In addition to the provisions laid down in the Certification Manual, the following requirements apply:

The applicant/participant shall inform Eurovent Certita Certification of any modification of the product portfolio by updating the declaration file (AHU-1) and sending the updated selection software together with the software update record sheet AHU-4C. Non-compliance of the applicant/participant is considered as non-application of procedures (see § III.2.1.1.).

EUROVENT CERTITA CERTIFICATION decides whether the modification is significant for the certified performance data or not. In the case of significant modifications EUROVENT CERTITA CERTIFICATION is entitled to request adequate tests to check the influence on performance data. This test shall not be considered as a surveillance one.

III.7 Suspension/cessation conditions

The general consequences of non-application of procedures are described in Certification Manual. In complement applied penalties can be:

- A certified range and/or production place is withdrawn from the Eurovent Certified Performance website for one year.
- At the end of the first penalty year and after a second checking, if failure occurs again, the certified range and/or production place is withdrawn from the Eurovent Certified Performance website for three years.

The level of penalties and the list of critical and non-critical non-conformities are listed in Appendix A.

APPENDIX A. TECHNICAL APPENDIXES

A.1 Purpose

The purpose of this Technical appendixes is to establish definitions and specifications for testing and rating of Air Handling Units for the related Eurovent Certified Performance Programme, in accordance with this Technical Certification Rules.

A.2 Testing requirements

A.2.1 Volume – pressure performance

For volume pressure performance, the laboratory sets airflow as a constant value, measures External Static Pressure (ESP), and rates Available Static Pressure (ASP).

A.2.2 Air flow rate – pressure – fan power input

Air flow rate, pressure and fan power input shall be established for three points on supply and one point on exhaust in the range of normal operation of the unit. Both the supply air side and the exhaust air side shall be measured (independently) and certified.

All pressure drops measured during the airflow test shall be converted at standard condition (1.2kg/m^3) in the test report.

During the test on both supply and exhaust side, only the tested air path should be open, and the other air path should be closed.

In case of fans with adjustable speed, the airflow and the ESP shall be set by adjusting the fan speed and the power consumption, sound power and ΔP of all components shall be measured.

In case of fans without adjustable speed, the airflow and the RPM shall be set and the power consumption, the ESP, sound power and ΔP of all components shall be measured.

The following procedure must be followed in case of a fan with adjustable speed for the 4 testing conditions (3 conditions for the supply and 1 condition for the exhaust):

1. Set air flow at nominal airflow by adjusting fan speed and measure clean filter pressure drop (PD). The Clean measured pressure drop should then be converted to standard conditions (1.2kg/m^3).
2. Determine the corrected design pressure drop (PD) using the following formula:

$$\text{Corrected Design PD} = \frac{\text{Declared Final PD} + \text{Measured Clean PD}^2}{2}$$

3. Determine the ESP_{test} by applying the following formula:

$$\text{ESPtest} = \text{Declared ESP} + (\text{Corrected Design PD} - \text{Measured Clean PD})$$

4. Set air flow to nominal airflow and ESP to ESP_{test} by adjusting fan speed and damper
    a. Once airflow and ESP_{test} are successfully set to desired values, the test is passed if the measured power consumption is within the acceptance criteria.
    b. If the fan reached its maximum speed the following conclusion must be made based on the situation of the nominal airflow and the ESP_{test}:
        i. The nominal airflow is reached but the ESP_{test} *cannot be reached*, then a correction of the air flow from the Technical Data Sheet and the maximum ESP that the unit can sustained will be requested to the Participant/Applicant. In that case the test is **not** considered as an initial test failure (cf section III.4.1 apply)

[2] *Converted at standard conditions*

ii. The nominal air flow cannot be reached, and the ESP is so low that the airflow cannot be increased, then the test is considered as an initial test failure and the procedure described under section *III.4.1 apply*.

A.2.3 Heating and cooling capacity

Thermal test shall be performed at two conditions in cooling and in heating:

- design conditions corresponding to values used to select the unit for test,
- slightly different conditions selected by Eurovent Certita Certification.

These conditions shall be chosen in the normal operating range of the unit selected for test. The corresponding performance characteristics shall be calculated using the same manufacturer's software.

Typical design thermal conditions shall be:

- for cooling:
  - air inlet temperature 27°C
  - air inlet humidity 47 % r.h.
  - water inlet temperature 7°C
- for heating:
  - air inlet temperature 10°C
  - water inlet temperature 60°C

The test shall be performed at the specified water flow rate and the specified air flow rate (by adjusting the ESP).

A.2.4 Heat recovery

Testing for heat recovery shall be carried out with at least 20 K difference, only one measuring point will be performed.

The pressure drop value will be transposed at standard conditions according to the following formula:

$$\Delta p_{standard} = \Delta p_{real} * \rho_{real} / \rho_{standard}$$

Where:

- *$\Delta p_{standard}$: HRS Pressure drop at standard condition.*
- *Δp_{real}: HRS Pressure drop at real condition (measured during the test).*
- *ρ_{real}: Real density (used during the test) measured / calculated before the heat exchanger (so inlet).*
- *$\rho_{standard}$: Standard density at 1,2 kg/m³.*

The following systems could be tested:

(1) Run-around coil system

Testing can be done on the complete system or on the coils only.

Test on the complete system

Coils and fluid circulating system should preferably be delivered ready for use with the air handling unit. Otherwise it will be completed in the laboratory by the manufacturer. Frequency of the pump shall be pre-set by the manufacturer but can be adjusted by the laboratory when provided by the manufacturer. Absorbed motor power of the circulation pump shall be measured if the pump is rated in the software output. Fluid side pressure drop and glycol percentage shall be measured. Tolerance on glycol content is +/-3%-points (in volume).

Test of the coils only

If the software doesn't allow selecting a system with 25% glycol, selection and test shall be done with water only. Otherwise, the unit shall be selected and tested with 25% (volume) ethylene glycol.

- Identical coils

If the coils on both air sides have the same geometry only one coil is tested at the declared inlet fluid temperature and the declared fluid mass flow rate. The measured capacity will be transposed to the other air side in order to calculate the outlet temperature.

If the configuration of fans and coils are different on the supply and the exhaust side, then the coil being installed downstream to the fan has to be tested (worst configuration for a uniform air flow across the coil).

- Different coils

In case the coils have different geometry (e.g. different fin spaces) both coils have to be tested.

(2) Rotary heat exchanger system

(3) Plate heat exchanger system.

A.2.5 Sound power level

(1) In duct sound power level

The test for determination of the in duct sound power level will be performed with free inlet and a duct with (at least) the length of one equivalent diameter at the inlet and at the outlet. The outlet shall terminate flush with the wall surface.

The method of measurement will be selected according to the possibilities of the test laboratory:

- by free field method in the inlet and outlet plane of the duct,
- by sound intensity method in the inlet and outlet plane of the duct,
- by the reverberation room method installing the inlet and outlet duct through the wall of a reverberation room.

The acoustic test will be performed with the specified air flow rate and fan speed at ambient conditions.

Corrections for end reflection will be made in accordance with the relevant Standards (see below A.3.6).

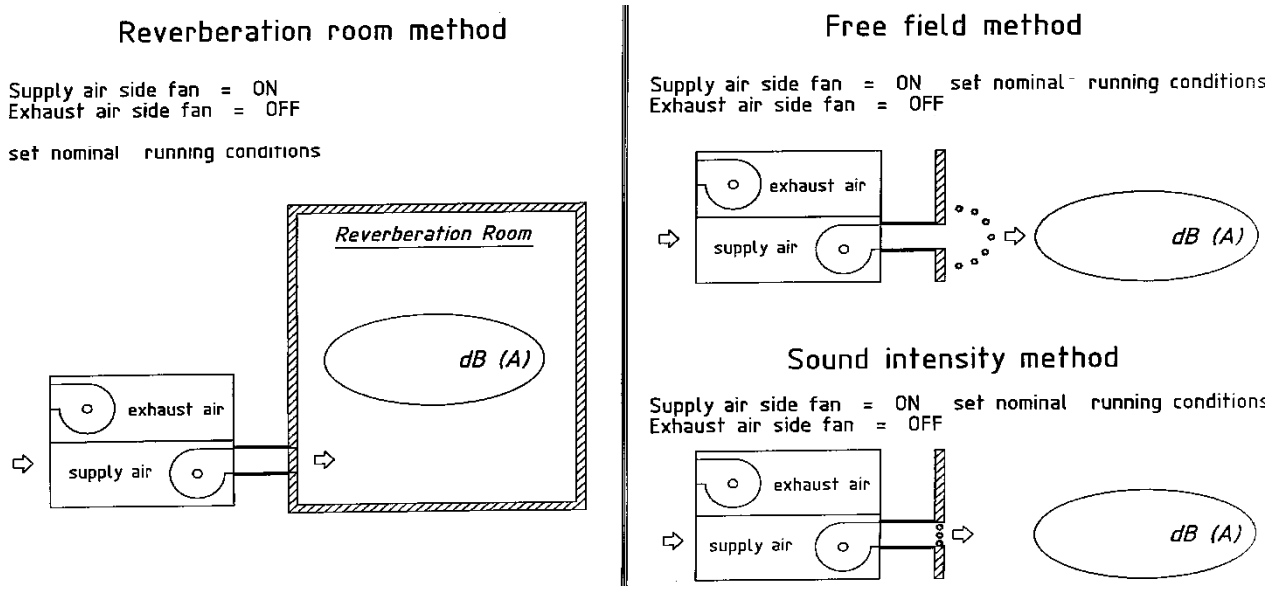


Figure 4: In duct sound power level measurement

(2) Airborne sound power level

The airborne sound power level will be measured with ducted inlet and ducted outlet.

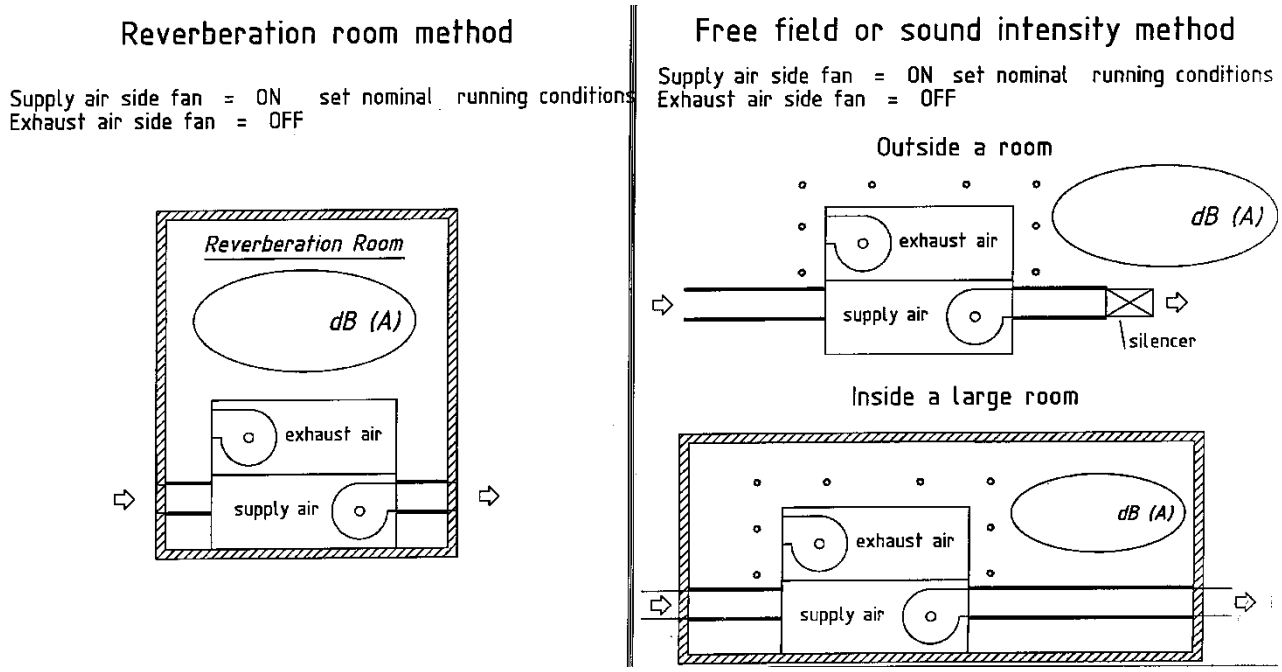


Figure 5: Airborne sound power level measurement

A.2.6 Check of insulation material

After a test on a standard MB according to EN 1886:2007, the laboratory shall drill a hole from the outside, take a picture and identify the insulation material.

A.2.7 Mechanical performances

In case the biggest size of a range has lower dimensions than the minimum dimensions required in EN 1886:2007 then the biggest size shall be tested with the conditions given in EN 1886:2007. All other requirements given in EN 1886:2007 shall be fulfilled.

The casing air leakage (CAL) shall be measured according to the EN 1886:2007 at -400Pa, +400Pa and +700Pa. The CAL shall then be calculated at +700 Pa using the formula (2) of the EN 1886:2007 using the measured value at +400Pa as input parameter.

CAL at -400Pa +400Pa must be reported in the report as well as the CAL at +700Pa calculated with the formula (2) but for information only.

A.3 Rating requirements

A.3.1 Air velocity in the AHU

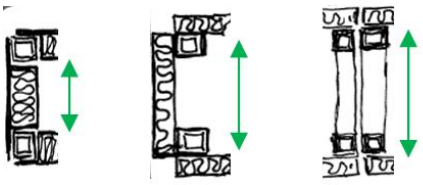


Figure 6: Several construction possibilities

Whatever the configuration of the mechanical construction, the cross-section to be used for the calculation of the air velocity is the distance between the panels of the section (filter section, or fan section if no filter section).

A.3.2 Fan pressure and absorbed power

Recalculation after update of software for fan external static pressure and absorbed power shall be based on nominal air flow and measured fan speed *for fixed speed fans or on nominal air flow and external static pressure for variable speed fans.*

All three dry duty points shall be recalculated and evaluated. The three dry duty points must be within the acceptance criteria. This is also applicable for the secret airflow point if used during the second recalculation.

The recalculation and evaluation procedure will be as follows *for fixed speed fans:*

- Reselect the real unit on measured fan speed and measured volume flow rate. The measured fan speed can be attained by changing the external static pressure until the displayed selection value is equal to the measured value.
- Compare the external static pressure in the selection with the measured external static pressure, (corrected for clean filter pressure drop). The available static pressure obtained from the reselection shall be within the acceptance criteria (≥ -4% or ≥ -15 Pa).
- Compare the measured power input with the power input obtained from the reselection. The measured value shall be within the allowable deviation (not higher than 3% of selection value).

The recalculation and evaluation procedure will be as follows for variable speed fans:

- *Reselect the real unit using the measured airflow and record the filter pressure drops (clean and design)*
- *Calculate the correction to apply to the external static pressure (to consider the clean filter installed in the real unit Vs design declaration from the software) as follow:*

ΔpCorrection= Δpdesign filter – Clean measured filter pressure drop

Δpdesign filter = Applied Design Filter(s) pressure drop + (Clean measured pressure drop – Clean applied pressure drop)/2

"Applied" means the value the software declares during the recalculation with measured airflow.

- *The corrected external static pressure shall then be used as the second input together with measured airflow.*
- *Compare the measured power input with the power input obtained from the reselection. The measured value shall be within the allowable deviation.*
- *There is no tolerance on the fan revolution.*

In case of a second recalculation the "secret" air flow point shall be recalculated and evaluated as defined above.

Secret air flow operating point: this point shall be in the range of the fan and will not be selected during the audit. It will be tested following the same process than the other points but will be used only in the case of a second recalculation of the unit.

The aim of this secret operating point is to ensure that the applicant/participant do not only modify its software for the selected and tested points but for the complete working range of the fan.

The secret air flow point will be selected by the laboratory and can be selected anywhere along the fan curve.

A.3.3 Recalculation on sound power levels

Recalculation after software update for sound power level shall be based on air flow and measured rpm.

A.3.4 Heating and cooling coils

Recalculation of coils shall be based on measured performance using test inlet conditions (mass flows air and water; inlet temperatures air and water).

A.3.5 Heat recovery

Consistency between DLL and stand-alone software shall be checked by the auditor during the Annual Onsite Checking. The manufacturer software shall not give better performances than the HRS supplier's stand-alone software. There shall be one digit after the decimal when displaying the heat recovery efficiency in the AHU selection software.

A.3.6 Sound power levels in unit openings - impact of end reflection

Low frequencies shall be corrected according to EN *13053:2019* duct end corrections.

A.3.7 Air density

Standard air density is set at 1.2 kg/m^3. If in printouts standard density is not used, then the actual density shall be stated and present in the printouts.

A.3.8 Management of filter holding system for pre-filtration

Should a certain type of filter holding system be used only for pre-filtration (ISO Coarse filters only), and always together with a second stage with a better FBL class, then the filter bypass leakage on the supply side of this option should not be displayed on the website. The auditor shall check that the software does not allow any fine filtration with this option, nor the unit to be calculated without a second filtration stage

A.4 Acceptance criteria

When tested in the laboratory the obtained performance data shall not be different than the acceptance criteria defined in the table below:

Performance	***Acceptance criteria***	***High Deviation***
Available External Static Pressure *(only for fixed speed fans)*	*Max. of* -4% or -15Pa	*Max. of* -25% *or -39Pa*
Absorbed motor power *(fixed speed fans)*	+3%	+15%
Absorbed motor power *(variable speed fans)*	*+6%*	*+18%*
Heat recovery efficiency	-3%-points	-6%
Heat recovery pressure drop (air side)	Max. of +10% or +15Pa	+26%
Water coil performances (heating/cooling)	-2%	
Water coil pressure drop (water side)	Max. of +10% or +2kPa	
Radiated sound power level casing	+3 db(A)	
Sound power level unit openings	+5 dB @125Hz5Hz +3 dB @ 250-8000Hz	
Run-around coils, fluid side pressure drop for each coil	Max. of +10% or +2kPa	
Absorbed motor power of circulation pump	+15%	
Casing Air Leakage	Same class or higher	

If lower performance is found than claimed on the unit (Real Unit or Model Box) tested, all other sizes or constructions not yet tested shall be re-rated in accordance with test measurements (to claim better class on one performance data on MB configuration, another MB with the construction parameter variation shall be tested).

APPENDIX B. FORMS

B.1 Submittal for certification by Manufacturer

Information to be provided by Manufacturer (except gray cells)

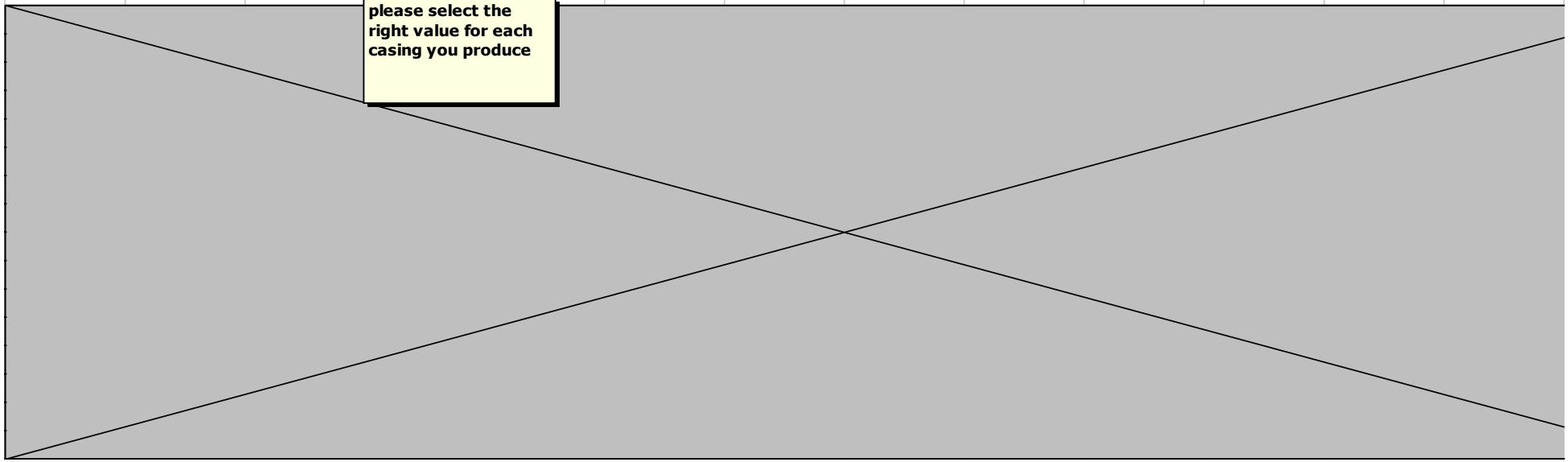
B.1.1 Form AHU-1A: Data list of certified models & sizes

AHU (RU - Q4, MB) - YYYY GENERIC												
Product Number	Master product number	Tested On	Rerated on	Created on	Last update on	Status	Participant Name	Product Name	Trade Name	Type of product	Range Name	BMG
Model Box Information						New	YOUR NAME	MB1		MB/MB/MEC	MYRANGE1	
						New	YOUR NAME	MB2		MB/MB/MEC	MYRANGE1	
						New	YOUR NAME	MB3		MB/MB/MEC	MYRANGE1	
						New	YOUR NAME	MB4		MB/MB/MEC	MYRANGE2	
						New	YOUR NAME	MB5		MB/MB/MEC	MYRANGE2	
												Example
						New	YOUR NAME	RU1		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU2		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU3		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU4		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU5		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU6		RU/R/HR	MYRANGE1	
						New	YOUR NAME	RU7		RU/R/HR	MYRANGE2	
						New	YOUR NAME	RU8		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU9		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU10		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU11		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU12		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU13		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU14		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU15		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU16		RU/R/NOHR	MYRANGE2	
Real Units Sizes												

RU/R/NOHR = without Heat recovery
RU/R/HR = with heat recovery

PERFORMANCES OF THE PRODUCT												
Standard												
CS class	CAL class @ -	CAL Class @ -	FBL class	TT class	TBF class	Casing accou	Casing accou	Casing accou	Casing accou	Casing accou	Casing accou	Casing accou
						dB	dB	dB	dB	dB	dB	dB
CsClass	CalClass	CalClass	FblClass	TtClass	TbfClass	Integer	Integer	Integer	Integer	Integer	Integer	Integer
??	??	??	??	??	??	??	??	??	??	??	??	??
??	??	??	??	??	??	??	??	??	??	??	??	??
??	??	??	??	??	??	??	??	??	??	??	??	??
??	??	??	??	??	??	??	??	??	??	??	??	??
??	??	??	??	??	??	??	??	??	??	??	??	??
D1(M)	**L3(M)**	**L3(M)**	**F9(M)**	**T4**	**TB3**	**8**	**10**	**12**	**12**	**14**	**28**	**35**

please select the right value for each casing you produce



TECHNICAL CHARACTERISTICS OF THE PRODUCT																
Standard					MB - Specifications											
Sub Range	Height	Width	Component	OutOfEU	Corner post	Mullion	Filter constr	Panel shape	Panel thickn	Insulation m	Insulation m	Insulation m	Insulation w	Sheet metal	Sheet metal	Sheet metal
	mm	mm							mm		kg/m³	W/m²/K			mm	mm
String	String	String	Boolean	Boolean	String	String	String	String	Decimal	String	Decimal	Decimal	String	String	Decimal	Decimal
				true or false												
				true or false												
				true or false												
				true or false												
				true or false												
					Al. 70x70	Al. 70x70	Pocket. met	Rectangular	46.0	RW	40.0	0.036	Loose	Galvanized	0.7	0.7
		please fill in the dimensions of the Real unit size		true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												
				true												

B.2 Submittal for certification by Brand Name

Information to be provided by the Brand Name (except gray cells)

B.2.1 Form AHU-2A: Data list of certified models & sizes (BN)

AHU (RU - Q4, MB) - 2014 GENERIC												
Product Number	Master product number	Tested On	Rerated on	Created on	Last update on	Status	Participant Name	Product Name	Trade Name	Type of product	Range Name	BMG
		Model Box Information				New	YOUR NAME	MB1		MB/MB/MEC	MYRANGE1	
						New	YOUR NAME	MB2		MB/MB/MEC	MYRANGE1	
						New	YOUR NAME	MB3		MB/MB/MEC	MYRANGE1	
						New	YOUR NAME	MB4		MB/MB/MEC	MYRANGE2	
						New	YOUR NAME	MB5		MB/MB/MEC	MYRANGE2	
												Example
						New	YOUR NAME	RU1		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU2		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU3		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU4		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU5		RU/R/NOHR	MYRANGE1	
						New	YOUR NAME	RU6		RU/R/HR	MYRANGE1	
						New	YOUR NAME	RU7		RU/R/HR	MYRANGE2	
		Real Units Sizes				New	YOUR NAME	RU8		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU9		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU10		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU11		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU12		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU13		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU14		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU15		RU/R/NOHR	MYRANGE2	
						New	YOUR NAME	RU16		RU/R/NOHR	MYRANGE2	

RU/R/NOHR = without Heat recovery
RU/R/HR = with heat recovery

B.3 Technical forms

B.3.1 Form AHU-3A: Technical specification related to tested real unit

Manufacturer														
Manufacuring Country/City + Contact details														
Software name/ Version / Revision Date														
Overall Dimensions (mm) & Weight (Kg)														
AHU Type (Range & Size)														
Model Box Designation/Characteristics														
Auditor Name														
Air Flow & Sound Performances (supply fan AND Exhaust)	**95%**		**Nominal**			**105,0%**	**Exhaust Nominal**		**Supply Fan Designation**			**Exhaust Fan Designation**		
	4750		5000			5250			Fan Type		Plug Fan	Fan Type		
ESP - External static pressure (Pa)									Manufacturer			Manufacturer		
Total static pressure (Pa)									Maximum Speed (rpm)			Maximum Speed (rpm)		
Power input @ terminal of motor or VFD (kW)									Fan Efficiency (%)			Fan Efficiency (%)		
Fan speed @ working point (rpm)									Motor Designation			Motor Designation		
Clean Filter(s) pressure drop (Pa)									Motor type (Power/Poles)			Motor type (Power/Poles)		
Heating Coil pressure drop (Pa)									Power Supply (V/P/F)			Power Supply (V/P/F)		
Cooling Coil DRY Pressure drop (Pa)									Nominal/Start Current (A)			Nominal/Start Current (A)		
Values transposed to 20°C ; 101325 Pa ; 1,2 kg/m3 - Dry Conditions									Motor Efficiency (%)			Motor Efficiency (%)		
Conditions during Sound Tests:	**Fan speed (rpm):**	0	**Air Flow (m3/h)**	5000	**ESP (Pa)**	0			VFD Model			VFD Model		
Octave Bands (Hz)	125	250	500	1000	2000	4000	8000	Total	VFD Manufacturer			VFD Manufacturer		
In-duct inlet sound power level (dB)									VFD Efficiency (%)			VFD Efficiency (%)		
In-duct outlet sound power level (dB)									Global Fan System Eff (%)			Global Fan System Eff (%)		
Airborne dB(A) (Radiated by casing)									Notes:					
Cooling Coil (Wet conditions)	**Cooling Point 1**				**Cooling Point 2**				Water Cooling Coil					
Air Volume flow rate (m^3/h)									**Designation**					
Air Mass Flow Rate (kg/h)	0				0				Coil Type			Fin Type		
Air Temp in/out (°C)									Manufacturer			Fin Spacing (mm)		
Medium in/out (°C)									Rows			Fin Thickness (mm)		
Medium flow rate (dm^3/h)									Circuits			Water content (l)		
Relative Humidity in/out (%)									Tube geometry			Connectors In/Out		
Medium pressure drop (kPa)									Tube			Droplet Eliminator		
Air Pressure drop Wet / Dry (Pa)									Overall Dimensions					
Droplet Eliminator Pressure drop									Note :					
Total Capacity (Sensible + Latent) (kW)														
Heating Coil	**Heating Point 1**				**Heating Point 2**				Water Heating Coil					
Air Volume flow rate (m^3/h)									**Designation**					
Air Mass Flow Rate (kg/h)									Manufacturer			Fin Type		
Air Temp in/out (°C)									Rows			Fin Spacing (mm)		
Medium in/out (°C)									Circuits			Fin Thickness (mm)		
Medium flow rate (dm^3/h)									Tube geometry			Water content (l)		
Medium pressure drop (kPa)									Tube			Connectors In/Out		
Air Pressure drop (Pa)									Overal Dimensions					
Capacity (kW)									Note :					
Heat Recovery System	**Winter Conditions only, Exhaust Air side must be @ Dry Conditions**								**Designation**					
Air Volume flow rate (m3/h) Supply / Exhaust									AAHE or AARE			Diameter		
Air Mass Flow Rate (kg/h) (Supp=Exha)	0				0				Categorie			Depth		
Outdoor Air inlet Temperature [21] (°C)									Manufacturer			Wave Height		
Supply Air Temperature [22] (°C)									Material			Wave Lenght		
Exhaust Air Inlet Temperature [11](°C)									By Pass			Purge Y/N		
Temp Efficiency Dry @ Balanced mass flow									Overal Dimensions			Rotation speed (AARE only)		
Air Pressure drop Supply | Exhaust (Pa)									Notes :					
Filter	**Supply**				**Exhaust**				**Supply**			**Exhaust**		
Clean Filter(s) pressure drop (Pa)									Type / Filter Class			Type & Filter Class		
Design Filter(s) pressure drop (Pa)									Filter Frame Withdrawal			Filter Frame Withdrawal		
Final Filter(s) pressure drop (Pa)									Number and Size			Number and Size		
CAL of Real UNit % or CAL Class -400Pa | +400pA									General Notes:					
Important Note : Selection shall be done based on Rating Standard in force - Drawing of the unit must be provided with the TDS - All required instructions for the lab to run the unit on the selected conditions shall be provided with the real unit to the test house. Before shipping the unit please wait the official request from your ECC contact.														
AHU TDS Version 01.2019														

B.3.2 Form AHU-3B: Technical specifications related to tested model box

INFORMATION RELATED TO TESTED UNIT and CERTIFIED VALUES
MECHANICAL CARACTERISTICS

MANUFACTURER:		
UP DATE:		
Eurovent test code/ Product number		
Serial Number		
Manufacturing place		
	name	email adress
Contact for technical questions:		
Contact for pickup of model box:		

MODEL BOX 1

Range names using this casing:				
Type name:				
Designation of the panel:				
Max.admissible pressure:		Pa		
Cover *(Painted, corrosive treatment,....)* :				
Option *(Special joint, hygienic.....)* :			material corners:	plastic (coated)
			material corner post:	aluminium
Length of model box:		mm	Additional stiffener inside the panel ?	
Width of model box:		mm	Number of access doors:	
Heigth of model box:		mm	Number of door locks on a door:	
			Number of hinges on a door:	
thickness of side panel:		mm	Additional fixing brackets	
thickness of bottom panel:		mm	Number fixing brackets	
thickness of roof panel:		mm	Design of door gaskets:	
thickness of access doors:		mm	Design of filter gaskets:	
Insulation type *(Rock wool, PU, mineral wool.....)* :				
specific volume of insulation:		kg/m³		
coefficient of heat conductivity of insulation:		W/mK	**Thermal breaks ...**	
			on access doors:	
Sheet metal material (inside):			on the panels:	
Sheet metal material (outside):			on the frame:	
Thickness of sheet metal (inside):		mm	on the mullion:	
Thickness of sheet metal (outside):		mm	on the connection of the section:	
Profile dimentions:		x	mm	

	Applied classes								
a - Casing strength				Maximum relative deflection:					mm/m
	- 400 Pa	+ 700 Pa					- 400 Pa	+ 700 Pa	
b - Casing air leakage						Maximum leakage rate:			$l.s^{-1}m^{-2}$
c - Filter bypass leakage					Maximum filter bypass leakage rate:				%
d - Thermal transmittance						Thermal transmittance range:			$W.m^{-2}.K^{-1}$
e - Thermal bridging factor									
		125	250	500	1000	2000	4000	8000	
f - Acoustical insulation									

(specified in EN 1886:2008)

B.4 Test result forms

B.4.1 Form AHU-4A: Recalculation after Real Unit Test

RE-CALCULATION AFTER REAL UNIT TEST				
Date of recalculation	XX/XX/XXXX			
Participant	XXX			
Participant contact	Name:	XXX	Email:	XXX
Auditor	Name:	XXX	Email:	XXX
Real unit designation	XXX			
Software Designation	XXX			
Version number	XXX			
Laboratory	TUV NORD OR DTI OR TUV SUD			

CAPACITY	1st point			2nd point			
	Applied	Measured	Deviation	Applied	Measured	Deviation	Result
Cooling kW			#VALEUR!			#VALEUR!	#VALEUR!
Heating kW			#VALEUR!			#VALEUR!	#VALEUR!

Tolerance -2%

		Water-side pressure loss in kPa						
		Applied		Measured		Deviation #1	Deviation #2	Result
		Water flow dm^3/h	Press. loss kPa	Water flow dm^3/h	Press. loss kPa			
Cooling	1st point					##########	#VALEUR!	#VALEUR!
	2nd point					##########	#VALEUR!	#VALEUR!
Heating	1st point					##########	#VALEUR!	#VALEUR!
	2nd point					##########	#VALEUR!	#VALEUR!

The pressure losses are compared with the following formulas #1 and #2:

Deviation#1 $\{[(\Delta p / q_m^{1.8})_{Measured} / (\Delta p / q_m^{1.8})_{Applied}] - 1\}$ *Tolerance: 10%*

*Deviation#2 {(Dp)Measured - (Dp / qm1,8)Applied * (qm1,8)Measured} Tolerance: 2.0kPa*

HEAT RECOVERY		Temperatures in °C	
		Applied	Measured
Supply air	In		
	Out		
Exhaust air	In		
	Out		
Ratio		#VALEUR!	#VALEUR!
Deviation		#VALEUR!	
Result		#VALEUR!	

Tolerance-3%-points

Air-side pressure loss in Pa				
Applied	Measured	Deviation #1	Deviation #2	Result
		#VALEUR!	#VALEUR!	#VALEUR!
		#VALEUR!	#VALEUR!	#VALEUR!

Deviation#1 Tolerance : 10%

Deviation#2 Tolerance: 15Pa

RUN-AROUND COILS	Fluid-side pressure loss in kPa (*)						
	Applied		Measured		Deviation #1	Deviation #2	Result
	Fluid flow dm^3/h	Press. loss kPa	Fluid flow dm^3/h	Press. loss kPa			
Cooling coil					##########	#VALEUR!	#VALEUR!
Heating coil					##########	#VALEUR!	#VALEUR!

(*) In case the Heat Recovery System is a Run-Around Coils. Tolerance: 10% or 2.0kPa

		Circulation pump absorbed power	
Applied		Deviation	#DIV/0!
Measured		Result	#DIV/0!

Tolerance: 15%

SOUND POWER

Conditions during acoustic test		
Fan speed:	2305	rpm
Air flow:	5000	m³/h
ESP:	250	Pa

CASING AIR LEAKAGE

	Applied	Measured	Result	
-400Pa			PASSED	
+400Pa*			PASSED	* if available

Tolerance : same class or higher

Octave Band In-duct OUTLET in dB

	125	250	500	1000	2000	4000	8000	Hz
Applied								dB
Measured								dB
Deviation	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	dB
Result	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	

Octave Band In-duct INTLET in dB

	125	250	500	1000	2000	4000	8000	Hz
Applied								dB
Measured								dB
Deviation	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	#VALEUR!	dB
Result	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	**#VALEUR!**	

AIRBORNE Sound Power - Total in dB(A)

Applied	Measured	Deviation	Tolerance	Result	
		#VALEUR!	3	**#VALEUR!**	dB(A)

RECALCULATION AFTER REAL UNIT TEST

Date of recalculation	XX/XX/XXXX
Participant	XXX
Real unit designation	XXX
Software Designation	XXX
Version number	XXX
Laboratory	TUV NORD OR DTI OR TUV SUD

Supply - Nominal conditions (3 points)

Air flow in m^3/h		External pressure in Pa (1)					Power input in kW (2)				Fan speed in rpm	
Applied	Measured	Applied	Measured	Available (3)	Deviation	Results	Applied	Measured	Deviation	Results	Applied	Measured
				#VALEUR!	#VALEUR!	#VALEUR!			#VALEUR!	#VALEUR!		
				#VALEUR!	#VALEUR!	#VALEUR!			#VALEUR!	#VALEUR!		
				#VALEUR!	#VALEUR!	#VALEUR!			#VALEUR!	#VALEUR!		

Supply - Secret air flow point (1 point)

Air flow in m^3/h		External pressure in Pa (1)					Power input in kW (2)				Fan speed in rpm	
Applied	Measured	Applied	Measured	Available (3)	Deviation	Results	Applied	Measured	Deviation	Results	Applied	Measured
				#VALEUR!	#VALEUR!	#VALEUR!			#VALEUR!	#VALEUR!		

Exhaust - Nominal conditions (1 point)													
Air flow in m^3/h		External pressure in Pa (1)					Power input in kW (2)				Fan speed in rpm	
Applied	Measured	Applied	Measured	Available (3)	Deviation	Results	Applied	Measured	Deviation	Results	Applied	Measured
				#VALEUR!	#VALEUR!	#VALEUR!			#VALEUR!	#VALEUR!		

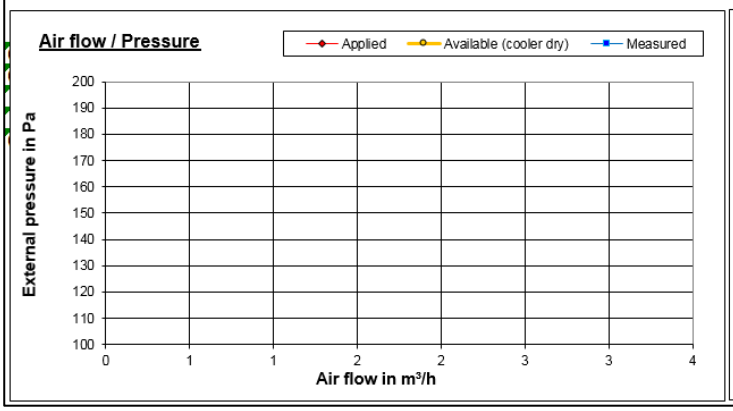
Values listed above are related to nominal condition ρ=1,2 kg/m³

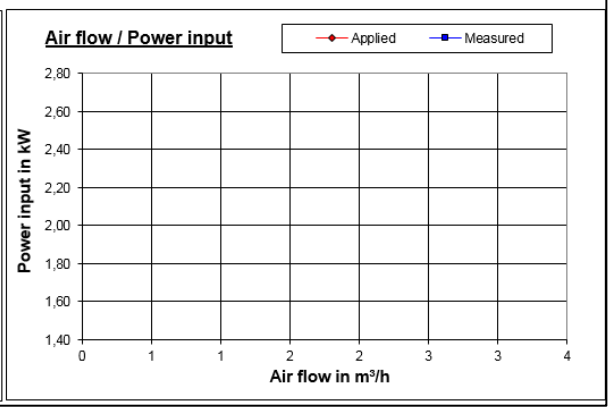
(1) Allowable deviation : -4 % or -15 Pa

(2) Allowable deviation : +3 %

(3) To get the available external pressure, the measured one must be lowered by the unconsidered part of the design filter pressure drop for the nominal conditions and dry cooler during the air flow test.

Correction for the ESP measured during air flow test	
	All pressure drops in Pa
Corrected design pressure drop of filter	#VALEUR!
Measured pressure drop of **clean filter**	
Difference to be taken in consideration @ nominal point 100%	**#VALEUR!**





RECALCULATION AFTER REAL UNIT TEST

Date of recalculation	XX/XX/XXXX
Participant	XXX
Real unit designation	XXX
Software Designation	XXX
Version number	XXX
Laboratory	TUV NORD OR DTI OR TUV SUD

Supply - Nominal conditions (3 points)

Air Flow Points	Air Flow Rate	$\Delta p_{clean\ filter}$ in Pa			$\Delta p_{design\ filter}$ in Pa			ESP in Pa	
	m³/h	measured	applied	$\Delta p_{clean,\ mea-app}$	applied	corrected	$\Delta p_{corr.\ design\ -\ clean}$	measured	**available**
95,0%				#VALEUR!		########	**#VALEUR!**		**#VALEUR!**
100,0%				#VALEUR!		########	**#VALEUR!**		**#VALEUR!**
105,0%				#VALEUR!		########	**#VALEUR!**		**#VALEUR!**

Supply - Secret air flow point (1 point)

Air Flow Points	Air Flow Rate	$\Delta p_{clean\ filter}$ in Pa			$\Delta p_{design\ filter}$ in Pa			ESP in Pa	
	m³/h	measured	applied	$\Delta p_{clean,\ mea-app}$	applied	corrected	$\Delta p_{corr.\ design\ -\ clean}$	measured	**available**
100,0%				#VALEUR!		########	**#VALEUR!**		**#VALEUR!**

Exhaust - Nominal conditions (1 point)

Air Flow Points	Air Flow Rate	$\Delta p_{clean\ filter}$ in Pa			$\Delta p_{design\ filter}$ in Pa			ESP in Pa	
	m³/h	measured	applied	$\Delta p_{clean,\ mea-app}$	applied	corrected	$\Delta p_{corr.\ design\ -\ clean}$	measured	**available**
100,0%				#VALEUR!		########	**#VALEUR!**		**#VALEUR!**

B.4.2 Form AHU-4C: Software Update Record Sheet

Company Logo

XXXXX Software Name
Software Update Record Sheet

Prepared By: _____

Software Revision	Date	Brief Description of update

APPENDIX C. CAMPAIGN SCHEDULE

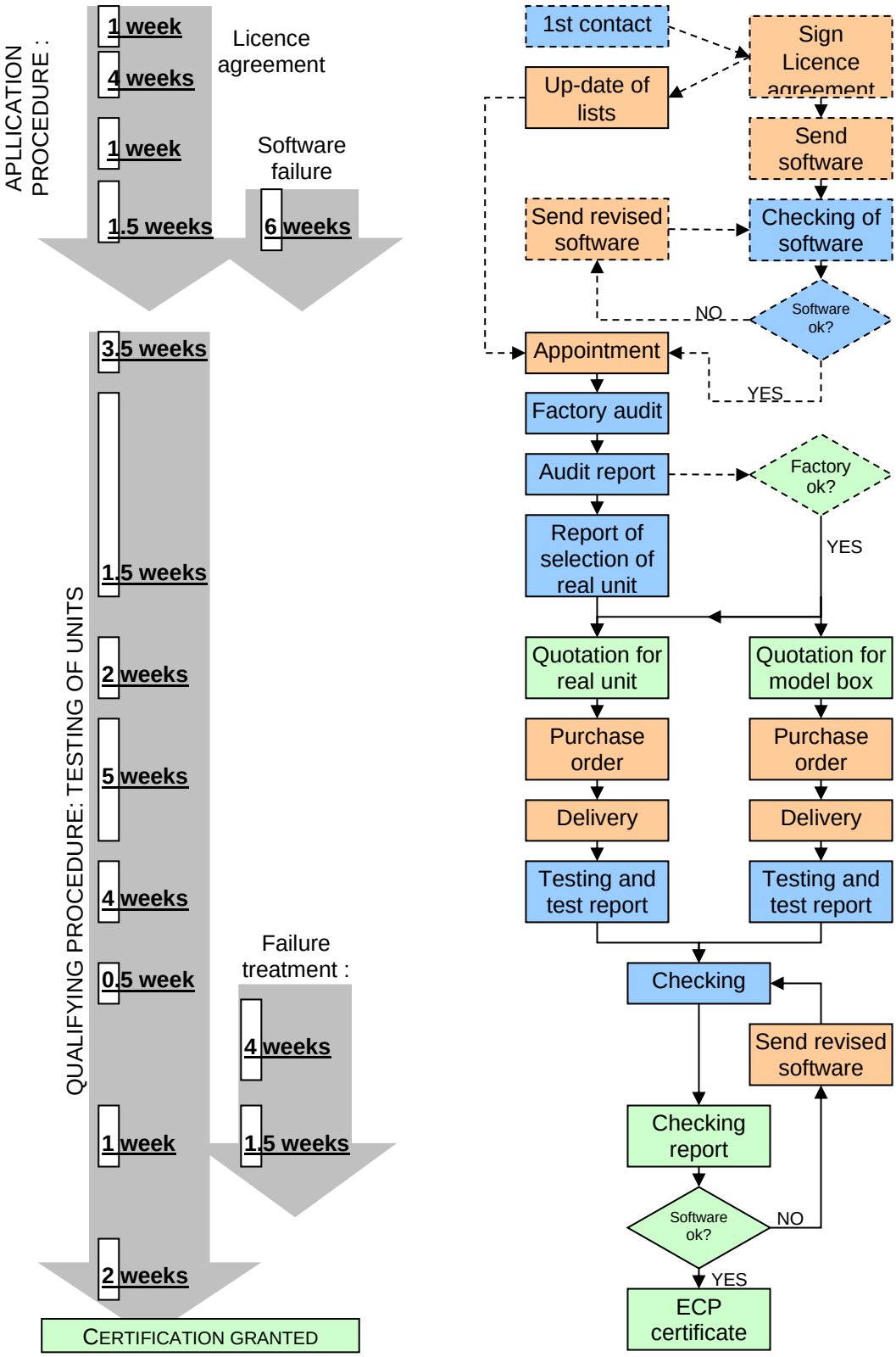
C.1 Application and test schedule

The process lasts an average of about 8½ months, including the preliminary steps. About 7 months are necessary for surveillance tests (pre-checking is not included).

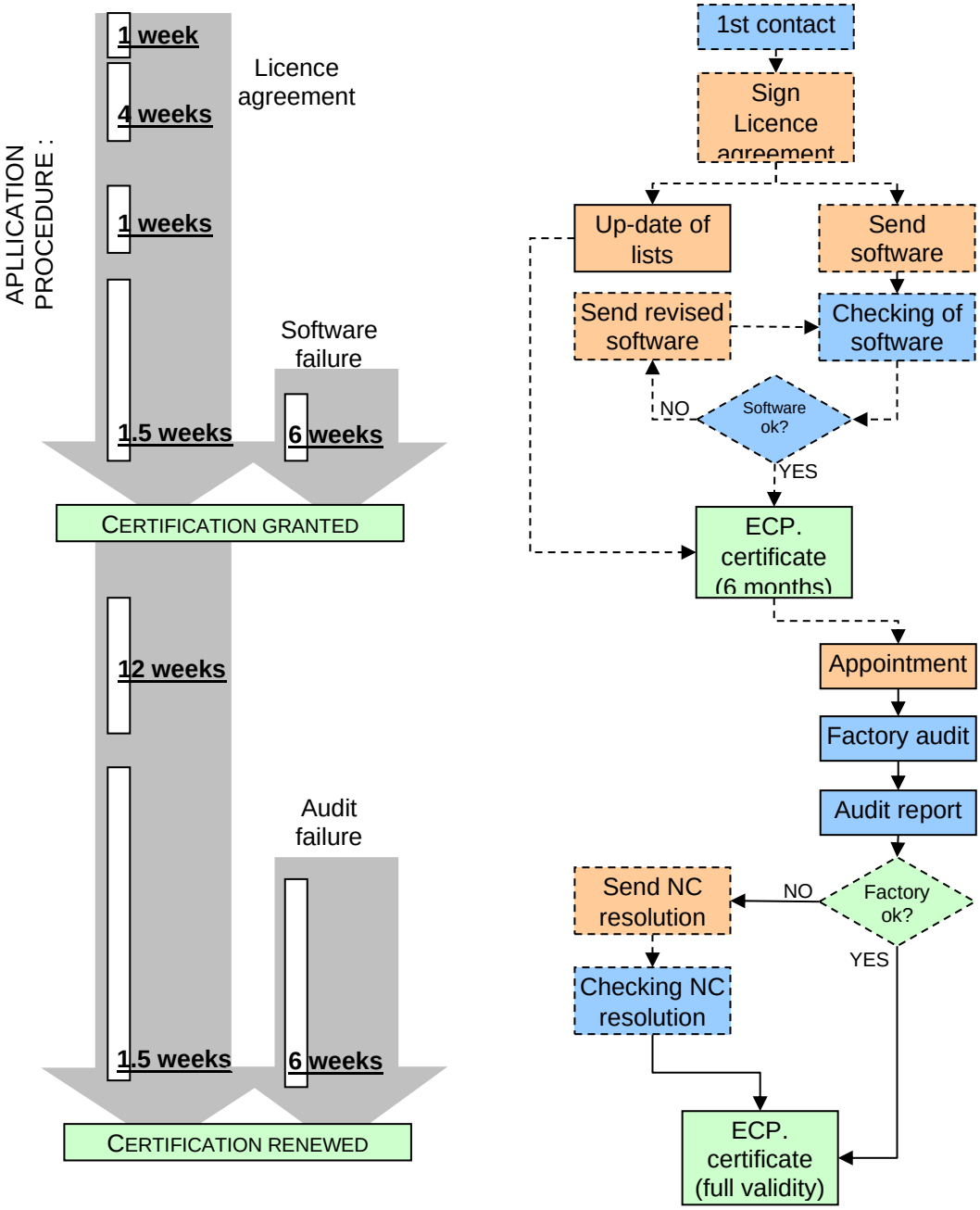
Certification Step How many weeks does it take?	min	max	Average week number
The auditor appointed by Eurovent Certita Certification contacts the manufacturer.	1	1	1
Manufacturer sends software to auditor.	1	4	3.5
The auditor pre-checks the software. When software does not meet the certification requirements, the manufacturer has to correct it and send a new version. When the software meets the certification requirements, the manufacturer makes an appointment with the auditor to audit the factory.	1	2	5
Waiting for the audit date.	1	4	7.5
The auditor audits manufacturer's factory, checks sale data and selects one unit for testing. The auditor gives the report to the manufacturer at the end of the audit and forward a signed copy to Eurovent Certita Certification, along with the technical data sheet of the RU selection. The manufacturer must up-date his list of products and then to send it to Eurovent Certita Certification (Forms AHU-1A and 1B).	0	1	9
Eurovent Certita Certification has to send the manufacturer the audit report and the quotation according to the technical form of the selected real unit(s). When necessary, Eurovent Certita Certification has also to send the quotation for the model box(es).	1	3	11
The manufacturer has to send the order/payment(s) to Eurovent Certita Certification. The unit(s) has(have) then to be delivered to the independent laboratory(ies) (2 to 6 weeks for Europe, 4 to 8 weeks for outside of Europe).	2	8	16
Waiting for the availability of the test rig.	0	5	18.5
The unit(s) is/are tested at the laboratory(ies).	1	2	20
The client manager checks that the software is in accordance with the test results. The laboratory has to send the test report to Eurovent Certita Certification.	1	2	21.5
Eurovent Certita Certification has to send the report (comments included) to the manufacturer. If the software is in accordance with the test results, the certification is granted for the next period.	0	2	22.5
In case the software is not in accordance with the test results, the manufacturer has to send the software revised according to the test results to the auditor.	2	6	26.5
The client manager has to check the revised software and send Eurovent Certita Certification a new, revised report.	1	2	28
Eurovent Certita Certification has to check this report and send it to the manufacturer. If the software is in accordance with the test results, the certification is granted for the next period.	0	2	29
In case the software is still not in accordance with the test results, the manufacturer may correct again and send back to the auditor for rechecking.	2	4	32
The client manager has to check the software and send a new report to Eurovent Certita Certification.	1	2	33.5
If the software is in accordance with the test results, the certification is granted for the next period. In case the software is still not in accordance with the test results the selection process has to start again from the beginning and the manufacturer's data are withdrawn from Eurovent Certified Performance Website until the certification is granted (min. one year after the first certification step).	0	1	34
TOTAL number of weeks necessary	15	51	**34**

Table 4: Minimum, maximum and average time needed for certification of a range

C.1.1 Planning for OEM application procedure



C.1.2 Planning for BN application procedure



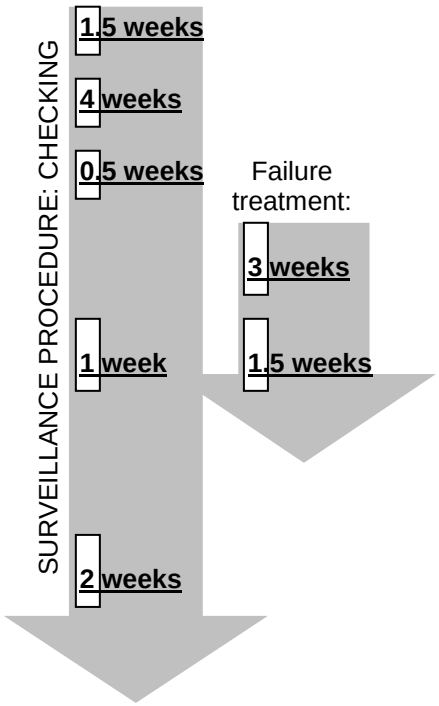
C.2 Checking of software schedule

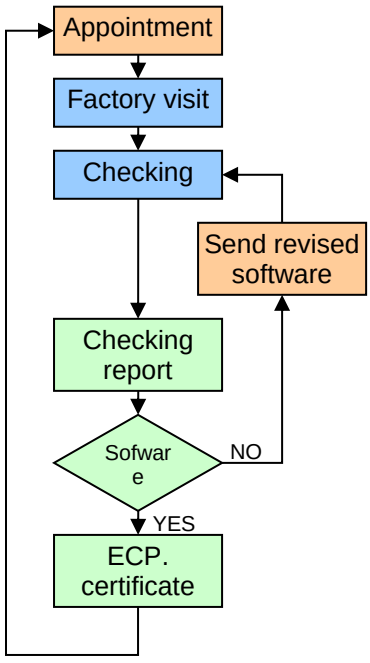
The process lasts an average of about 3½ months.

Certification Step			
How many weeks does it take?	**min**	**max**	
			Average week number
Eurovent Certita Certification informs the manufacturer about the need for an audit of the factory.	1	1	1
The manufacturer has to give to the auditor an appointment for audit of the factory.	1	2	2.5
Waiting for the audit date.	1	4	5
The auditor has to audit manufacturer's factory and check sale data. The auditor gives the report to the manufacturer at the end of the audit and forward a signed copy to Eurovent Certita Certification.	0	1	6.5
Eurovent Certita Certification has to send the report including its comments to the manufacturer. If the onsite software version is in accordance with the certified software version kept by the technical auditor and the last test results, the certification is granted for the next period.	0	2	7.5
In case the software is not in accordance with the test results, the manufacturer has to send the revised software according to the test results to the auditor.	2	4	10.5
The auditor has to finalize the recheck of the software and send back to Eurovent Certita Certification a new report.	1	2	13
If the software is in accordance with the test results, the certification is granted for the next period. In case the software is still not in accordance with the test results it is considered as violation of rules.	0	1	13.5
TOTAL number of weeks necessary	6	17	13.5

Table 5: Schedule for annual onsite checking – Minimum, maximum and average time needed for certification of a new AHU range

C.2.1 Planning for on-site checking of software





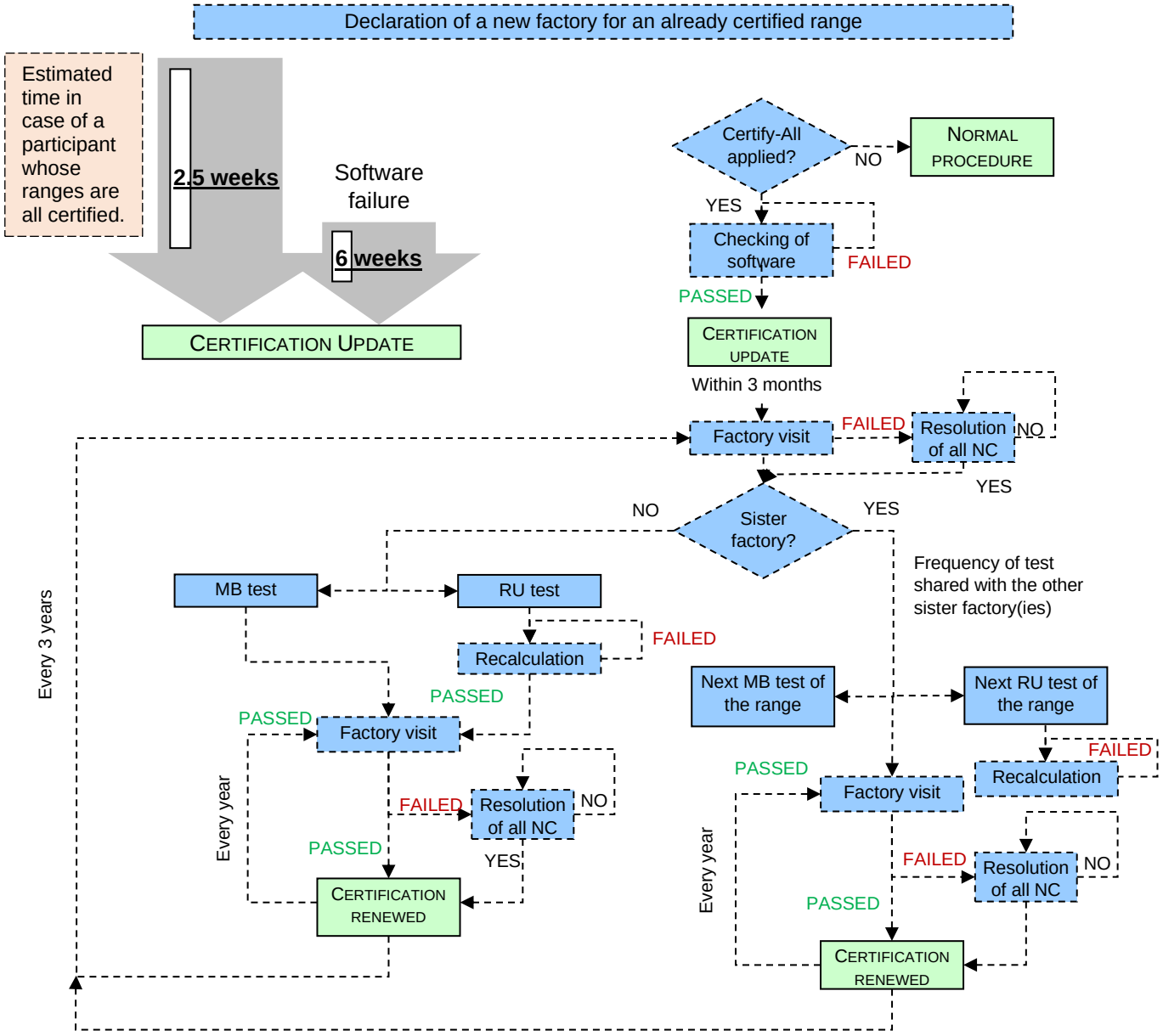
C.3 Annual surveillance procedure schedule

	Q1	Q2	Q3	Q4
Eurovent Certita Certification sends notification for the beginning of the Annual Surveillance Procedure	30/09/n-1	31/12/n-1	31/03/n	30/06/n
Payment of Annual Onsite Checking (AOC) from Participant is completed	31/10/n-1	31/01/n	30/04/n	31/07/n
AOC date with assigned auditor is planned	30/11/n-1	28/02/n	31/05/n	31/08/n
AOC is conducted by the auditor	01/01 – 31/03/n	01/04 – 30/06/n	01/07 – 30/09/n	01/10 – 31/12/n
AOC report is given to Participant during the audit closing meeting	-			
Critical NC are corrected	4 weeks after audit (unless otherwise sipulated)			
Non-critical NC are corrected	Next AOC			
Diploma are valid until	30/09/n+1	31/12/n+1	31/03/n+2	30/06/n+2

Note: The audit period (or quarter: Q1, Q2, Q3 or Q4) is defined by ECC for each individual participant and shall remain the same for the following campaigns even if delays are experienced regarding the audit date.

C.4 Planning for manufacturers adding a new factory for an already certified range

C.4.1 Planning for manufacturers introducing a new factory (or already known factory) for an already certified range



APPENDIX D. METHODOLOGIES

D.1 Methodology for the consistency check on small and large coils

The following methodology is to be used for checking that the performances given for small and large coils are consistent with each other:

1) Select a small size air handling unit (AHU) with an air volume performance below the upper limit (3 m3/s) of the test laboratory.

2) Select a cooling coil or heating coil in the AHU on inlet conditions within the normal operating range for water coils.

Register the coil code of the coil manufacturer or at least the distinctive characteristics of the selected coil, like coil geometry, pipe configuration, tube dimensions, fin thickness and fin spacing, number of rows, header diameters.

Change the air outlet temperature until the coil performs at maximum duty (0% safety on performance). If the safety margin is not displayed during the selection, increase the coil performance in small steps until the software automatically switches to another coil (different coil code or configuration).

3) Record at least the following selection data at maximum duty point of the selected coil.

- air volume flow [m3/s or m3/h]
- coil capacity [kW]

- air inlet temperature [°C]
- air inlet humidity [% or g/kg]
- water inlet temperature [°C]
- air outlet temperature [°C]
- air outlet humidity [% or g/kg]
- water outlet temperature [°C]
- water (fluid) flow [kg/h, kg/s, m3/h, dm3/s]
- air (face) velocity on finned area [m/s]
- water (fluid) velocity in tubes [m/s]
- air side pressure drop [Pa]

If available, the following data can also be collected.

- fluid side pressure drop [kPa]
- condensate flow (cooling coils) [l/h, kg/h]
- finned dimensions [mm]
- number of circuits [-]
- external heat exchange surface [m2]

4) Select a larger AHU with an internal cross section of at least three times the cross section of the small (reference) size AHU. Alternatively, the number of full size filters in the large AHU shall be at least three times more than in the small AHU.

5) Choose an initial air volume performance proportional to the size increase of the unit.

6) Select a cooling coil or heating coil in the AHU on the same air inlet conditions, water temperatures and design outlet temperature as applied for the coil in the small AHU.

If different brands and/or coil types (geometry) can be selected, choose the same type as in the small AHU. In case the same coil geometry cannot be obtained, ask AHU manufacturer's representative the reason for this alteration. Deliberate what changes are needed to get the same coil geometry.

Check if the coil geometry is the same (same rows, fin spacing, tube thickness, foil fin thickness, tube diameter, fin and tube material). Circuit's number, tubes number and connectors diameter shall be different.

Compare face velocity and media velocity in tubes, respectively +/-2% and +/-10% tolerances can be used.

Fine tune the air volume flow until the face velocity on the large coil is the same as on the small coil.

Change the outlet temperature and maximum fluid side pressure drop alternately until the coil performs at maximum duty with more or less the same water velocity in the tubes as for the small coil.

A (small) deviation in fluid velocity is still acceptable for a reliable consistency check.

Register the same selection data as mentioned under point 3.

7) Conduct the consistency check as follows:

   a) Calculate the ratio Rv between the fine-tuned air volume flow across the large unit and the small unit.

   b) Calculate the ratio Rp between the capacity of the large coil and the small coil

   c) Calculate the ratio Rw between the water flow through the large coil and the small coil

   d) Compare Rv and Rp.

   e) Both figures should be more or less the same. Consistency is granted if figures do not deviate by more than 5% (this figure has to be evaluated after the one year transition period).

f) Compare Rp and Rw.

Basically, both figures shall be the same. A deviation of 1% however is acceptable.
Bigger deviations indicate that a mistake during the selections has been made!

8) If the associated data are available, the following additional checks can be performed.

a) Calculate the ratio Ra between the finned surface of the large coil and the small coil

b) Calculate the ratio Re between the external heat exchange surface of the large coil and the small coil

c) Calculate the ratio Rc between the condensate flow of the large cooling coil and the small coil

d) Compare Ra and Re. Values shall be basically the same.

Compare Rp with Rc. Values should be nearly the same.

These additional checks are not mandatory and serve only as verification enhancement!

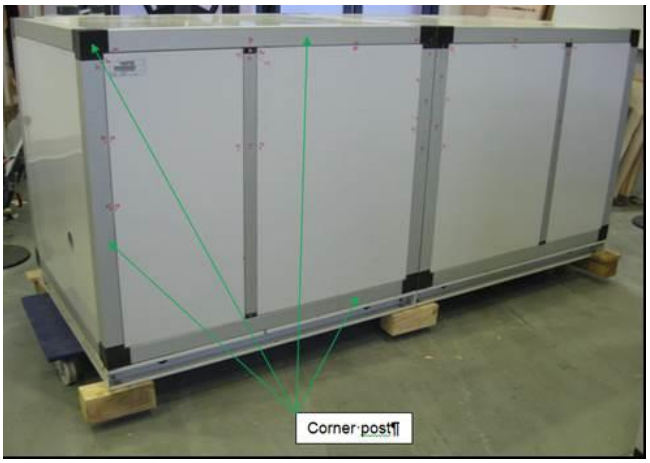
9) Some practical facilitation tips

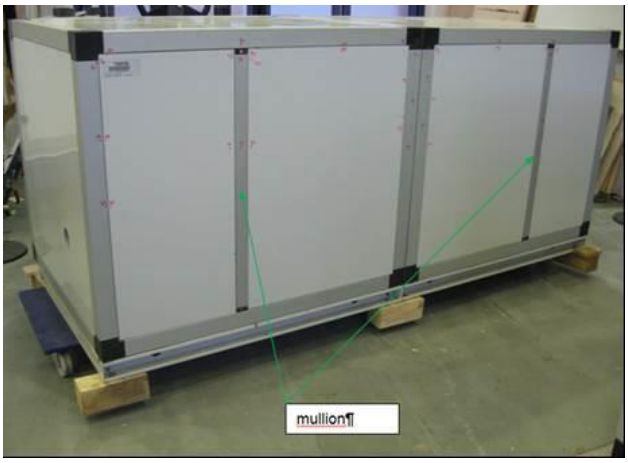
- Select the small unit size in such a way that velocity in the cross section is between 2 and 2.5 m/s
- Set, where possible, the maximum fluid side pressure drop for the small coil on a relatively low value (15 kPa)
- Use rounded figures for air inlet temperature and humidity
- Use rounded figures for water inlet- and outlet temperature
- Change the outlet air temperature in small steps to find the maximum duty point of the coil
- Ask for a stand-alone selection software program from the coil supplier
- Use the AHU selection software and coil selection software together to simplify the selections
- To compare coils with many rows and/or narrow fin spacing select air outlet temperature between water temperatures (small temperature differential)

D.2 Construction variations of AHU model boxes

D.2.1 Corner post (corner and frame)

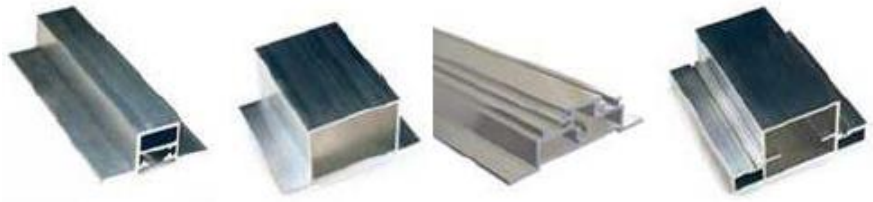
- material: steal/aluminium/plastic
- shape (see pictures):
- thickness of the material
- with/without thermal break





D.2.2 Mullion

- material: steal/aluminium/plastic
- shape (see pictures):
- thickness of the material
- with/without thermal break



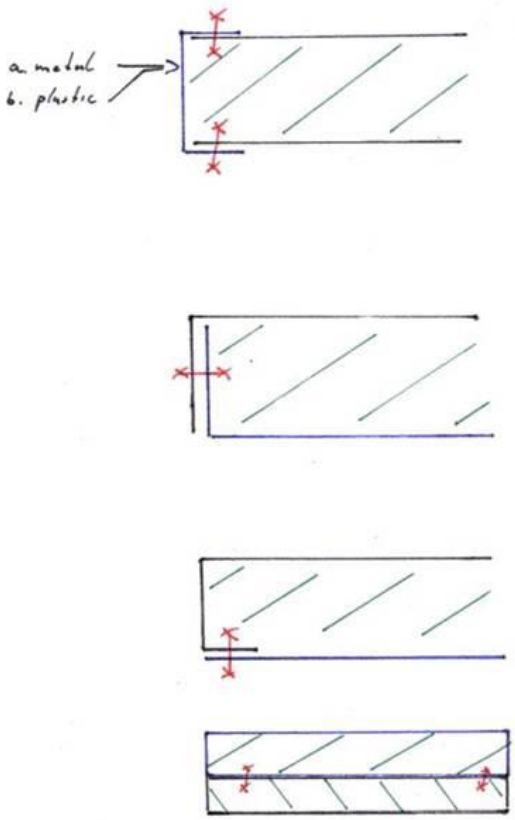
D.2.3 Filter holding system.

Definition: Modular holding frame to hold a filter within an air handling unit

- fixed or laterally extractable
- position in the unit (fixed on mullion or on panel)
- kind of filter gasket (flat/profiled)
- material/thickness of gasket
- fixing of gasket (glued/clamped/foamed)
- fixing of filter cell (with springs/screws/...)
- used sealing material (gasket/silicone/...)

D.2.4 Panel shape

- with/without thermal break
- design (see sketch)



APPENDIX E. SELECTION SOFTWARE MANDATORY REQUIREMENTS

The auditor assigned by Eurovent Certita Certification shall receive a software program, on a CD-Rom or a website with remote access. Other access facilities are only possible in consultation with Eurovent Certita Certification and the auditor. The primary language of the software including outputs must be in English.

The software must be able to calculate operating points between the upper and lower operating condition without changing any components (for example):

- The operating point of fan (nominal air flow = 100 %) must calculate by +5% and -5% of nominal air flow. The fan speed must be constant. The external pressure will be variable. The software must calculate the power input (in kW) at the electric terminal of the motor / FU-controller.
- The software must have the possibility to calculate the heating capacity with the selected heating coil between the upper and lower operating condition. It must be possible to change the air flow rate, the water flow rate, the air inlet temperature. The software must show and print out the results. The software must give a warning, in case that the result data run out of limits.
- The software must have the possibility to calculate the cooling capacity with the selected cooling coil between the upper and lower operating condition. It must be possible to change the air flow rate, the water flow rate, the air inlet temperature and the air inlet humidity.The software must show and print out the results. The software must give a warning, in case the result data run out of limits.
- The software must have the possibility to calculate the heat recovery capacity with the selected heat recovery system between the upper and lower operating condition. It must be possible to change the air flow rate, the supply air inlet temperature and humidity, the exhaust air inlet temperature and humidity. The software must show and print out the results. The software must give a warning, in case the result data run out of limits.

The selection software must have the following Mandatory requirements including Input data & Output data.

E.1 General Requirements

- Printouts should be provided as a minimum pdf file.
- There must be only one Eurovent certified software version.
- All components must be described by product key or relevant information (manufacturer name and reference).
- Calculations must all be at a minimum in SI units. The manufacturer is authorized to display data from the selection software in non-SI units as an option.
- The software must show a sketch of the AHU
- Software shall be able to store and restore the selection details from the same software version without any alterations of the calculation.
- Should the certified performances change due to the software revision, it shall not be possible to get the printout of the project without a new calculation considering the performances revision.
- $F_{s\text{-}Pref}$ value of the energy efficiency class calculation shall be available on the software for the sake of the energy efficiency class check during the audit

Item	*Acceptance criteria*	*Non critical NC*	*Critical NC*
$F_{s\text{-}Pref}$	*Max of +/- 0,01 or equal*	*Between +/- 0,01 and +/-0,04 or equal*	*Out of +/- 0,04*

General:

- all data which are asked for in Form AHU-4A “Recalculation after Real Unit Test” must be given from the selection software.

E.2 Mandatory Input Data

- Reference nomenclature of unit i.e. ABC 40.
- Upper & lower Summer & Winter operating conditions (outdoor air temp & humidity).
- Air flow rate & external pressure.
- Heating coil water inlet temp, water flow rate or water outlet temp & supply air temp behind the heater coil.
- Cooling coil water inlet temp, water flow rate or water outlet temp & outlet air temp & relative humidity and supply air temp and humidity behind the cooler.
- Selected filter section (filter class).
- Selected fan section (fan type, motor type).
- Selected inlet & outlet sections.
- Selected heat recovery system with all necessary inputs (Rotary, Plate HX & Run around coils.)

E.3 Mandatory information to be found on printouts

E.3.1 General information

- On the first page:
  - Unique identification No or reference of the selection
  - Unit range
  - Unit designation

  Eurovent Energy efficiency class *as described in Appendixes F and G*. Preferably the graphical energy efficiency label shall be displayed. Otherwise the statement: “Eurovent energy efficiency class X”, must be announced (where X is the label letter and sign). *Air handling units with heat exchangers in combination with an integrated extract/exhaust-to-supply air heat pump are exempt from calculating and displaying an energy efficiency class, as the ECC calculation methodology of 2016 does not cover and reflect the heat recovery effect and energy saving potential of ait-to-air heat pumps.*

  - If the graphical energy efficiency label is not used the Eurovent Certified Performance mark shall be displayed

  - If it is not allowed to display the Eurovent Certified Performance mark or energy class/label, a statement shall be written instead, e.g. “Heat recovery component- and/or fan selection beyond certified software do not comply with Eurovent Certified performance rules for label designation”.
- On each page (including the first page):
  - Software name, version code and version date
  - Printout date

- Page numbering with total number of pages of the printout (e.g. page x of y)
- Statement “This component is not included in the software Eurovent certified”, if a component, serving a certified performance (e.g. fan, coil, HRS, etc.), cannot be selected within the certified software. This statement is not required for non-certified components that are not included in the software (e.g. filters, attenuators, humidifiers, etc.).
- Unit sketches with overall dimensions, unique identification No of the selection and software version must be available on selection printouts.

E.3.2 Technical data

The technical specification of a quoted AHU shall include all technical data required to verify the claimed energy efficiency class:

General

- Nominal flow rate in m^3/s or m^3/h
- Velocity in the cross section of the filter section (or of the fan cross section if no filter)
- Inlet, outlet and airborn sound power: octave bands in dB and total sound power in dB(A).
- Air Density if set at $1.2kg/m^3$ then no need to be on printout, otherwise actual density must be provided on selection output.
- Design winter outdoor temperature (temperature at the inlet of the unit) for the selected unit
- Mixing ratio (RCA/SUP) at design winter outdoor temperature (maximum value 85%)
- External static pressure for the supply and extract unit (where applicable)
- Basic unit construction (same as model box name), as declared on the Eurovent Certified Performance website.
- It is not mandatory to display the leakage class of the Model Box (M) but the leakage rate of the Real Unit shall be declared (either by displaying the casing air leakage (CAL) rate in % or the corresponding CAL class (R) as per EN 1886:2007). The maximum of the following shall be specified on the printouts:
  - CAL @ -400Pa is mandatory on printouts
  - CAL @ +400Pa is mandatory on printouts
- Maximum internal leakage rate (%) of bidirectional ventilation units (BVUs) or carry over (for regenerative heat exchangers only); both measured or calculated according to the pressurisation test method or tracer gas test method at declared system pressure
- ErP identification code (NRVU / RVU – BVU / UVU)
- Internal static pressure drop across the components in the AHU. The two requirements below shall be fulfilled:

  o the air side pressure drop across each component is specified in the technical specification
  - the external static pressure and static fan pressure for the design duty point is specified.
  - Fan system effect shall be considered:
    - Either by displaying an additional pressure drop or
    - Within the fan performances. In this case a statement shall be provided (e.g.:“The fan system effect is taken into account in the fan performances.”)
- Reference city and optionally design dry-bulb, wet-bulb and dew point temperature (from ASHRAE 2017 Climatic Design Condition) used for the assessment or the Energy Efficiency Class for summer application (preferably the reference city). *The reference city is mandatory to be displayed on all printouts and If applicable the reference city must be displayed right below the energy efficiency label for summer application.*

- *As a minimum, the following decimal places and significant values for the performances used for the fs-pref value calculation (if one parameter has more than these required decimal places/significant figures, it is mathematically rounded for the calculation).*

Pressure drop *[Pa]: 0 decimal places* *Illustration 325 Pa*	***Area*** *[m²]: 3 significant figures* *Illustration 2,32m² or 3,00m²*
Fan capacity *[kW]: 3 significant figures* *Illustration 4,82kW or 5,02*	***Velocity*** *[m/s]: 3 significant figures* *Illustration 1,84 m/s*
Temperature *[°C]: 1 decimal place* *Illustration 32,8°C or 39,0°C*	***Air flow*** *[m3/h]: 3 significant figures* *Illustration 4520 m3/h or 8450 m3/h*
HRS efficiency *[%]: 2 significant figures* *Illustration 78%*	***Air flow*** *[m3/s]: 3 significant figures* *Illustration 3,21 m3/s or 1,00 m3/s*
Relative humidity *[%]: 0 decimal place* *Illustration 45%*	***Humidity efficiency*** *[%]: 2 significant figures* *Illustration 78%*

The useful fan static pressure increases to calculate the fan reference power can be derived from all data sets.

Fans

- Fan speed in rpm
- Absorbed electrical power from the mains for each fan in the AHU, including the power losses in any motor speed controller. If no fan speed controller is quoted, but the fan needs such a device to operate on the design fan speed, the power loss of such device shall be included in the specified absorbed power.
- Fan efficiency for Uni-Directional Units (UVUs) (η_{vu})
- Internal Specific Fan Power of ventilation components (SFP_{int}) in W/(m^3/s)

Filters

- Filter type and class (acc. to ISO 16890:2016)
- Pressure drops: clean, design and final conditions (the final pressure drop shall not be less than the minimum defined in the Table *1* below)
- Filter Energy Performance calculated according to the *ECP-11-FIL*(latest version in force) for filter (section A.I) and the Eurovent 4/21:2018; preferably energy classification
- The AHU energy efficiency shall be calculated on design filter pressure drop (however, it is allowed to display the fan performance based on the clean filter pressure drop). This is not applicable for ISO coarse filters.

Filter class	Final pressure drops
ISO coarse	The smallest value of the following: • DP_{init} +50 Pa • DP_{init} x 3
ISO ePM_1; ISO $ePM_{2.5}$ ISO ePM_{10}	The smallest value of the following: • DP_{init} + 100 Pa • DP_{init} x 3

Table 1: Minimum final pressure drops for filters

Heat recovery system (HRS)

- Dry temperature efficiency (no condensation on extract side) of the HRS for design winter operation at equal mass flows (extract flow equal to design supply flow)
- Air side pressure drop across the heat recovery system on the extract side and supply side for the design air flows at winter condition and standard density 1.2 kg/m^3.
- Brine concentration in fluid of run around coil system (where applicable)

Coils

- Statement if air side pressure drop cooling coil is for dry ("dry pressure drop") or wet ("wet pressure drop") condition or statement if fan has been designed for dry or wet condition.
- Heating coil: air side Inlet/Outlet temperatures, airside pressure drop, water flow, & waterside Inlet/Outlet temperatures & pressure drop.
- Cooling coil: air side Inlet/Outlet temperatures, inlet/Outlet relative humidity, air side pressure drops (designed: wet or dry, both can be provided, however dry shall be always visible in the software), waterside flow rate and Inlet/Outlet temperatures and pressure drop.
- Air velocity in the finned part of the coil (if not in the printout, at least in the software)

Additional requirements for the Hygienic option:

If the Hygienic option is selected the print-out of the selection software must include the following data, in addition to the one already listed above:

- General arrangement: The general disposition of the components and design of the AHU shall be included.
- Unit housing: The selection software shall include the dimension of the housing as well as the accessibility to the components (localisation and dimensions of doors and hatches). Mechanical characteristics shall be included:
  - Casing Strength
  - Thermal bridging
- Components: The selection software shall include the components used for the AHU as well as their properties:
  - Filters: dimensions and weight
  - Droplet Separator: Dimensions and weight
  - Cooling/Heating Coils: Fin thickness, distance between fins
  - Fans: Type and property

The mark of the hygienic option as well as the level achieved for the unit must be displayed on the first page of the print-out, this mark can replace the ECP mark.

APPENDIX F. ENERGY EFFICIENCY CLASS FOR WINTER APPLICATION

F.1 Foreword

In this method the impacts of the various factors are weighted together to establish the final energy class.

Energy to Air Handling Units (AHUs) can be divided into two main groups; thermal energy (for heating and cooling) and electrical energy for fans. Different levels for thermal energy consumption for heating are covered by the consideration of the Heat Recovery System (HRS) efficiency. The climate dependency for the thermal energy consumption is considered and the difference in primary energy between thermal energy and electrical energy is taken into account to evaluate the impact of the pressure drops across the HRS (factors 1 to 2). The thermal energy for cooling is not considered because it will have less impact (negligible for most of Europe). Regarding electrical energy for fans, the method only accounts for the impact of the unit size and efficiency of fan assembly. Other components (e.g. coils) are not individually covered (hence the total pressure increases for fans are not considered) because there is a huge variation in the use of components in different AHU applications. The major influencing factors; velocity, HRS pressure drop, overall static efficiency of the supply and/or the extract air fan and efficiency of the electric motor(s), will give a good estimation of the used energy for fans. The classification, however, cannot be considered as a system energy label. Use LCC calculations to evaluate differences between systems.

The required values for the classes adopted in the calculations are taken from the European Standard EN13053:2019: “Ventilation for buildings – Air handling units – Rating and performance for units, components and sections.”

A 6 months transition period from the publication of this TCR release is applicable for the modified equation ($P_{airside\text{-}ref}$).

F.2 Prerequisites

- *The temperatures are considered in °C.*
- The calculations shall be made with standard air density = 1.2 kg/m³
- In the calculations for classification evaluation, the design conditions for winter time shall be used for air flows, outdoor temperature, mixing ratio, heat recovery efficiency, etc.
- The velocities in the calculations are the air velocities in the AHU cross-section based on the inside unit area for *outdoor*, respectively extract air flow of the air handling unit. The velocity is based on the area of the filter section of the respective unit, or if no filter is installed, it is based on the area of the fan section
- The relationship between velocity in the cross section of the unit and internal static pressure drop is considered to be exponential to the power of 1.4:

$$\Delta p_{st-1} = \left(\frac{v_1}{v_0} \right)^{1.4} \times \Delta p_{st-0}$$

- *V1 is the air speed in the AHU and the V0 coming from the reference table corresponding to a class.*
- The heat recovery dry efficiency at balanced air volume flows shall be used. If the extract (also called “exhaust air in”) air volume flow across the heat recovery section diverges from the supply air volume flow through the heat recovery section, the efficiency shall be calculated for both air volume flows equal to the supply air volume flow. For efficiency evaluation the supply air volume for the heat recovery section, winter time shall be taken (the supply air volume flow of the unit can be higher in case of a mixing section).
- For pressure drop evaluation of the heat recovery section the design air volume flows across the heat recovery for winter time shall be taken. Pressure drop increase due to

condensation is not considered! Air pressure drop shall be considered for standard air density at 1.2 kg/m^3

- Heat recovery efficiency figures for run around coil systems shall be based on fluid with the actual ethylene glycol design percentage, design fluid flows and design inlet temperatures.
- Weighting ratio between electric energy and thermal energy is 2 (1 kWh electric energy ≈ 2 kWh (primary) thermal energy).
- An empirical formula for the equivalence between the efficiency and the pressure drop of a heat recovery system, as a function of the outdoor climate, has been derived from numerous energy consumption calculations all over Europe, (see Figure 7 below): $f_{pe} = (-0.0035 \times t_{ODA} - 0.79) \times t_{ODA} + 8.1$ [Pa/%]

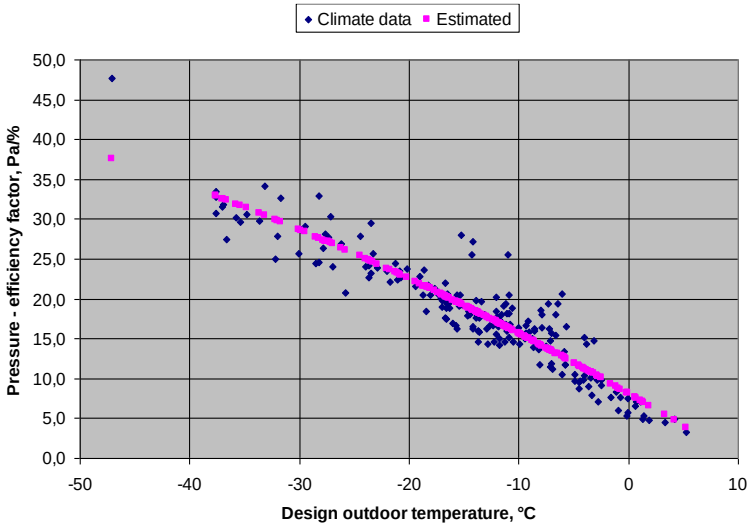


Figure 7: Equivalence Efficiency / Pressure Drop

F.3 Air Handling Unit subgroups

Three subgroups, with different label signs, are defined *(the display of the energy efficiency class for winter application is mandatory for any project falling under any subgroup)*:

F.3.1 Subgroup 1

Units for full or partial outdoor air at design winter temperature ≤ 9°C.

This subgroup will consider the velocity in the filter cross section, the HRS efficiency and pressure drop and the mains power consumption to the fan(s). The class signs are **A+** to **E**.

This subgroup comprises units connected to outdoor air with the design outdoor temperature, winter time ≤ 9°C. The unit can be supply only or supply and extract unit, and can be with or without HRS. If it is a supply only unit, there shall be no consumption and no pressure drop on the extract side. If the unit doesn't have a HRS, the heat recovery efficiency shall be considered as 0. If the unit contains a mixing section; it will be treated within this group as long as the amount of recirculation air is less than 85 %. If more recirculation is claimed, the calculation value for 85% shall be used in the applicable equation for pressure correction Δ_{pz}.

F.3.2 Subgroup 2

Recirculation units or units with design inlet temperatures always > 9°C.

This subgroup will only consider the cross section velocity of the filter section and mains power consumption to the fan(s). The class signs are from **A+↻** to **E↻**.

This subgroup includes units with 100% recirculation air, units connected to outdoor air for which the design outdoor temperature during winter time > 9°C or units with (pre-conditioned) inlet temperature > 9°C emanating from a make-up air unit up-stream. The unit can be a supply only or supply and extract unit. If it is a supply only unit, there shall be no consumption and no pressure drop on the extract side. Even if the heat recovery efficiency is not taken into account in the calculation, the unit can be with or without HRS.

F.3.3 Subgroup 3

Stand-alone extract air units.

This subgroup will only consider the cross section velocity of the filter section and mains power consumption to the fan(s). The class signs are from **A+↑** to **E↑**.

This subgroup is for pure extract air units (First reason to allocate an energy label to this kind of unit application is that they could not include heat recovery. Another reason is that the design outdoor temperature has no relevance for such units).

F.4 Reference table

CLASS	All Units	Units for full or partial outdoor air at design winter temperature ≤ 9°C		
	Velocity	Heat recovery system		Fan Efficiency Grade
	v_{class} [m/s]	η_{class} [%]	Δp_{class} [Pa]	$NG_{ref\text{-}class}$ [-]
A+ / A+↬ / A+↑	1.4	83	250	64
A / A↬ / A↑	1.6	78	230	62
B / B↬ / B↑	1.8	73	210	60
C / C↬ / C↑	2.0	68	190	57
D / D↬ / D↑	2.2	63	170	52
E / E↬ / E↑	No calculation required			No requirement

Table 6: Table for energy efficiency calculations

The lowest classes E, E↬ and E↑ have no requirements.

F.5 Methodology

The principle is to establish whether the selected unit with different energy parameters will consume no more energy than a unit that would exactly meet the requirements for the aimed class in Table 6: Table for energy efficiency calculations.

Perform the four following steps for respective air sides, supply and/or extract:

1) Assume an AHU is designed to meet the requirements for a particular class, so apply the corresponding class values (subscript “class”) from Table 6: Table for energy efficiency calculations:
   - for velocity v_{class}
   - for Fan Efficiency Grade $NG_{ref\text{-}class}$

If subgroup 1 (units for full or partial outdoor air at design winter temperature ≤ 9°C), apply also:
   - heat recovery efficiency η_{class}
   - pressure drop Δp_{class}

2) Use, for the actual air handling unit to be classified at design air flow, winter time, the actual selection values (subscript “s”) values:
   - fan static pressure increase $\Delta p_{s\text{-}static}$
   - external pressure drop $\Delta p_{s\text{-}external}$
   - velocity v_s
   - power supplied from mains to selected fan $P_{s\text{-}sup}$ if supply air side else $P_{s\text{-}ext}$

If subgroup 1 use also:
   - HRS dry efficiency η_s
   - HRS pressure drop $\Delta p_{s\text{-}HRS}$

3) Calculate the pressure correction due to velocity Δp_x

If subgroup 1, then calculate:
   - pressure correction due to HRS pressure drop Δp_y (see F.7)

- pressure correction due to HRS efficiency Δp_z (see F.8)

4) Calculate fan reference power $P_{air\ side\text{-}ref}$ for the actual air handling unit side, i.e. $P_{sup\text{-}ref}$ if supply air side or $P_{ext\text{-}ref}$ if extract air side (see F.9).

Final check consists in verifying whether the selected unit meets the absorbed power consumption criterion for the aimed class. So calculate the absorbed power factor; $f_{s–Pref}$ (see F.10). If the value $f_{s\text{-}Pref}$ is equal or lower than 1, the unit meets the requirements for the class. If not, the same calculation procedure shall be repeated for a lower class.

F.6 Pressure correction due to velocity; Δpx

$$\Delta p_x = \left(\Delta p_{s\text{-}internal} - \Delta p_{s\text{-}HRS}\right) \times \left\{1 - \left(\frac{v_{class}}{v_s}\right)^{1,4}\right\}$$

where:
- Δp_x = pressure correction due to velocity [Pa]
- $\Delta p_{s\text{-}internal}$ = $\Delta p_{s–static}$ - $\Delta p_{s–external}$ internal pressure drop across components; exclusive system effect pressure drops [Pa]
- $\Delta p_{s\text{-}static}$ = useful fan static pressure increase measured between fan inlet and fan outlet [Pa]
- $\Delta p_{s\text{-}external}$ = external (ductwork system) pressure drop [Pa]
- $\Delta p_{s\text{-}HRS}$ = HRS pressure drop [Pa] (0 if no HRS or subgroup 2 or 3)
- v_{class} = value from Table 6 [m/s]
- v_s = velocity in AHU filter (fan if no filter) cross section [m/s]

With pressure drop correction for velocity, the equivalence figures for primary energy and the corrections for heat recovery it is possible to make a conversion to static pressure surplus or deficit compared to a unit fully compliant with the energy class. A surplus of static pressure means that the actual unit demands a higher static pressure; a deficit of static pressure means that the actual unit needs a lower static pressure than the class compliant unit. Hence, a surplus of static pressure means higher energy consumption while a deficit of static pressure will mean lower energy consumption.

F.7 Pressure correction due to HRS pressure drop; Δpy

$$\Delta p_y = \Delta p_{s\text{-}HRS} - \Delta p_{class}$$

where:
- Δp_y = pressure correction due to HRS pressure drop [Pa]
- $\Delta p_{s\text{-}HRS}$ = HRS pressure drop (0 if no HRS or subgroup 2 or 3) [Pa]
- Δp_{class} = value from Table 6 [Pa] (0 if subgroup 2 or 3)

F.8 Pressure correction due to HRS efficiency; Δpz

$$\Delta p_z = \left(\eta_{class} - \eta_s + 5 \times cf_{heater}\right) \times \left(1 - \frac{mr}{100}\right) \times f_{pe}$$

where:
- Δp_z = pressure correction due to HRS efficiency [Pa]
- η_s = HRS dry efficiency winter [%] (0 if no HRS or subgroup 2 or 3)
- η_{class} = value from Table 6 [%] (0 if subgroup 2 or 3)
- mr = mixing ratio, winter (recirculation air / supply air; maximum), allowed range 0 to 85 [%]
- f_{pe} = pressure – efficiency factor
  = $(-0.0035 \times t_{ODA} - 0.79) \times t_{ODA} + 8.1$ [Pa/%]
- t_{ODA} = design outdoor temperature, winter [°C]
- cf_{heater} = correction for electrical heater (reheater, i.e. heater downstream the HRS).
  = 0 when there is no electrical heater
  = 1 when there is an electrical heater

F.9 Fan reference power; Psup–ref if supply air side or Pext-ref if extract air side

The total static pressure correction $\Delta p_x + \Delta p_y + \Delta p_z$ has a negative or positive value. A negative value means that the required static pressure for the selected unit is lower than the static pressure for the class compliant unit would be. For a positive pressure value it is just the other way round. Now the fan reference power for a class compliant unit has to be derived from the available static pressure of the selected unit by taking into account the calculated pressure corrections.

$$P_{airside-ref} = \frac{\left|\Delta P_{s-static} - \left(\Delta p_x + \Delta p_y + \Delta p_z\right)\right| \cdot q_{v-s}}{(a \cdot ln\left(P_{airside-ref}\right) - b + NG_{ref})/100}$$

where: $P_{air\ side\text{-}ref}$ = fan reference power [kW] (use $P_{sup–ref}$ for supply air side or $P_{ext–ref}$ for extract air side)
$q_{v\text{-}s}$ = air volume flow rate [m^3/s]
NG_{ref} = Fan Efficiency Grade corresponding to the class value in %
a, b = coefficients as per Table 7 below.

$P_{air\ side\text{-}ref}$	a	b	NG_{ref}
≤ 10 kW	4,56	10,5	$NG_{ref\text{-}class}$
> 10 kW	1,1	2,6	$NG_{ref\text{-}class}$

Table 7: Coefficients for the calculation of Pair side-ref

The first iteration of $P_{air\ side\text{-}ref}$ being:

$$P_{airside-ref(1st\ iteration)} = \frac{\left|\Delta P_{s-static} - \left(\Delta p_x + \Delta p_y + \Delta p_z\right)\right| \cdot q_{v-s}}{NG_{ref}/100}$$

F.10 Absorbed power factor; fs–Pref

$$f_{s\text{-}Pref} = \frac{P_{s\text{-}sup} + P_{s\text{-}ext}}{P_{sup\text{-}ref} + P_{ext\text{-}ref}} \leq 1$$

where: $f_{s\text{-}Pref}$ = absorbed power factor
$P_{s\text{-}sup}$ = active power supplied from the mains, including any motor control equipment, to selected supply air fan [kW]
$P_{s\text{-}ext}$ = active power supplied from the mains, including any motor control equipment, to selected extract air fan [kW]
$P_{sup\text{-}ref}$ = supply air fan reference power [kW]
$P_{ext\text{-}ref}$ = extract air fan reference power [kW]

F.11 Heat recovery for run around coil systems

The following applies for run around coil systems.

Regarding the glycol or temperature, no corrections of efficiency shall be considered: efficiency shall be evaluated on the actual glycol percentage and actual temperatures.

A correction shall be applied for the efficiency at balanced airflows. If the real correction can be obtained from the selection software, it is always possible using it. Otherwise, the following equation shall be used:

$$\varphi_{1:1} = \varphi_s x \sqrt{\frac{\dot{m}_{ODA}}{\dot{m}_{ETA}}}$$

where: $\varphi_{1:1}$ = efficiency for balanced airflows [%]

φ_s = actual efficiency for unbalanced airflows [%]

$\frac{\dot{m}_{ODA}}{\dot{m}_{ETA}}$ = outdoor (supply) air flow [kg/s] / extract air flow [kg/s]

Equation is valid for a minimum extract air flow of 0.6 x supply air side or a maximum extract air flow of 1.2 x supply air side. If ratio is out of the limits, the 0.6 and 1.2 corrections shall be used.

F.12 Assessment of the Energy Efficiency Class in case of swimming pool units

AHUs with dynamic outdoor air flow rate in heating period (i.e. swimming pool units) must be treated differently.

1) Heating period must be clearly defined in the printout or the software.
2) Thermal efficiency and pressure drop of the heat recovery, as well as the power input and mixing ratio, shall be determined at the point of the highest expected air flow rate across the heat recovery section during heating period.
3) Design outdoor temperature shall remain for winter condition.

APPENDIX G. *ENERGY EFFICIENCY CLASS FOR SUMMER APPLICATION*

The main idea is from numerous hourly energy consumption, calculated from all over Europe, Middle East, North Africa and some extreme weather locations totalizing 58 places, create a model that balance the benefit of 3 different solutions that could result in AHU energy saving.

1) Humidity Recovery
2) Reduction of the pressure drop in the Heat Recovery System (HRS) bypass
3) Indirect adiabatic cooling (IAC)

The base used to assess the energy efficiency class for summer application is the same than the winter application described in appendix F. The difference with the calculation for summer application is based on the correction factors (Δp_y, Δp_z), each of the 3 features listed above will have an impact on the correction factors (Δp_y, Δp_z).

Note: there are no impacts on Δp_x which is purely linked to the fan performance.

Important note: Until further notice and/or update of this TCR, only the humidity recovery feature (1) must be considered for the calculation of the Energy Efficiency Class.

The Indirect Adiabatic Cooling and the reduction of the pressure drop in the HRS bypass will be considered only later; they then must be ignored at the moment for the calculation of the EEC.

The display of the energy efficiency class for summer application *is* mandatory for any project falling under subgroup 1 (cf section G.2.). In other words, the display of the energy efficiency class for summer application is optional for projects falling under subgroup 2 or 3 (cf section.G.2.).

Any Participant displaying the EEC for summer application is entitled to base its assessment on a region approach (cf section 0 for further details), the city approach being highly recommended.

A 6 months transition period from the publication of this TCR release is applicable for the modified equations ($P_{airside\text{-}ref}$ and $f_{pe\text{-}DewP}$).

G.1. Prerequisites

- *The temperatures are considered in °C.*
- The calculations shall be made with standard air density = 1.2 kg/m³
- In the calculations for classification evaluation, the design conditions for summer time shall be used for air flows, outdoor temperature, mixing ratio, heat recovery efficiency, etc.
- The ASHRAE 2017 Monthly design Dry Bulb 2% data shall be used to determine the design dry bulb temperature and the design dew point temperature. The location where the unit will be installed must be used as reference. See section 0for further details.
- The ASHRAE 2017 Coldest Month 99% data shall be used to determine the winter design outdoor temperature. See section 0 for further details.
- The velocities in the calculations are the air velocities in the AHU cross-section based on the inside unit area for *outdoor*, respectively extract air flow of the air handling unit. The velocity is based on the area of the filter section of the respective unit, or if no filter is installed, it is based on the area of the fan section
- The relationship between velocity in the cross section of the unit and internal static pressure drop is considered to be exponential to the power of 1.4:

$$\Delta p_{st-1} = \left(\frac{v_1}{v_0}\right)^{1.4} \times \Delta p_{st-0}$$

- *V1 is the air speed in the AHU and the V0 coming from the reference table corresponding to a class.*

- The heat recovery dry efficiency and wet efficiency at balanced air volume flows shall be used. If the extract (also called “exhaust air in”) air volume flow across the heat recovery section diverges from the supply air volume flow through the heat recovery section, the efficiency shall be calculated for both air volume flows equal to the supply air volume flow. For efficiency evaluation the supply air volume for the heat recovery section, summer time shall be taken (the supply air volume flow of the unit can be higher in case of a mixing section).
- For pressure drop evaluation of the heat recovery section the design air volume flows across the heat recovery for summer time shall be taken. Air pressure drop shall be considered for standard air density at 1.2 kg/m^3
- Heat recovery efficiency figures for run around coil systems shall be based on fluid with the actual ethylene glycol design percentage, design fluid flows and design inlet temperatures.
- Weighting ratio between electric energy and thermal energy is 2 (1 kWh electric energy ≈ 2 kWh (primary) thermal energy).
- This summer label consider that a cooling system is installed and therefore condensation can occur. If an AHU is installed in a system without cooling device (within or outside the AHU) and no enthalpy control then the humidity efficiency η_{s-H} must be set at 0.

G.2. Subgroups

The energy efficiency labelling for summer application is divided in three subgroups (1, 2 and 3).

G.2.1. Subgroup 1

The unit fall under the subgroup 1 if the outdoor conditions of the place where the unit will be installed are the following (*The class signs are **A+** to **E***):

- Winter Design condition (from ASHRAE 2017 Climatic Design Conditions)[3] ≥ -3°C **AND** Design dry-bulb temperature (from ASHRAE 2017 Climatic Design Conditions) ≥ 30°C

  OR
- Winter Design condition (from ASHRAE 2017 Climatic Design Conditions) ≥ -3°C **AND** Design dew-point temperature (calculated with wet bulb temperature from ASHRAE 2017 Climatic Design Conditions) ≥ 17°C

  OR
- Design dry-bulb temperature (from ASHRAE 2017 Climatic Design Conditions) ≥ 30°C **AND** Design dew-point temperature (calculated with wet bulb temperature from ASHRAE 2017 Climatic Design Conditions) ≥ 17°C

G.2.2. Subgroup 2

If the outdoor conditions where the unit will be installed are different than the ones defined above, then the unit fall under subgroup 2 and the class will be displayed with an arrow. The class will then be the same than the winter application one (subgroup 2 when Winter design temperature T_{oda}>9°C).

*Recirculation units also fall under subgroup 2. The class signs are from **A+↻** to **E↻**.*

G.2.3. Subgroup 3

This subgroup will only consider the cross-section velocity of the filter section and mains power consumption to the fan(s).

This subgroup is for pure extract air units (First reason to allocate an energy label to this kind of unit application is that they could not include heat recovery. Another reason is that the design outdoor

[3] *The winter design outdoor temperature is only used to determine the subgroup of the energy efficiency calculation for summer application. It is not mandatory to use this value for the assessment of the energy efficiency class for winter condition.*

temperature has no relevance for such units). The class will then be the same than the winter application one (subgroup 3).

Refer to Methodology for winter application for further details. *The class signs are from **A+↑** to **E↑**.*

G.3. Reference cities and region approach

G.3.1. City approach

It is highly recommended to use the city approach.

The design dry bulb temperature and the design wet bulb temperature are obtained from the "ASHRAE 2017 Climatic Design Conditions" – Table "Monthly design dry bulb and mean coincident wet bulb temperature" – Line data: 2%. The highest temperature recorded in this line must be used for the calculation.

Example:

Monthly Design Dry Bulb and Mean Coincident Wet Bulb Temperatures	0.4%	DB	13.7	15.2	20.4	25.0	27.8	31.1	33.3	35.3	28.9	23.7	17.3	13.6
		MCWB	12.0	10.6	12.7	16.6	19.4	21.1	21.1	21.5	19.0	18.0	14.0	12.1
	2%	DB	12.3	12.6	17.6	22.2	25.2	28.2	30.6	30.9	25.9	20.9	15.3	12.5
		MCWB	10.9	9.9	12.0	14.5	17.6	20.0	20.4	20.1	18.4	16.6	13.3	11.3
	5%	DB	11.2	11.2	15.2	19.5	23.1	26.0	28.4	28.3	23.2	18.8	13.7	11.3
		MCWB	9.8	9.4	11.0	13.3	16.5	19.1	19.5	19.3	17.1	15.5	12.1	10.3
	10%	DB	9.9	10.0	13.4	17.2	20.9	23.9	26.3	25.8	21.3	17.2	12.4	10.1
		MCWB	8.7	8.5	10.2	12.1	15.4	17.9	18.7	18.4	16.2	14.6	11.2	9.1

The winter design outdoor temperature is obtained from the "ASHRAE 2017 Climatic Design Conditions" – Table "Annual Heating and Humidification Design Conditions" – Line data "Coldest month": 99%.

Example:

Annual Heating and Humidification Design Conditions														
Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest month WS/MCDB				MCWS/PCWD to 99.6% DB	
			99.6%			99%			0.4%		1%			
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD
1	-5.6	-3.5	-8.9	1.8	-3.7	-6.6	2.2	-2.6	14.0	10.8	12.7	10.4	2.5	10

The location used as reference must be the location where the unit will be installed. The user must select the closest location from the site where the AHU will be installed.

Source: http://ashrae-meteo.info/index.php.

G.3.2. Region approach

Alternatively to the city approach the Participant is entitled to use the region approach when the exact location of the project is unknown. Each region is linked to a reference city from the "ASHRAE 2017 Climatic Design Conditions". The Participant must refer to a region from the Eurovent Energy Efficiency Class database available on the restricted access of the Eurovent Certita Certification website (https://extfile.eurovent-certification.com/AHU/).

G.4. Methodology for summer application

The principle is to establish whether the selected unit with different energy parameters will consume no more energy than a unit that would exactly meet the requirements for the aimed class in 0 for summer application.

Perform the four following steps for respective air sides, supply and/or extract if in subgroup 1:

4) Assume an AHU is designed to meet the requirements for a particular class, so apply the corresponding class values (subscript "class") from 0 for summer application:
   - for velocity v_{class}
   - for Fan Efficiency Grade $NG_{ref\text{-}class}$
   - heat recovery dry efficiency $\eta_{T\text{-}class}$

- heat recovery wet efficiency $\eta_{H\text{-}class}$
- pressure drop $\Delta p_{T\text{-}class}$ and $\Delta p_{H\text{-}class}$

5) Use, for the actual air handling unit to be classified at design air flow, summer time, the actual selection values (subscript “s”) values:
   - fan static pressure increase $\Delta p_{s\text{-}static}$
   - external pressure drop $\Delta p_{s\text{-}external}$
   - velocity v_s
   - power supplied from mains to selected fan $P_{s\text{-}sup}$ if supply air side else $P_{s\text{-}ext}$
   - HRS temperature efficiency $\eta_{s\text{-}T}$
   - HRS humidity efficiency $\eta_{s\text{-}H}$
   - HRS pressure drop $\Delta p_{s\text{-}HRS}$
6) Calculate the pressure correction due to velocity Δp_x
   - pressure correction due to HRS pressure drop Δp_y (see 0)
   - pressure correction due to HRS efficiency Δp_z (see 0)
7) Calculate fan reference power Pair side-ref for the actual air handling unit side, i.e. $P_{sup\text{-}ref}$ if supply air side or $P_{ext\text{-}ref}$ if extract air side (see 0).

Final check consists in verifying whether the selected unit meets the absorbed power consumption criterion for the aimed class. So calculate the absorbed power factor; $f_{s–Pref}$ (see 0). If the value $f_{s\text{-}Pref}$ is equal or lower than 1, the unit meets the requirements for the class. If not, the same calculation procedure shall be repeated for a lower class.

G.5. Humidity recovery on Energy Efficiency Class methodology (1st step)

G.5.1. Determination of the three functions $f_{T\text{-}H}$, $f_{pe\text{-}DB}$, $f_{pe\text{-}DewP}$

The inputs are the summer outdoor location design conditions: Dry bulb temperature and Dew-point temperature.

The aim is to quantify the impact of the humidity recovery. Different empirical formulas for the equivalence between the efficiency and the pressure of a heat recovery system, as a function of the outdoor climate, have been derived from numerous energy consumption calculation.

For more information about the calculations and how the coefficients have been obtained, refer to the end of this appendix – section 0

G.5.1.1. Methodology used to determine the function $f_{T\text{-}H}$

$f_{T\text{-}H}$ is a factor that weighs the importance between recovery temperature and recovery humidity. The higher the value, the less important the humidity recovery..

$$f_{T-H} = a * X_{axis}^{b}$$

- Y-axis is the coefficient f_{T-H} (between >0.15 and 1)
- X-axis is an equation having for inputs dry and dew-point temperatures

$$X_{axis} = \frac{C1 * T_{dryB} - C2 * T_{dew-p}}{C3}$$

Where:

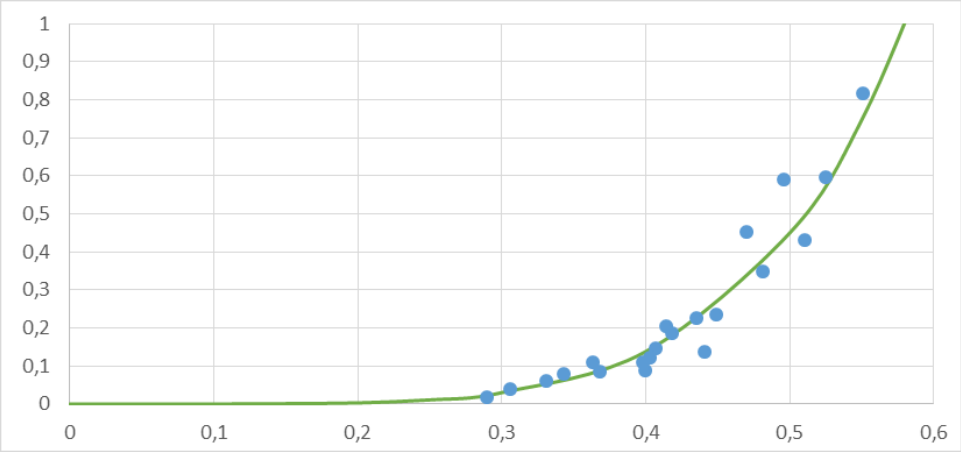
	c_1	c_2	c_3	a	b
Coefficients	**1,805**	**1**	**100**	**18,6**	**5,3**

Data in green: input from user
Data in blue: reference data from the tool

Data in orange: calculated based on input data from user

The design dry bulb temperature and the design wet bulb temperature are obtained from the "ASHRAE 2017 Climatic Design Conditions" – Table "Monthly design dry bulb and mean coincident wet bulb temperature" – Line data: 2%. The location used as reference must be the location where the unit will be installed. The user must select the closest location from the site where the AHU will be installed.

Source: http://ashrae-meteo.info/index.php



The limits of the coefficient $f_{T\text{-}H}$ are the following:

Limits	Min.	Max.
	0.15	1

If the value of the coefficient is lower or higher than the above limits, then the limit value must be considered.

e.g.: if $f_{T\text{-}H}$ is equal to 1.2 then the value to be considered is 1. If $f_{T\text{-}H}$ is equal to 0.12 then the value to be considered is 0.15.

G.5.1.2. Methodology used to determine the function $f_{pe\text{-}DB}$

f_{pe-DB} is a factor that weighs HRS pressure drop and dry efficiency for a design dry bulb temperature.

$$f_{pe-DB} = a * X_{axis}^3 + b * X_{axis}^2 + c * X_{axis}$$

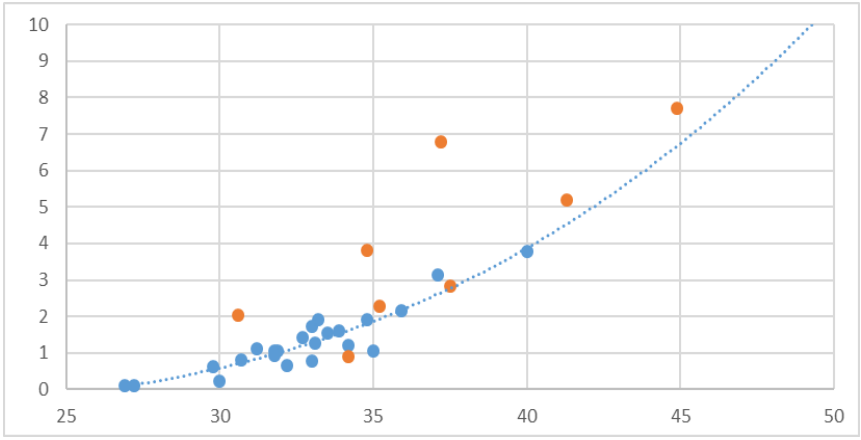
- Y-axis [Pa], in opposite to the winter application the relation between HRS pressure drop and efficiency almost don't exist. In other words to dry bulb temperature of 35 °C if the HRS efficiency increase 1% the pressure drop admissible for that reason is to 2 Pa.
- X-axis is the dry-bulb temperature

$$X_{axis} = T_{dryB}$$

Where:

	A	B	C
Coefficients	**0,0002**	**-0,0057**	**0,017**

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user



The limits of the coefficient $f_{pe\text{-}DB}$ are the following:

Limits	Min.	Max.
	1	No limit

If the value of the coefficient is lower or higher than the above limits, then the limit value must be considered.

G.5.1.3. Methodology used to determine the function $f_{pe\text{-}DewP}$

$f_{pe-DewP}$ is a factor that weighs HRS pressure drop and humidity efficiency for a design dew point temperature.

$$f_{pe-DewP} = a * X_{axis}^2 + b * X_{axis} + c$$

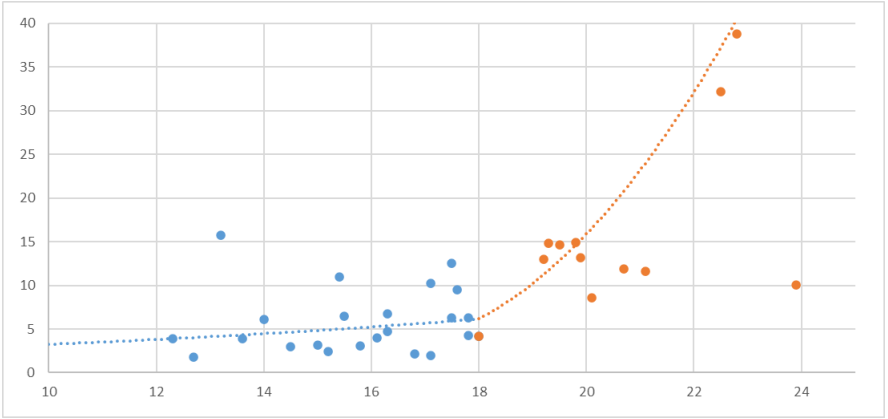
- Y-axis [Pa], similar to the f_{pe-DB}. The relation is different and for a dew point temperature of 20 °C the admissible pressure drop is 15 Pa.
- X-axis is the dew-point temperature

$$X_{axis} = T_{dewpoint}$$

Where:

	Dew-point Temperature	*a*	*b*	*c*
Coefficients	*≤ 18*	***0,0141***	***-0,0346***	***2,2***
	> 18	***0,8216***	***-26,38***	***214,8***

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user



Note: this coefficient is the one with the less trend but this has a small impact on final result.

Now that the three functions have been determined the correction factors Δp_x, Δp_y, Δp_z can be assessed.

G.5.2. Reference table

The following reference is applicable for the calculation of the correction factors for summer application:

CLASS	All Units	Units for full or partial outdoor air at design summer: winter dry bulb temperature ≥ -3°C AND dry bulb temperature ≥ 30°C OR winter dry bulb temperature ≥ -3°C AND dew-point temperature ≥ 17°C OR dry bulb temperature ≥ 30°C AND dew-point temperature ≥ 17°C				
	Velocity	Heat recovery system				Fan Efficiency Grade
	v_{class} [m/s]	$\eta_{class-T}$ [%]	$\Delta p_{class-T}$ [Pa]	$\eta_{class-H}$ [%]	$\Delta p_{class-H}$ [Pa]	$NG_{ref-class}$ [-]
A+	1.4	83	167	81	222	64
A	1.6	78	160	73	213	62
B	1.8	73	155	65	207	60
C	2.0	68	151	58	202	57
D	2.2	63	147	50	197	52
E	No calculation required					No requirement

Table 8: Table for energy efficiency calculations (summer application)

G.5.3. Pressure correction due to HRS pressure drop; Δpy

$$\Delta P_y = [\Delta P_{s-HRS} - \Delta P_{class-T}] * f_{T-H} + [\Delta P_{s-HRS} - \Delta P_{class-H}] * (1 - f_{T-H}) \quad \textbf{(Eq. 1.1)}$$

Where:

ΔP_{s-HRS}, is the HRS pressure drop from real selection, (subscript "s" refers to selection values)

$\Delta P_{class-T}$ and $\Delta P_{class-H}$, are reference values from the reference table section 0

f_{T-H}, refer to section 0.

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.5.4. Pressure correction due to HRS efficiency; Δpz

$$\Delta P_z = \left[(\eta_{class-T} - \eta_{s-T}) * f_{pe-DB} * f_{T-H} + (\eta_{class-H} - \eta_{s-H}) * f_{pe-DewP} * (1 - f_{T-H}) - \left[\eta_{s-H} * \left({}^{1}/_{f_{T-H}} - 1\right)\right]\right] * \left(1 - \frac{mr}{100}\right)$$

a b c

Where:

η_{s-T}, current selection temperature efficiency
η_{s-H}, current selection humidity efficiency* (cf note below)
$\eta_{class-T}$ and $\eta_{class-H}$, are reference values from the reference table section 0 f_{T-H}, refer to section 0
f_{pe-DB}, refer to section 0
$f_{pe-DewP}$, refer to section 0
mr, mixing ratio, as winter application

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

Note: Temperature wet efficiency is different than humidity efficiency. Temperature wet efficiency shall not be used for this calculation.

η_{s-T} and η_{s-H} must be set to 0 in case of supply only unit (no HRS).

And where:

a) Expresses the benefit or penalty, so the balance between the selection temperature efficiency and the class value multiply by factor f_{pe-DB}, convert the efficiency to pressure. It is also multiplied by factor f_{T-H} to balance the dry and humidity Heat Recovery;

b) As the term a), expresses the balance between the real humidity efficiency and the class value, too;

c) Expresses the benefit to use humidity recovery, used only in the equation for the supply side.

Explanation of term **c)**

It is possible with the factor f_{T-H} to have a relation between Latent and Sensible capacity as showed below.

$$\left({}^{1}/_{f_{T-H}} - 1\right) = \frac{1}{f_{T-H}} - 1 = \frac{1 - f_{T-H}}{f_{T-H}} = \frac{1 - \frac{Qs}{Q_s + Q_L}}{\frac{Qs}{Q_s + Q_L}} = \frac{Q_s + Q_L - Q_s}{Q_s} = \boldsymbol{\frac{Q_L}{Q_s}}$$

In the main equation, the factor $\left({}^{1}/_{f_{T-H}} - 1\right)$ needs to be multiplied by the humidity efficiency (η_{s-H}) to consider the latent capacity recovered.

G.6. Insert the internal decrease static pressure when HRS is on bypass mode on Energy Efficiency Class methodology (2nd step)

The internal decrease of the static pressure when the HRS is on bypass mode is considered only for the summer application.

G.6.1. Determination of the function $f_{Sp-bypass}$

$f_{Sp-bypass}$ is a factor (0< f < 1) that weighs the working time period of HRS bypass on summer application. (Value 1 when 100% time works the bypass, value 0 when 100% time works the HRS)

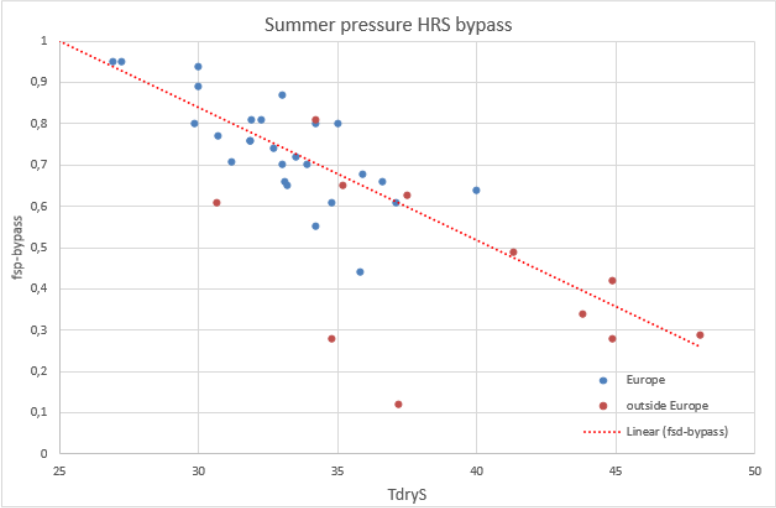
$$f_{SP-bypass} = a * X_{axis} + b$$

- Y-axis is the coefficient $f_{Sp-bypass}$
- X-axis is the Design Dry bulb temperature

$$X_{axis} = T_{DB}$$

Where:

	a	b
Coefficients	**-0,0322**	**1,8**



G.6.2. Pressure correction due to HRS pressure drop; Δp_y

Considering that $\Delta P_{s-bypass}$ is the pressure drop of current selection HRS bypass, the decrease of the static pressure drop when the HRS is on bypass mode is considered in the bypass circuit. In the heat recovery there is no impact, it is then necessary to assess the two circuits separately:

- In the heat recovery circuit ΔP_{y-HRS}
- In the bypass circuit $\Delta P_{y-bypass}$

The two pressure drop will then be weighted to obtained Δp_y from both circuits.

G.6.2.1. In the Heat Recovery circuit

$$\Delta P_{y-HRS} = [\Delta P_{s-HRS} - \Delta P_{class-T}] * f_{T-H} + [\Delta P_{s-HRS} - \Delta P_{class-H}] * (1 - f_{T-H}) \textbf{ (Eq. 1.2)}$$

Where:

ΔP_{s-HRS}, is the HRS pressure drop from real selection, (subscript "s" refers to selection values)
$\Delta P_{class-T}$ and $\Delta P_{class-H}$, are reference values from the reference table section 0
f_{T-H}, refer to section 0.

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.6.2.2. In the Bypass circuit

$$\Delta P_{y-bypass} = [\Delta P_{s-bypass} - \Delta P_{class-T}] * f_{T-H} + [\Delta P_{s-bypass} - \Delta P_{class-H}] * (1 - f_{T-H}) \textbf{ (Eq. 1.3)}$$

Where:

$\Delta P_{s-bypass}$, is the pressure drop of current selection HRS bypass
$\Delta P_{class-T}$ and $\Delta P_{class-H}$, are reference values from the reference table section 0
f_{T-H}, refer to section 0.

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.6.2.3. Weighting ratio between both circuits

$$\Delta P_y = (\Delta P_{y-HRS}) * (1 - f_{Sp-bypass}) + (\Delta P_{y-bypass}) * (f_{Sp-bypass}) \textbf{ (Eq. 1.4)}$$

Where:

ΔP_{y-HRS}, refer to section 0
$\Delta P_{y-bypass}$, refer to section 0
$f_{Sp-bypass}$, refer to section 0

G.7. Insert Indirect adiabatic cooling on Energy Efficiency Class methodology (3rd step)

The additional pressure drop of the indirect adiabatic cooling is considered only for the summer application. This additional pressure drop is added to the HRS pressure drop.

G.7.1. Determination of the function f_{IAC}

f_{IAC}, is a factor (multiplication) that reflect the increase on dry recovery, if doesn´t exist it will be equal to 1.

$$f_{IAC} = a * e^{b*X_{axis}}$$

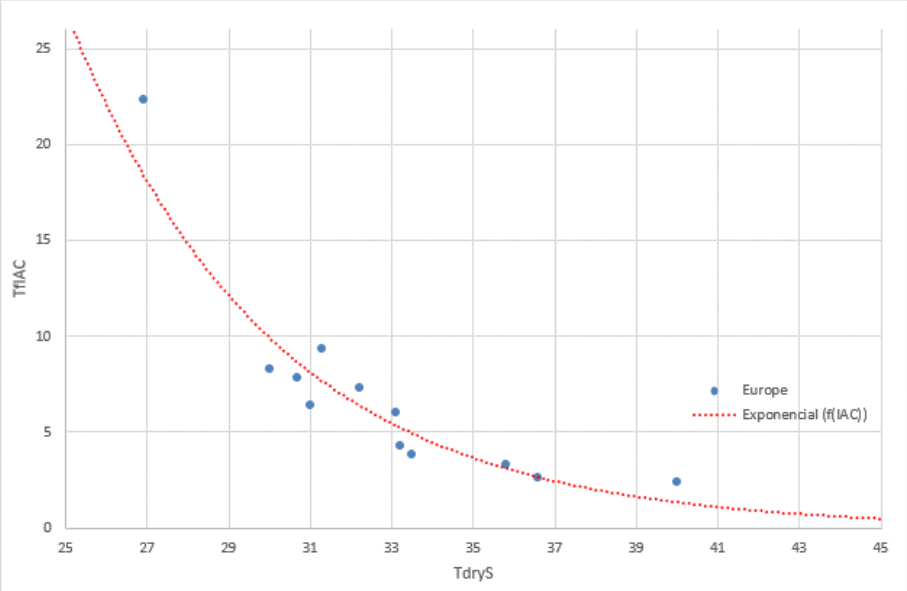
- Y-axis is the coefficient f_{IAC}
- X-axis is the Design Dry bulb temperature

$$X_{axis} = T_{DB}$$

Where:

	a	b
Coefficients	**4000**	**-0,2**

For more information about the calculations and how the coefficient have been obtained, refer to the end of this appendix – section […].



G.7.2. Pressure correction due to HRS pressure drop; Δp_y

Under section 02:

It was defined:

-In the Heat Recovery circuit

$$\Delta P_{y-HRS} = [\Delta P_{s-HRS} - \Delta P_{class-T}] * f_{T-H} + [\Delta P_{s-HRS} - \Delta P_{class-H}] * (1 - f_{T-H})$$

- In the Bypass circuit

$$\Delta P_{y-bypass} = [\Delta P_{s-bypass} - \Delta P_{class-T}] * f_{T-H} + [\Delta P_{s-bypass} - \Delta P_{class-H}] * (1 - f_{T-H})$$

G.7.2.1. In the Heat Recovery circuit

$$\Delta P_{y-HRS} = [\Delta P_s - \Delta P_{class-T}] * f_{T-H} + [\Delta P_s - \Delta P_{class-H}] * (1 - f_{T-H})$$ **(Eq. 1.5)**

Where:

$\Delta P_s = \Delta P_{s-HRS} + \Delta P_{s-IAC}$ (ΔP_{s-IAC} needs to be used in the equation only on the extract side)

ΔP_{s-HRS}, is the HRS pressure drop from real selection, (subscript "s" refers to selection values)

ΔP_{s-IAC}, is the indirect adiabatic cooling pressure drop (0 for supply side)

$\Delta P_{class-T}$ and $\Delta P_{class-H}$, are reference values from the reference table section 0
f_{T-H}, refer to section 0.

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.7.2.2. In the Bypass circuit

$$\Delta P_{y-bypass} = \left[\Delta P_{circ-bypass} - \Delta P_{class-T}\right] * f_{T-H} + \left[\Delta P_{circ-bypass} - \Delta P_{class-H}\right] * (1 - f_{T-H}) \quad \textbf{(Eq. 1.6)}$$

Where:

$\Delta P_{circ-bypass} = \Delta P_{s-bypass} + \Delta P_{s-IAC}$ (ΔP_{s-IAC} needs to be used in the equation only on the extract side)
$\Delta P_{s-bypass}$, is the pressure drop of current selection HRS bypass
ΔP_{s-IAC}, is the indirect adiabatic cooling pressure drop (0 for supply side)
$\Delta P_{class-T}$ and $\Delta P_{class-H}$, are reference values from the reference table section 0
f_{T-H}, refer to section 0.

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.7.3. Pressure correction due to HRS efficiency; Δp_z

Under section 0 the impact of the humidity recovery was considered, resulting in the Equation 2.1:

$$\Delta P_z = \left[(\eta_{class-T} - \eta_{s-T}) * f_{pe-DB} * f_{T-H} + (\eta_{class-H} - \eta_{s-H}) * f_{pe-DewP} * (1 - f_{T-H}) - \left[\eta_{s-H} * \left({}^{1}/_{f_{T-H}} - 1\right)\right]\right] * \left(1 - \frac{mr}{100}\right)$$

It needs to include the benefit of IAC, so the new equation is

$$\Delta P_z = \left[(\eta_{class-T} - \eta_{s-T}) * f_{pe-DB} * f_{T-H} + (\eta_{class-H} - \eta_{s-H}) * f_{pe-DewP} * (1 - f_{T-H}) - \underbrace{\left[\eta_{s-T} * f_{IAC} + \eta_{s-H} * \left({}^{1}/_{f_{T-H}} - 1\right)\right]}_{d}\right] * \left(1 - \frac{mr}{100}\right) \quad \textbf{(Eq. 1.7)}$$

Where:

η_{s-T}, current selection temperature efficiency
η_{s-H}, current selection humidity efficiency
$\eta_{class-T}$ and $\eta_{class-H}$, are reference values from the reference table section 0 f_{T-H}, refer to section 0
f_{pe-DB}, refer to section 0
$f_{pe-DewP}$, refer to section 0
f_{IAC}, refer to section 0 (0 supply side)
mr, mixing ratio, as winter application

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

η_{s-T} and η_{s-H} must be set to 0 in case of supply only unit (no HRS)

The term d) expresses the benefit of using IAC taking in consideration the HRS dry efficiency.

G.8. Final equations

The final equations include the influence of the three features defined in the sections above:

- Humidity Recovery
- Reduction in pressure drop in the Heat Recovery System (HRS) bypass
- Indirect adiabatic cooling (IAC)
- As for each feature it is the correction factors which are impacting, the rest methodology to determine the energy efficiency for summer application remaining the same.

G.8.1. Pressure correction; Δp_y

In order to consider the pressure drop in the bypass circuit Δp_y must be split into two sections:

- In the heat recovery circuit ΔP_{y-HRS}
- In the bypass circuit $\Delta P_{y-bypass}$

G.8.1.1. In Heat Recovery circuit

The final equation for ΔP_{y-HRS} is the following:

$$\boldsymbol{\Delta P_{y-HRS}} = [\Delta P_s - \Delta P_{class-T}] * f_{T-H} + [\Delta P_s - \Delta P_{class-H}] * (1 - f_{T-H})$$

Where:

$\Delta P_s = \Delta P_{s-HRS} + \Delta P_{s-IAC}$
ΔP_{s-HRS}, is the HRS pressure drop from real selection, (subscript "s" refers to selection values)
ΔP_{s-IAC}, is the indirect adiabatic cooling pressure drop
$\Delta P_{class-T}$ and $\Delta P_{class-H}$, are reference values from the reference table section 0
f_{T-H}, refer to section 0.

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.8.1.2. In Bypass circuit

The final equation for $\Delta P_{y-bypass}$ is the following:

$$\boldsymbol{\Delta P_{y-bypass}} = [\Delta P_{circ-bypass} - \Delta P_{class-T}] * f_{T-H} + [\Delta P_{circ-bypass} - \Delta P_{class-H}] * (1 - f_{T-H})$$

Where:

$\Delta P_{circ-bypass} = \Delta P_{s-bypass} + \Delta P_{s-IAC}$
$\Delta P_{s-bypass}$, is the pressure drop of current selection HRS bypass
ΔP_{s-IAC}, is the indirect adiabatic cooling pressure drop
$\Delta P_{class-T}$ and $\Delta P_{class-H}$, are reference values from the reference table section 0
f_{T-H}, refer to section 0.

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.8.1.3. Weighting ratio between both circuits

The final equation for $\Delta P_{y-bypass}$ is the following (balance between both circuits)

$$\boldsymbol{\Delta P_y} = (\Delta P_{y-HRS}) * (1 - f_{Sp-bypass}) + (\Delta P_{y-bypass}) * (f_{Sp-bypass})$$

Where:

ΔP_{y-HRS}, refer to section 0

$\Delta P_{y-bypass}$, refer to section 0
$f_{Sp-bypass}$, refer to section 0

G.8.2. Pressure correction due to HRS efficiency; Δp_z

The final equation for ΔP_z is the following:

$$\boldsymbol{\Delta P_z} = \left[(\eta_{class-T} - \eta_{s-T}) * f_{pe-DB} * f_{T-H} + (\eta_{class-H} - \eta_{s-H}) * f_{pe-DewP} * (1 - f_{T-H}) - \left[\eta_{s-T} * f_{IAC} + \eta_{s-H} * \left({}^{1}/_{f_{T-H}} - 1\right)\right]\right] * \left(1 - \frac{mr}{100}\right)$$

Where:

η_{s-T}, current selection temperature efficiency
η_{s-H}, current selection humidity efficiency
$\eta_{class-T}$ and $\eta_{class-H}$, are reference values from the reference table section 0
f_{T-H}, refer to section 0
f_{pe-DB}, refer to section 0
$f_{pe-DewP}$, refer to section 0
f_{IAC}, refer to section 0
mr, mixing ratio, as winter application

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.9. Fan reference power; $P_{sup-ref}$ if supply air side or $P_{ext-ref}$ if extract air side

The fan reference is then calculated just like the winter application using the following formula:

$$P_{airside-ref} = \frac{\left|\Delta P_{s-static} - (\Delta p_x + \Delta p_y + \Delta p_z)\right| \cdot q_{v-s}}{(a \cdot ln(P_{airside-ref}) - b + NG_{ref})/100}$$

Where: $P_{air\ side-ref}$ = fan reference power [kW] (use $P_{sup-ref}$ for supply air side or $P_{ext-ref}$ for extract air side)
q_{v-s} = air volume flow rate [m³/s]
NG_{ref} = Fan Efficiency Grade corresponding to the class value *in %*
a, b = coefficients as per table below.

$P_{air\ side-ref}$	a	b	NG_{ref}
≤ 10 kW	4,56	10,5	$NG_{ref-class}$
> 10 kW	1,1	2,6	$NG_{ref-class}$

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

The first iteration of $P_{air\ side-ref}$ being:

$$P_{airside-ref(1st\ iteration)} = \frac{\left|\Delta P_{s-static} - (\Delta p_x + \Delta p_y + \Delta p_z)\right| \cdot q_{v-s}}{NG_{ref}/100}$$

G.10. Absorbed power factor; f_{s-Pref}

$$f_{\text{s-Pref}} = \frac{P_{\text{s-sup}} + P_{\text{s-ext}}}{P_{\text{sup-ref}} + P_{\text{ext-ref}}} \leq 1$$

where: f_{s-Pref} = absorbed power factor

$P_{s\text{-}sup}$ = active power supplied from the mains, including any motor control equipment, to selected supply air fan [kW]
$P_{s\text{-}ext}$ = active power supplied from the mains, including any motor control equipment, to selected extract air fan [kW]
$P_{sup\text{-}ref}$ = supply air fan reference power [kW]
$P_{ext\text{-}ref}$ = extract air fan reference power [kW]

Data in green: input from user
Data in blue: reference data from the tool
Data in orange: calculated based on input data from user

G.11. Methodology and data used to define the different factors

G.11.1. List of country used for the definition of the different factors

European place list

Country	Place	Country	Place	Country	Place
Greece	Andravida	Spain	Madrid	Denmark	Copenhagen
Greece	Athens	France	Marseille	Germany	Frankfurt
Bosnia and Herzegovina	BANJA LUKA	Italy	Milano	Finland	Helsinki
Spain	Barcelona	Italy	Naples	Lithuania	KAUNAS
Serbia	BELGRADE	France	Nice	Sweden	Kiruna
France	Bordeaux	Italy	Palermo	Poland	Krakow
Hungary	DEBRECEN	Spain	Palma	Slovenia	Ljubljana
Portugal	Faro	Montenegro	PODGORICA	Germany	Munich
Portugal	Funchal	Portugal	Porto	Norway	Oslo
Turkey	Istanbul	Italy	Rome	France	Paris
Turkey	Izmir	Spain	Seville	Czech	PRAGUE
Portugal	Lajes	Greece	Thessaloniki	Sweden	Stockholm
Cyprus	Larnaca	Netherlands	Amsterdam	Poland	Warsaw
Spain	Las Palmas	Turkey	Ankara		
Portugal	Lisbon	Germany	Berlin		

Winter extreme conditions

Country	Place
Russian	ARHANGELSK
Russian	Chita
USA	Fort Yukon
Canada	Resolute

Humid extreme conditions

Country	Place
Thailand	Bangkok
Brazil	Manaus

Dry and hot extreme conditions

Country	Place	Country	Place
UAE	Abu Dhabi	Tunisia	Tunis
Algeria	Algiers	Egypt	Kharga
Morocco	Casablanca	Kuwait	Kuwait
Israel	Tel Aviv	Saudi Arabia	Riyadh
Libya	Tripoli		

G.11.2. Climate data

The climate source data used to plot the graph and determine the different factors was the energyplus weather.

Climate source data: https://energyplus.net/weather

The climate data type is “IWEC – International Weather for Energy Calculations”, more information on: https://energyplus.net/weather/sources#IWEC

G.11.3. Season of the year (Summer or Winter)

The determination of the season is based on **HDD** and **CDD** “Heating and Cooling degree days”

Source method **European Environment Agency:** https://www.eea.europa.eu/data-and-maps/indicators/heating-degree-days/assessment

G.11.4. Heat recovery simulation

The simulations were hourly and all over the year.

Two situations were made:

- Dry system with temperature control
- Humidity recovery with enthalpy control

The extract air conditions were:

- Winter 18 °C dry bulb temperature and 11 °C dew-point temperature (relative humidity 63%)
- Summer 25 °C dry bulb temperature and 14 °C dew-point temperature (relative humidity 50%)
- Summer with Indirect Adiabatic Cooling (IAC) 19 °C dry bulb temperature and 17,5 °C dew-point temperature (relative humidity 90%), same Enthalpy than 25 °C / 50%

Criterion to recovery active:

- On dry system was: external temperature vs extract air conditions
- On wet system was: external enthalpy vs extract air conditions

G.11.5. Temperature design reference

The reference dry temperature and dew-point temperature derivate from ASHRAE 2013 Monthly design Dry Bulb 2% data (database 2017 was not available at the time of the simulations, the year 2013 was then used).

Source : http://ashrae-meteo.info/index.php

APPENDIX H. *HYGIENIC OPTION FOR AIR HANDLING UNITS*

Refer to 2021-07 ECP-05-2021 Appendix H for HAHU.

Performances on line
www.eurovent-certification.com

EUROVENT CERTITA CERTIFICATION
48-50 Rue de la Victoire, 75009 Paris, FRANCE
Phone: +33 (0)1 7544 7171
www.eurovent-certification.com