TECHNICAL CERTIFICATION RULES OF THE EUROVENT CERTIFIED PERFORMANCE MARK

Indoor Air Quality and Energy Efficiency of Ventilation Systems

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The purpose of this Technical Certification Rules is to prescribe procedures for the operation of the Eurovent Certified Performance (ECP) certification programme for Indoor Air Quality and Energy Efficiency of Ventilation Systems (IAQVS), in accordance with the Certification Manual.

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I. GENERAL INFORMATION

I.1 Scope

The programme scope covers components of mechanical ventilation systems (see §I.3.26) for single dwellings (single family homes and apartments).

The categories of ventilation systems covered by the scope are the following:

- Central, single flow : supply ventilation (see §I.3.35) or exhaust ventilation (see §I.3.20) without heat recovery
- Central, double flow: balanced ventilation (see §I.3.10)
  - including heat recovery
  - without heat recovery
- Single-room, single flow: decentralised continuous ventilation (see §I.3.15) for supply or exhaust
- Single-room, double flow (balanced ventilation)
  - including heat recovery
    - recuperative heat exchanger with two fans
  - without heat recovery

The ventilation system components covered by the scope are listed in Appendix A.

Single-room, double flow ventilation systems with alternating airflows, also called decentralised alternating ventilation (see §I.3.14), are excluded from the scope at this stage. Their inclusion in the scope will be re-examined as soon as their modelling implementation in the computational kernel is ready.

The following products are specifically excluded from the scope:

- Air extraction cooker hoods that are not physically connected to the ventilation system,
- Air recirculating cooker hoods,
- Stand-alone air cleaners,
- Photocatalytic filters and any other filter type not covered by Appendix A.

I.2 Certified performances

The programme is intended to certify the performance of an assembly of components forming a specific ventilation system with respect to Indoor Air Quality and Energy Efficiency. The performances are evaluated considering the whole assembly, which enables to assess the synergies between its constituting components.

The ventilation system is evaluated through simulations. The simulations are generated by a computational kernel in consistency with the ventilation system description and application field. The simulations provide a number of performance indicators that enable to assess the ventilation system performance from both Indoor Air Quality (see §I.2.1) and Energy Efficiency (see §I.2.2) perspectives

I.2.1 Indoor Air Quality performance indicators

The following Indoor Air Quality (IAQ) performance indicators are assessed:

- Carbon dioxide (CO_2) concentration
- Air Relative Humidity (RH)
- Formaldehyde concentration

In addition to the above indicators, the programme will address the ventilation system ability to treat particulate matters (PM) in a second stage. The PM indicator will be introduced in the certification scheme as soon as the complex modelling of both outdoor and indoor sources treatment is complete.

The IAQ indicators are expressed by individual grades from 0 (bad Indoor Air Quality) to 5 (good Indoor Air Quality).

They are rounded to one decimal place.

E.g. : If ICO_2 = 3.44 the value will be reported as 3.4. For 3.45 the reported value is 3.5.

I.2.2 Energy Efficiency indicators

The following Energy Efficiency performance indicators are assessed:

- Energy consumption of the fan (E_{fan})
- Consumption induced by air renewal ($E_{heating}$)

They are expressed in kWh/annum (rounded to the nearest integer).

I.2.3 Performance items not covered by the programme

The following performances are not considered:

- Thermal comfort, including summer comfort
- Acoustic comfort.

The programme will address these performances in a subsequent phase.

I.3 Definitions

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

I.3.1 Actuator

According to standard EN 12792:2003, an actuator is a device, electrically, pneumatically, or hydraulically operated, which acts as a motor to change the position of movable devices such as valves or dampers.

I.3.2 Air diffusion

According to standard EN 12792:2003, air diffusion can be defined as the distribution of the air in a space, called the treated space, in a manner to satisfy certain specified conditions such as air change rate, pressure, cleanliness, temperature, humidity, air velocity and noise level, in a specified zone within this treated space which is called the occupied zone. It is usually achieved by means of air terminal devices (see §I.3.5), which form the common boundaries between the treated space and the air distribution system (see §I.3.3).

I.3.3 Air distribution

According to standard EN 12792:2003, air distribution can be defined as the transportation of a specified air flow to or from the treated space generally by means of straight ducts (see §I.3.32) and fittings (see §I.3.16). Along the ducts, devices for the purpose of treating the air (e.g., cleaning, heating, cooling, humidifying or dehumidifying, etc.) and known as air treatment devices (see §I.3.9), may be inserted.

I.3.4 Air extraction cooker hood

According to standard EN 12792:2003, an air extraction cooker hood is a device intended to collect contaminated air from above a cooking appliance and which discharges the collected air to the outside of the building.

I.3.5 Air terminal device

According to standard EN 12792:2003, an air terminal device (ATD) is an air diffusion component (see §I.3.2) in a ventilation system which is designed with the purpose of achieving the predetermined movement of air into or from a treated space. They can be divided into the following categories:

- automatically controlled devices having moving parts which interact with a change in local conditions, such as temperature, humidity, CO_2 concentration, pressure difference, air flow rate, etc.
- fixed devices without any adjustable parts
- manually adjustable devices having adjustable parts which can be manually adjusted.

Examples: supply ATD (see §I.3.34), exhaust ATD (see §I.3.19), grilles, diffusers, etc.

I.3.6 Air terminal unit

According to standard EN 12792:2003, an air terminal unit is an air distribution equipment (see §I.3.3), inserted into or added to the ends of ducts, which fulfils either manually or automatically one or more of the following functions:

- controls the velocity or pressure and/or temperature of the air;
- controls the air flow rate;
- mixes primary streams of different temperatures or humidities;
- mixes within the device primary air with air from the treated space.

Examples: Fan assisted induction terminal unit with constant flow rate (“Constant air Volume”) ; Fan assisted induction terminal unit with variable flow rate (“Variable air Volume”); etc.

I.3.7 Air tightness class

According to standard EN 12792:2003, the air tightness class is the measure of the tightness of a ductwork system, defined at the maximum permitted air leakage factor, called “air leakage limit” (f_{max}). The air tightness classification (see Table 1) from A (worst class) to D (best class) defines the air leakage limit f_{max} for each air tightness class. To meet an air tightness class, both leakage and strength criteria shall be fulfilled in accordance with the relevant testing standard (see §A.3.1.1).

Table 1: Air tightness classification

Air tightness class	*Air leakage limit f_{max} [$m^3 \cdot s^{-1} \cdot m^{-2}$]*	
A	$0.027 \times p_t^{0.65} \times 10^{-3}$	with p_t the test pressure
B	$0.009 \times p_t^{0.65} \times 10^{-3}$	
C	$0.003 \times p_t^{0.65} \times 10^{-3}$	
D	$0.001 \times p_t^{0.65} \times 10^{-3}$	

I.3.8 Air transfer device

According to standard EN 12792:2003, an air transfer device is an air terminal device (see §I.3.5) designed to allow the transfer of air from one space/room to another space/room.

Example: self-regulating air inlets, etc.

I.3.9 Air treatment

According to standard EN 12792:2003, air treatment is the process by which the state of the air is modified with respect to various properties such as temperature, moisture content, dust content, bacterial count, gas and vapour contents, etc.

I.3.10 Balanced ventilation system

A ventilation system is referred to as “balanced” when both supply and exhaust air flows are provided mechanically thanks to a bidirectional ventilation unit (see §I.3.11).

I.3.11 Bidirectional ventilation unit (BVU)

According to regulation (EU) N°1253/2014, a bidirectional ventilation unit is a ventilation unit (see §I.3.40) producing an air flow between indoors and outdoors and which is equipped with both exhaust and supply fans.

I.3.12 Control parameter

According to regulation (EU) N°1253/2014, a control parameter is a measurable parameter or set of measurable parameters that are assumed to be representative of the ventilation demand (e.g., the level of relative humidity (RH), carbon dioxide (CO_2), presence, etc.).

I.3.13 Control system

According to standard EN 12792:2003, a control system is an arrangement of elements interconnected and interacting in such a way as to maintain or influence in a prescribed manner specified conditions.

I.3.14 Decentralised alternating ventilation unit

A decentralised alternating ventilation unit is a non-ducted ventilation unit (see §I.3.27) which ensures both exhaust and supply ventilation functions in an alternative way thanks to a reversible fan. It can also be referred to as a “push-pull” ventilation unit.

I.3.15 Decentralised continuous ventilation unit

A decentralised continuous ventilation unit is a non-ducted ventilation unit (see §I.3.27) which ensures either an exhaust or a supply ventilation function.

I.3.16 Duct fitting

According to standard EN 12792:2003, a duct fitting is a component of ductwork incorporating one or several of the following changes relative to:

- the length of the duct;
- the orientation of the duct;
- the shape of the straight length of the duct;
- the area of the cross-section of the duct.

Examples: Bends, T-pieces, reducers, couplings, etc.

I.3.17 Ducted ventilation unit

According to regulation (EU) N°1253/2014, a ducted ventilation unit means a ventilation unit (see §I.3.40) intended to ventilate one or more rooms or enclosed space in a building through the use of air ducts, intended to be equipped with duct connections. It can be also referred to as “centralised” ventilation unit.

I.3.18 Exhaust air

According to standard EN 12792:2003, the exhaust airflow is the air flow discharged to the atmosphere.

I.3.19 Exhaust air terminal device

According to standard EN 13142:2013, the exhaust air terminal device (see §I.3.5 and §I.3.18) is the device through which air leaves the treated space.

I.3.20 Exhaust ventilation system

A ventilation system is referred to as “exhaust” when the exhaust airflow (see §I.3.18) is extracted mechanically from the building thanks to a unidirectional ventilation unit (see §I.3.36).

I.3.21 Externally mounted air transfer device

According to standard EN 13142:2013, an externally mounted air transfer device (see §I.3.8) is a device designed to allow the passage of air through the building envelope with the minimum ingress of rain, snow, foreign bodies, etc.

I.3.22 Flow regulator

Air flowrate control devices, also called flow regulators, can be defined as follows:

I.3.22.1 Constant air flowrate control device

According to standard EN 12792:2003, a constant air flowrate control device is a component which maintains the air flow rate at a required constant value when the pressure differential between high and low pressure sides vary within the limits for which the component is designed.

I.3.22.2 Variable air flowrate control device

A variable air flowrate control device is a component which interacts with a change in local conditions, such as temperature, humidity, CO_2 concentration, pressure difference, air flow rate, etc.

I.3.23 Habitable room

According to standard EN 13141-11:2015, a habitable room is a room in a building for purposes such as living (living room), sleeping (bedroom), or studying (study room). Wet rooms (kitchens, bathrooms, toilet rooms), closets, hall, storage, or utility spaces are not considered habitable rooms.

I.3.24 Integrated sensor

An integrated sensor is a sensor integrated in a standalone component that combines the functions of a sensor (see §I.3.31) and actuator (see §I.3.1). It can be mechanical (e.g., fabric) or electronic but with embedded controller.

E.g., Electronic sensors located at the valve level which directly actuates the valve opening/closing.

I.3.25 Leakage factor

The leakage factor (f) is the leakage flow rate per unit of ductwork surface area [$m^3 \cdot s^{-1} \cdot m^{-2}$] with q_v the leakage air flow rate [$m^3 \cdot s^{-1}$] at a given test pressure and A the ductwork surface area [m^2]:

$$f = \frac{q_v}{A}$$

I.3.26 Mechanical ventilation system

According to standard EN 12792:2003, a ventilation system (see §I.3.38) is said mechanical when the ventilation is achieved with the aid of powered air movement components.

I.3.27 Non-ducted ventilation unit

According to regulation (EU) N°1253/2014, a non-ducted ventilation unit means a single room ventilation unit intended to ventilate a single room or enclosed space in a building, and not intended to be equipped with duct connections. It can be also referred to as “decentralised” ventilation unit.

I.3.28 Relative air humidity

According to standard EN 12792:2003, the relative air humidity is, in humid air, the ratio expressed as a percentage of the water vapour's actual pressure to the saturated vapour pressure at the same dry bulb temperature.

I.3.29 Remote sensor

Sensor (see §I.3.31) which is located apart from the actuator (see §I.3.1), wireless connected or not.

I.3.30 Residential ventilation applications

This certification programme considers as residential the ventilation applications involving single and multiple dwellings in consistency with the definition that appears in regulation (EU) N°1253/2014 which specifies that a ventilation unit is considered residential when:

- the maximum flow rate does not exceed 250 m^3/h;

or

- the maximum flow rate is between 250 and 1 000 m^3/h and the manufacturer declares its intended use as being exclusively for a residential ventilation application;

I.3.31 Sensor

According to standard EN 12792:2003, device or instrument designed to detect and measure a variable.

I.3.32 Straight duct component

According to standard EN 12792:2003, a straight duct component is a duct component with a constant straight section along the considered element; it can be either rigid, semi-rigid or flexible, a flexible duct is one which can change orientation without the use of a fitting (see §I.3.16).

I.3.33 Supply air

According to standard EN 12792:2003, the supply airflow means air flow entering the treated space, or air entering the system after any treatment.

I.3.34 Supply air terminal device

According to standard EN 13142:2013, the supply (see §I.3.33) air terminal device (see §I.3.5) is the device through which air enters the treated space.

I.3.35 Supply ventilation system

A ventilation system is referred to as “supply” when the supply airflow (see §I.3.33) is provided mechanically to the building thanks to a unidirectional ventilation unit (see §I.3.36).

I.3.36 Unidirectional ventilation unit (UVU)

According to regulation (EU) N°1253/2014, a unidirectional ventilation unit is a ventilation unit (see §I.3.40) producing an air flow in one direction only, either from indoors to outdoors (exhaust) or from outdoors to indoors (supply), where the mechanically produced air flow is balanced by natural air supply or exhaust.

I.3.37 Ventilation

According to standard EN 12792:2003, ventilation designates the supply and removal of air to and from a treated space.

I.3.38 Ventilation system

According to standard EN 16798-3:2017, a ventilation system is a combination of appliances designed to supply interior spaces with outdoor air and to extract polluted indoor air.

I.3.39 Ventilation system package (for a single dwelling)

According to standard EN 13142:2013, a ventilation system package is a combination of compatible components which are tested, delivered and installed as specified by the manufacturer, to complete a residential ventilation system when sold as a single product. It may exclude minor parts such as tapes, sealants and screws.

I.3.40 Ventilation unit (VU)

According to regulation (EU) N°1253/2014, a ventilation unit (VU) is an electricity driven appliance equipped with at least one impeller, one motor and a casing, and intended to replace utilised air by outdoor air in a building or a part of a building.

I.4 Contributors

Not applicable.

II. REQUIREMENTS OF THE REFERENCE DOCUMENT

II.1 Reference documents

II.1.1 Evaluation method descriptive documents

The evaluation method is detailed in the documents listed below:

- EN-CAPE 19.006 C: Development of a Method of Characterizing Ventilation System Performance, CSTB
- EN-CAPE 18.202 C: IAQ Certification Tool for Ventilation Systems - Modeling of the Systems, CSTB
- EN-CAPE 18.203 C: Indoor Air Quality Certification Tool for Ventilation Systems - Single-Family Home Reference System, CSTB

The methodology for the post-treatment of performance results (spider diagram and related labelling) is detailed in Appendix C and Appendix D.

II.1.2 Applicable regulations

It is the responsibility of the applicant/participant to ensure that the components constituting the system(s) he declares for certification are compliant with the applicable regulations.

II.2 Specific requirements

II.2.1 Specific requirements for declaration of data

The applicant/participant shall declare certified and/or justified and/or default values in accordance with the provisions specified in Appendix A.

II.2.1.1 Certified input performance data

The input performance data of a given ventilation system component can only be considered as certified if it was obtained in the following circumstances:

- the ventilation system component performance testing was conducted by an ISO 17025:2017 accredited laboratory in accordance with the applicable approved standard(s) (see Appendix A),

and

- the certification was granted by a third-party certification body accredited according to standard ISO 17065:2012.

The certification diploma and related accreditation certificates will have to be provided in the admission file (see §III.1.1).

Certified values are taken as is (without any correction).

II.2.1.2 Justified input performance data

The input performance data can get the status "justified" if the ventilation system component performance data is justified by a test report issued by an ISO 17025:2017 accredited laboratory in accordance with the applicable approved standard(s) (see Appendix A).

The test report and related ISO 17025:2017 accreditation certificate will have to be provided in the admission file (see §III.1.1).

To be acceptable, the test report will have to comply with the requirements specified in ISO 17025:2017. The test report shall notably include:

- the test results in their entirety
- an estimation of the overall measurement uncertainty
- a proper description of the tested object
- detailed information about the test conditions
- information about the calibration of the measuring equipment (calibration date as a minimum)

The measured data displayed in the test report(s) shall enable to justify the input data provided by the manufacturer. It is authorized to obtain the data by means of interpolation between actual measurements but extrapolation is not allowed. To be accepted, the interpolated point P_i of coordinates (x_i;y_i) shall be obtained from measured points P_{m1} (x_{m1} ; y_{m1}) and P_{m2} (x_{m2} ; y_{m2}) with:

- x_{m1} and x_{m2} comprised between [0.8x_i ; 1.2x_i] (the axis x representing the flow rate)
- y_{m1} and y_{m2} comprised between [0.8y_i ; 1.2y_i] (the axis y representing the pressure or the power consumption depending on the situation).

Note: For a constant airflow fan, a test report comprising 2 measurement curves corresponding to 150m^3/h and 200m^3/h will be accepted as justification for operational curves located in the range [135m^3/h;165m^3/h] and [180m^3/h;220m^3/h]. If the manufacturer wants to declare operating points in the non-covered ranges then an additional test report covering this extra operating area must be provided.

For specific cases where the test method is not worldwide recognised, other criteria can be relied upon for the acceptance of a test report. EUROVENT CERTITA CERTIFICATION will proceed to the validation on a case-by-case basis.

Justified values are downgraded in accordance with the provisions specified in Appendix A and Appendix C.

II.2.1.3 Default values

Whenever a ventilation system component can neither be certified nor justified (not manufactured by the OEM for instance) then a default value can be considered (see Table 2). The authorized default values are listed in Table 3.

II.2.1.4 Consistency between declared data and information provided to customers

The applicant/participant shall provide evidence that the declared system data are consistent with the information provided to actual customers:

- Links to commercial website(s)
- Selection software(s)
- Commercial or technical brochures
- Etc.

When the system is not commercially available yet, the corresponding draft documentation shall be provided to EUROVENT CERTITA CERTIFICATION for validation. The final documentation will have to be provided to EUROVENT CERTITA CERTIFICATION when published.

II.2.2 Quality management requirements

II.2.2.1 Use of mark logo

The participant shall respect the marking requirements of the certification manual and of the Technical certification rules if the certification mark is used on its technical documentations (see §II.3.2).

II.2.2.2 Management of customer claims

Customer claim and their treatment related to certified systems components shall be done, recorded and maintained available.

II.3 Marking

It is highly recommended that the participating company indicates participation in the EUROVENT CERTIFIED PERFORMANCE (ECP) programme for Indoor Air Quality and Energy Efficiency of Ventilation Systems by the following means.

II.3.1 Eurovent Certified performance mark and associated label

II.3.1.1 Eurovent Certified Performance mark (ECP)

The ECP mark alone is not allowed to be displayed. Any communication about certification shall be done using the specific label (see §II.3.1.2).

II.3.1.2 Specific label

Whenever the participant communicates about the present certification, it is mandatory to use the label provided by EUROVENT CERTITA CERTIFICATION.

The label, specific to each certified ventilation system and corresponding to a given climate (see Appendix D), is issued by EUROVENT CERTITA CERTIFICATION at the same time as the corresponding certificate.

The participant receives two or three labels, depending on the number of climates selected (see §III.1.3.2 and §III.1.4).

The label content is detailed in Appendix D.

II.3.2 Use of the certification mark by the Participant

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

II.3.2.1 Display of Eurovent Certified Performance mark on production units

The marking on products is not applicable for the IAQVS certification programme. Only the marking on documentation (see §II.3.2.2) is allowed.

II.3.2.2 Display of Eurovent Certified Performance mark on technical documentation

The provisions of the Certification Manual apply.

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 admission: declaration file, product performance certification diplomas (see §II.2.1.1) and/or test reports (see §II.2.1.2) for all concerned ventilation components, the ISO 17025 accreditation certificate for the laboratory(ies), the ISO 17065 accreditation certificate for the certification body(ies) whenever different from EUROVENT CERTITA CERTIFICATION and relevant literature.

The Applicant has to declare a ventilation system as complete as possible, that is including all the components manufactured by his company or group. He can declare the system(s) of his choice.

When the Applicant does not manufacture the whole list of components, the missing components will be considered using default values when authorised (see §A.2). When default values are not authorised, the Applicant shall declare complementary components from a supplier who shall be officially associated to the certification as partner of the applicant. The complementary components performance data shall be certified (see §II.2.1.1) or justified (see §II.2.1.2). Acceptable certifications and testing standards are detailed in Table 2. The references of the concerned components will be available on the website www.eurovent-certification.com, so the Applicant shall get the authorization from the partner first.

III.1.1.1 Performance data units

All characteristics shall be expressed in SI Units.

III.1.1.2 Certification forms

Submittal of data shall be completed using the dedicated form IAQVS-1 which will be used to declare performance ratings and complete the technical description of the ventilation system (see Appendix B).

III.1.2 Admissibility of the application

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

EUROVENT CERTITA CERTIFICATION will evaluate the certification diplomas and/or test reports, accreditation certificates and technical documentation provided by the applicant and ask for complementary information whenever necessary.

EUROVENT CERTITA CERTIFICATION will then proceed to a desk study (see §III.1.3.1) to check the compliance of the declared system against the present Technical Certification Rules.

Compliance to requirements specified in the present technical certification rules is necessary prior to running the computational kernel (see §III.1.3.2).

III.1.3 Implementation of checking operations

III.1.3.1 Desk study

The desk study will enable to check the requirements specified in §II.

A desk study is required to check the requirements listed in §II. It consists of a checking of all relevant documents provided by the applicant (see §III.1.1).

Particular attention will be drawn to the certification diplomas and accreditation certificates and consistency with the technical documentation will be verified (see §II.2.1.4).

If the applicant provides a new document related to the declared system after the desk study is complete, the review of this additional element will be conducted as extra and invoiced as such.

A desk study is considered "satisfactory" when all the requirements listed in the present Technical Certification Rules are met.

III.1.3.2 Computational kernel running

Once the desk study is complete and satisfactory, EUROVENT CERTITA CERTIFICATION runs the computational kernel with the components input data (downgraded whenever applicable, see §II.2.1) in order to obtain the indicators (see §I.2.1 and §I.2.2) corresponding to the system submitted for the certification.

The run conducted for the base configuration of the system is called “base run”.

The “base run” package price comprises one simulation for the average (i.e., temperate) climate and one simulation for one climate of the applicant’s choosing (cold climate or warm climate). The average climate is systematically simulated for comparison purposes.

The following adjustment to the base configuration does not require additional element review:

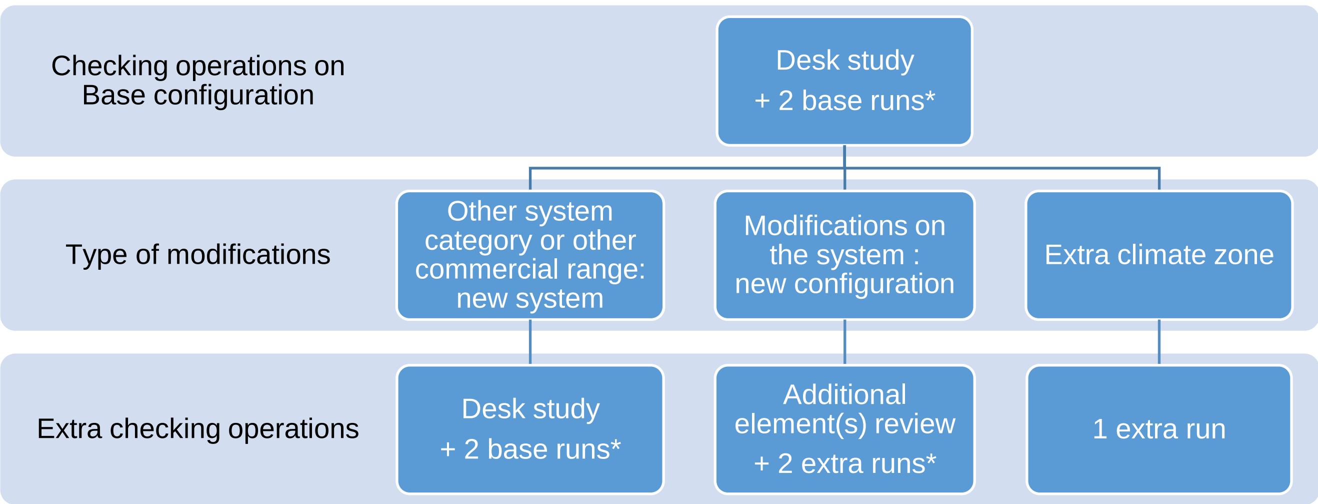
- additional climate (warm/cold climate if the cold/warm climate was chosen in addition to the average climate for the “base run”)

Any modification that affects :

- the composition of the ventilation system (change of component(s))
- the control (example: combination of CO_2 detection and HR detection vs HR detection alone)
    - the action of changing the setpoint (example from 800 ppmv to 1000 ppmv for a CO_2 sensor threshold)
    - the action of modifying the control by adding/removing/changing one or several sensor(s).
- the ventilation unit fan curve
- the application field (dwelling size range)
- heat exchanger efficiency
- heat exchanger leakage
- ductwork airtightness class
- etc.

is considered as a new configuration and additional elements are expected for review according to §III.1.3.1 (see also Figure 1).

A change of ventilation system category (i.e., central versus single-room, or single flow versus double flow, see §I.1) or a change of commercial range (i.e., “RangeABC” vs “RangeDEF”) is considered as a new system (new base configuration) to be evaluated according to §III.1 (see Figure 1).



*average climate + chosen climate

Figure 1 : Checking operations flowchart for one system

III.1.4 Evaluation and decision

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

If the checking operations enabled to confirm that all requirements specified in §II are fulfilled, EUROVENT CERTITA CERTIFICATION provides the obtained ratings to the applicant.

The applicant shall communicate his decision to publish the certified ratings or to request modifications on the system (or withdrawal of the original system and submission of a new system) by filling in the related form in the specified delay (see §B.2). EUROVENT CERTITA CERTIFICATION proceeds to the certification decision or to the extra/new checking operations accordingly.

The decision to grant the certification is submitted to the completion of the following requirements:

- The desk study is complete and satisfactory. In particular, all certification diplomas and/or test reports and the related accreditation certificates comply to the requirements specified in §II.2.1 and certification diplomas, when applicable, are still valid (certification was not suspended and its term of validity has not expired yet on the date of decision),
- The applicant has communicated his decision to publish the concerned system configuration(s)
- All invoices have been paid in full.

When the certification is granted, a certificate and two (or three, depending on the number of climates selected) related labels (see Appendix D) are issued by EUROVENT CERTITA CERTIFICATION and provided to the participant. Besides, EUROVENT CERTITA CERTIFICATION publishes the certified systems on the website www.eurovent-certification.com. The information published on the website are the following:

- Same information as on the label (see D.1) corresponding to the whole application field (all dwelling sizes and configurations combined).
- System description (list of components, components description, name of partner supplier when applicable, etc.)
- Application field (dwelling sizes and configurations)
- Certified performance indicators for IAQ (see §I.2.1) and EE (see §I.2.2) and global IAQ indicator (see §C.3.2) corresponding to each dwelling size.

From that moment on, the participant is authorized to communicate about his certification in compliance with the provisions specified in §II.3.2.

III.2 Surveillance procedure

The provisions of the Certification Manual apply.

III.2.1 Implementation of surveillance operations

III.2.1.1 Desk study (annual surveillance)

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

Every year, EUROVENT CERTITA CERTIFICATION will proceed to a verification of the validity of the certification diplomas and/or test reports and of the accreditation certificates. If the participant needs to provide a new document (system changed or documents validity expired), the review of this additional element will be conducted as extra and invoiced as such.

Besides, EUROVENT CERTITA CERTIFICATION will check that the references to the certification are done in such a way that there is no possible confusion between certified and non-certified systems in accordance with §II.3.

EUROVENT CERTITA CERTIFICATION will also check the consistency of technical and commercial documentation as per §II.2.1.4.

The desk study is considered as “not satisfactory” when at least one of the following non-conformities occur:

- A modification (see §III.3) was not duly declared;
- A certification diploma/test report/accreditation certificate is invalid or missing;
- The technical and commercial documentation does not comply with §II.3.

If the desk study is "not satisfactory", EUROVENT CERTITA CERTIFICATION will ask the participant to resolve the non-conformity(ies) within a specific delay. Passed this delay, if the non-conformity(ies) remain unsolved the corresponding system(s) will be removed from the website and certification will be suspended. If the non-conformity(ies) are duly solved, the desk study becomes "satisfactory" and the certification process can move forward with the computational kernel running (whenever necessary, see III.2.1.2) and the certification decision (see §III.2.2).

III.2.1.2 Computational kernel running (whenever necessary)

If the certified ventilation system has been modified (see §III.3) or that the participant wants to obtain ratings corresponding to other configuration(s) (see Figure 1), EUROVENT CERTITA CERTIFICATION will run the computational kernel in order to obtain the related indicators.

III.2.1.3 Submission of a new system for certification

The participant can submit a new system for certification at any time. The whole admission procedure (see §III.1) is thus completed by EUROVENT CERTITA CERTIFICATION for the new system to obtain the corresponding indicators.

III.2.2 Evaluation and decision

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

If the annual surveillance operations (see §III.2.1) enabled to confirm that all requirements specified in §II are fulfilled, EUROVENT CERTITA CERTIFICATION provides the obtained ratings to the participant.

The participant shall communicate his decision to publish the certified ratings or to request modifications on the system (or withdrawal of the original system and submission of a new system) by filling in the related form in the specified delay (see §B.2). EUROVENT CERTITA CERTIFICATION proceeds to the extra/new checking operations if necessary.

The decision to renew the certification is submitted to the completion of the following requirements:

- The desk study is complete and satisfactory. In particular, all certification diplomas and/or test reports and the related accreditation certificates comply to the requirements specified in §II.2.1 and certification diplomas, when applicable, are still valid (certification was not suspended and its term of validity has not expired yet on the date of decision),
- The applicant has communicated his decision to publish the concerned system configuration(s)
- All invoices have been paid in full.

When the aforementioned requirements are met:

- If the system was unchanged since last certificate, EUROVENT CERTITA CERTIFICATION will renew the certificate with a new validity date which will be provided to the participant and the published data will remain on the website www.eurovent-certification.com.
- If the system was modified, EUROVENT CERTITA CERTIFICATION will publish the updated data on the website www.eurovent-certification.com and provide a new certificate and two (or three, depending on the number of climates selected) related labels to the participant.

Obsolete configurations are removed from the website www.eurovent-certification.com.

III.3 Declaration of modifications

The provisions of the Certification Manual apply.

III.3.1 Changes concerning the participant

The provisions of the Certification Manual apply.

III.3.2 Changes concerning production entities

The provisions of the Certification Manual apply.

III.3.3 Changes concerning the quality organisation of the manufacturing and/or marketing process

The provisions of the Certification Manual apply.

III.3.4 Changes concerning the certified system

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 (IAQVS-1). Non-compliance of the applicant/participant is considered as non-application of procedures (see Certification Manual).

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 the provision of adequate element(s) (e.g., test report(s)) to check the influence on performance data.

Whenever the performance data is impacted, EUROVENT CERTITA CERTIFICATION will proceed to a new run of the computational kernel to obtain the updated performance indicators.

III.4 Suspension/cessation conditions

The general consequences of non-application of procedures are described in Certification Manual.

APPENDIX A. RATING REQUIREMENTS

A.1 Purpose

The purpose of this appendix is to establish specifications for the consideration of input performance data as “certified” or “justified” in the computational kernel, in accordance with these Technical Certification Rules.

A.2 General requirements

The manufacturer shall state the intended application field of the ventilation system, and of its constituting components whenever necessary.

The Table 2 indicates when certified/justified/default values can be used as input data.

A.3 Testing and rating requirements for residential ventilation components/products

In addition to the provisions specified in §II.2, the following specific requirements apply.

Table 2: Summary table

Ventilation system component	***Certified value as per II.2.1.1***	***Justified value as per II.2.1.2***	***Default value as per II.2.1.3***	***Testing and rating requirements***	***Approved certification programmes[1]***
Ductwork components	possible without penalty	possible with penalty	possible[2]	A.3.1	ECP-DUCT; QB40
Self-regulating air inlets			forbidden	A.3.2.1(a)	NF205; QB37
Humidity sensitive air inlets				A.3.2.1(b)	QB37
Other types of air inlets used in humidity sensitive systems[4]				A.3.2.1(c)	QB37
Other air inlets/outlets[5]	N/A[3]			A.3.2.1(d)	/
Self-regulating air terminal devices	possible without penalty			A.3.3.1(a)	NF205
Humidity sensitive air terminal devices (exhaust side)				A.3.3.1(b)	QB37
Other types of air terminal devices used in humidity sensitive systems[4]				A.3.3.1(c)	QB37
Other air terminal devices	N/A[3]			A.3.3.1(d)	/
In-duct air volume flow regulators	possible without penalty			A.3.4	NF 205
Exhaust unidirectional ventilation units (for centralised systems)[4]				A.3.5	NF205, QB37
Supply ventilation units (for centralised and decentralised systems)	N/A[3]			A.3.6	/
Ducted mechanical bidirectional ventilation units (including heat recovery)	possible without penalty			A.3.7	ECP-RAHU; NF205
Non-ducted mechanical bidirectional ventilation units (including heat recovery)	N/A[3]			A.3.8	/
Filters	N/A			A.3.10	N/A

[1] Exhaustive list which can evolve in future revisions according to ECC evaluation of existing schemes.
[2] Only when the applicant/participant does not manufacture ductwork components, see §III.1.1
[3] No certification programme available to this day.
[4] The QB37 certification will be recognized only for components part of humidity sensitive systems

Table 3: Default value for air tightness class of the ductwork system

Ventilation system component	*Performance item*	*Default value as per II.2.1.3*
Ductwork components	Air tightness class	3A

A.3.1 Ductwork components

A.3.1.1 Airtightness class value

To be considered as "certified" the airtightness class (see §I.3.7) value shall have been obtained from a complete certification test (both leakage and strength testing steps) conducted on a typical ductwork system in accordance with the appropriate standard (see Table 4) and that the certification test proved that both leakage and strength criteria are fulfilled, i.e.:

- the leakage factor f (see §I.3.25), shall be lower than the air leakage limit f_{max} (see §I.3.7) for all the test pressures p_t ("leakage criterion");
- the ductwork shall withstand the static pressure limits (p_s) without permanent deformation, or any sudden change in leakage flow rate or test pressure ("strength criterion").

Besides, the typical ductwork system tested shall comply with the following criteria:

- the test sample shall contain a representative variety of duct dimensions, materials and fittings;
- the test section shall include straight ducts of a minimum length of 2.5 m;
- the ductwork surface area to be tested shall be at least 10 m^2 ;
- the ratio (L/A) between the total joint length (L) and ductwork surface area (A) shall be comprised between 1 and 1.5 m^{-1}.

Table 4 : Test standards for ductwork systems

Type of ductwork	*Appropriate test standard*
Metallic circular	EN 12237:2003, "Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts"
Metallic rectangular	EN 1507:2006, "Ventilation for buildings. Sheet metal air ducts with rectangular section. Requirements for strength and leakage"
Non-metallic circular	EN 17192:2018, "Ventilation for buildings. Ductwork. Non-metallic ductwork. Requirements and test methods"
Non-metallic semi-circular	

Whenever the certification scheme (from which the certified airtightness class is obtained) is not managed by EUROVENT CERTITA CERTIFICATION, the detail of the corresponding certification rules shall enable to check the compliance to the aforementioned criteria.

A certified airtightness class complying with the aforementioned criteria (QB40 or ECP-DUCT) will be taken as it is (no modification).

A value justified by a test report ("justified value") will be downgraded by one airtightness class.

Example: The applicant/participant declares an airtightness class C. If the value is certified as per the present paragraph, then the input considered in the calculation is C. If it is justified by a test report the value is downgraded and the input becomes B.

A.3.2 Externally mounted air transfer devices

A.3.2.1 Aerodynamic characteristics

(a) Self-regulating air inlets

For air inlets automatically controlled according to the pressure difference, the aerodynamic characteristics (pressure/flow rate curve) shall be measured and the results presented according to

- EN 13141-1:2019, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 1: Externally and internally mounted air transfer devices"

The self-regulating air inlet is described in the computational kernel by its nominal airflow rate Q_{nom} (e.g., 22 m^3/h) associated to its operating pressure range (e.g., [20;100] Pa).

A certified airflow rate value (NF205 or QB37) will be taken as is (no modification).

An airflow rate value justified by a test report ("justified value") will be downgraded when running the computational kernel by :

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate to obtain the EE indicators as explained in C.1.2.1.

(b) Humidity sensitive air inlets

For air inlets controlled by relative humidity, the aerodynamic characteristics (humidity/flow rate curve at a given pressure difference) shall be measured and the results presented in accordance with

- NF E 51 732:2005, "Controlled mechanical ventilation components — Facade air inlets — Characteristics and function ability".

or

- EN 13141-9:2008, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 9: Externally mounted humidity-controlled air transfer device".

A humidity sensitive air inlet is described in the computational kernel by its operating airflow rates Q_{min} and Q_{max} (e.g., 5 and 45 m^3/h) associated to their respective humidity levels H_{min} and H_{max} (e.g., 50 and 65%) for a given pressure difference ΔP (e.g., 20 Pa). The applicable control must be properly described too (see §A.3.2.2).

Values of a QB37 certified component will be taken as it is (no modification).

Airflow rates values justified by a test report ("justified values") will be downgraded when running the computational kernel by :

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate to obtain the EE indicators as explained in C.1.2.1.

(c) Other types of air inlets used in humidity sensitive systems

For air inlets used in humidity sensitive systems but that are neither self-regulated nor controlled by relative humidity, the aerodynamic characteristics (humidity/flow rate curve at a given pressure difference) shall be measured and the results presented in accordance with

- NF E 51 732:2005, "Controlled mechanical ventilation components — Facade air inlets — Characteristics and function ability".

A QB37 certified airflow rate value will be taken as is (no modification).

An airflow rate value justified by a test report ("justified value") will be downgraded when running the computational kernel by :

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate to obtain the EE indicators as explained in C.1.2.1.

(d) Other air inlets/outlets[5]

For air inlets/outlets[5] other than categories mentioned in A.3.2.1(a), A.3.2.1(b) and A.3.2.1(c), no certification programme is available to this day so it is mandatory to justify the values as follows:

- the aerodynamic characteristics (pressure/flow rate curve) have to be extracted from a test report complying with the requirements exposed in §II.2.1.2, in which case the data shall have been measured and be presented in accordance with test standard

  EN 13141-1:2019, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 1: Externally and internally mounted air transfer devices".

[5] For supply ventilation systems, air inlets are used as air outlets.

- the properties related to other control parameters than those mentioned in A.3.2.1(a) and A.3.2.1(b) (CO_2, presence, etc.), when applicable, shall be subject to a specific test conducted as per §A.3.9.

A test report shall be provided as rating evidence.

Airflow rates values justified by a test report ("justified values") will be downgraded when running the computational kernel by:

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate to obtain the EE indicators as explained in C.1.2.1.

The input data related to the control (e.g., sensor thresholds) shall be downgraded according to C.2 whenever appropriate (see also §A.3.9).

A.3.2.2 Controls

The type of control(s) (automatic due to pressure difference, humidity controlled, etc.) as well as its function (ramp-linear or ramp-tophat) shall be specified in the technical description of the air inlet.

Whenever several control parameters (see §I.3.12) are combined (e.g., relative humidity and manual boost), the resulting airflow rate to be considered (minimum, maximum or average of the controls outputs) shall be specified.

In addition, whenever the control involves a sensor, the provisions specified in A.3.9 apply.

A.3.3 Exhaust and supply air terminal devices

A.3.3.1 Aerodynamic characteristics

(a) Self-regulating air terminal devices (exhaust or supply side)

For air terminal devices automatically controlled according to the pressure difference, the aerodynamic characteristics (pressure/flow rate curve and pressure loss coefficient) shall be measured and the results presented in accordance with :

- EN 13141-2:2010 "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 2: Exhaust and supply air terminal devices"

The self-regulating air terminal device is described in the computational kernel by its nominal airflow rate Q_{nom} (e.g., 60 m^3/h) associated to its nominal operating pressure P_{nom} (e.g., 80 Pa).

A NF205 certified airflow rate value will be taken as is (no modification).

An airflow rate value justified by a test report ("justified value") will be downgraded when running the computational kernel by :

- decreasing the airflow rate Q_{nom} to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate Q_{nom} to obtain the EE indicators as explained in C.1.2.1.

(b) Humidity sensitive air terminal devices (exhaust side)

For air terminal devices controlled by relative humidity, the aerodynamic characteristics (pressure/flow rate curve and pressure loss coefficient) shall be measured and the results presented in accordance with

- NF E 51 713:2005, "Controlled mechanical ventilation (VMC) components — Extract air terminal devices for VMC — Characteristics and fitness for purpose",

or

- EN 13141-10:2008, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 10: Humidity controlled extract air terminal device"

A humidity sensitive air terminal device is described in the computational kernel by its operating airflow rates Q_{min} and Q_{max} (e.g., 12 and 80 m^3/h) associated to their respective humidity levels H_{min} and H_{max} (e.g., 30 and 75%) for a given operating pressure range [P_{min} ; P_{max}] (e.g., [100 ; 200] Pa).

The applicable control must be properly described (see §A.3.2.2).

Values of a QB37 certified component will be taken as it is (no modification).

Airflow rates values justified by a test report ("justified values") will be downgraded when running the computational kernel by :

- decreasing the airflow rates Q_{min} and Q_{max} to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rates Q_{min} and Q_{max} to obtain the EE indicators as explained in C.1.2.1.

Humidity levels values justified by a test report ("justified values") will be downgraded when running the computational kernel by offsetting the humidity levels H_{min} and H_{max} to obtain the IAQ and EE indicators as explained in C.2.

In the case where the humidity sensitive air terminal device integrates a manual trigger (switch, cord; etc.) or presence sensor which enables to activate a complementary airflow rate Q_{timer} during a given period of time t_{timer} (e.g., 30 minutes):

- If the device is QB37 certified, the complementary airflow rate Q_{timer} is considered in the calculation for the declared period of time t_{timer} (no modifications);
- If the device is not QB37 certified but that a test report is provided, the data is considered justified and the following applies:
  - in case of a manual trigger the period of time t_{timer} is applied without modification;
  - in case of a presence sensor, the provisions specified in A.3.9 apply;
  - the downgrading procedure is applied on the complementary airflow rate Q_{timer} by
    - decreasing Q_{timer} to obtain the IAQ indicators as explained in C.1.1;
    - increasing Q_{timer} to obtain the EE indicators as explained in C.1.2.1;

otherwise, the complementary airflow rate Q_{timer} will not be considered in the calculation.

(c) Other types of air terminal devices used in humidity sensitive systems

For air terminal devices used in humidity sensitive systems even though they are <u>not</u> controlled by relative humidity, the aerodynamic characteristics (pressure/flow rate curve and pressure loss coefficient) shall be measured and the results presented in accordance with

- NF E 51 713:2005, " Controlled mechanical ventilation (VMC) components — Extract air terminal devices for VMC — Characteristics and fitness for purpose",

A "fixed" air terminal device is described in the computational kernel by its fixed operating airflow rate Q_{fixed} (e.g., 30 m^3/h).

An air terminal device integrating a manual trigger (switch, cord) or presence sensor which enables to activate a complementary airflow rate Q_{timer} during a given period of time t_{timer}, is described in the computational kernel by its minimum and complementary operating airflow rates Q_{min} and Q_{timer} (e.g., 10 and 60 m^3/h), associated to the duration t_{timer} (e.g., 30 minutes).

The applicable control (switch; cord; presence detector; etc.) must be properly described (see §A.3.2.2).

Values of a QB37 certified component will be taken as is (no modifications).

Values justified by a test report ("justified values") will be downgraded when running the computational kernel by :

- decreasing the airflow rate value Q_{fixed} (for fixed air terminal devices) or Q_{timer} (for air terminal devices with triggered complementary airflow) to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate value Q_{fixed} (for fixed air terminal devices) or Q_{timer} (for air terminal devices with triggered complementary airflow) to obtain the EE indicators as explained in C.1.2.1

In case of a manual trigger (switch; cord; etc.) the period of time t_{timer} is applied without modification.

In case of a presence sensor, the provisions specified in §A.3.9 apply.

(d) Other air terminal devices (exhaust or supply side)

For air terminal devices other than categories mentioned in A.3.3.1(a), A.3.3.1(b) and A.3.3.1(c), no certification programme is available to this day so it is mandatory to justify the values as follows:

- the aerodynamic characteristics (pressure/flow rate curve and pressure loss coefficient) have to be extracted from a test report complying with the requirements exposed in §II.2.1.2, in which case the data shall have been measured and be presented in accordance with test standard:

  EN 13141-2:2010 “Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 2: Exhaust and supply air terminal devices”.

- the properties related to other control parameters than those mentioned in A.3.3.1(a) and A.3.3.1(b) (CO_2, presence, etc.), when applicable, shall be subject to a specific test conducted as per §A.3.9.

A test report shall be provided as rating evidence.

Airflow rates values justified by a test report (“justified values”) will be downgraded when running the computational kernel by:

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate to obtain the EE indicators as explained in C.1.2.1.

A.3.3.2 Controls

The type of control (timer, automatic due to pressure difference, humidity controlled, etc.) as well as its function (duration of the peak flow rate in case of a timer for instance) shall be specified in the technical description of the air terminal device.

Whenever several controls parameters (see §I.3.12) are combined, the resulting airflow rate to be considered (minimum, maximum or average of the controls outputs) shall be specified.

In addition, whenever the control involves a sensor, the provisions specified in A.3.9 apply.

A.3.4 In-duct air volume flow regulators

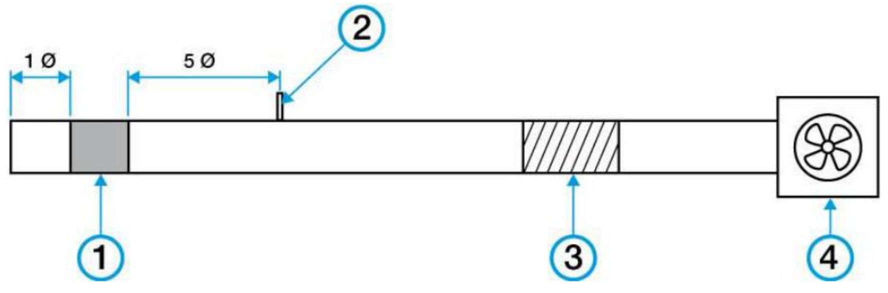
A.3.4.1 Aerodynamic characteristics

For in-duct air volume flow regulators (see §I.3.22), the aerodynamic characteristics (pressure/flow rate curve and pressure loss coefficient) shall be measured and the results presented in accordance with :

- NF E 51-776-1:2018, “ Ventilation for buildings — Control elements in duct — Part 1: Tests”,

or

- EN 13141-2:2010 “Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 2: Exhaust and supply air terminal devices”, in which case the test set-up represented on Figure 2 is to be used.



1	Regulator under test	2	Static pressure tap	3	Flow meter	4	Fan

Figure 2 : EN 13441-2 test set-up for in-duct devices (source: NF205)

Besides, the self-regulating characteristic, when applicable, should be verified in compliance with standard :

- NF E 51-776-2:2018, " Ventilation for buildings — Control elements in duct — Part 2: Characteristics and self-adjusting operating requirement",

The in-duct air volume flow regulator is described in the computational kernel by its airflow rate set-point(s) Q_{set_i} (e.g., 60 m^3/h) associated to its nominal operating pressure range [P_{min} ; P_{max}] (e.g., [100 ; 200] Pa).

NF205 certified airflow rate value(s) will be taken as is (no modification).

An airflow rate value justified by a test report ("justified value") will be downgraded when running the computational kernel by :

- decreasing the airflow rate set-point Q_{set_i} to obtain the IAQ indicators as explained in C.1.1
- increasing the airflow rate set-point Q_{set_i} to obtain the EE indicators as explained in C.1.2.1.

The input data related to the control (e.g., sensor thresholds) shall be downgraded according to C.2 whenever appropriate (see §A.3.9).

A.3.4.2 Controls

The type of control as well as its function shall be specified in the technical description of the in-duct air volume flow regulator.

Whenever several controls parameters (see §I.3.12) are combined, the resulting airflow rate to be considered (minimum, maximum or average of the controls outputs) shall be specified.

In addition, whenever the control involves a sensor, the provisions specified in A.3.9 apply.

A.3.5 Exhaust ventilation units

A.3.5.1 Aerodynamic characteristics

The following characteristics:

- Air flow/ pressure/power input curves,
- Air volume flow extracted from each terminal device (reference)
- Air volume flow extracted from each terminal device (maximum)
- Effective (total) power input (reference flow rate)
- Effective (total) power input (maximum flow rate)

shall be measured on the assembled system according to standard:

- EN 13141-6:2014, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 6: Exhaust ventilation system packages used in a single dwelling".

Data of certified ventilation units (NF205 or QB37) will be taken as is (no modification).

Data justified by a test report ("justified values") will be downgraded when running the computational kernel by downgrading the fan curves as follows:

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the fan electric consumption to obtain the EE indicators as explained in C.1.2.2.

The input data related to the control (e.g., sensor thresholds) shall be downgraded according to C.2 whenever appropriate (see §A.3.9).

A.3.5.2 Controls

The fan control mode (speed or flow rate) shall be specified.

The fan set point(s) (speed or flow rate) can :

- be fixed (e.g., single speed)
- be driven by a control to be described in the tool (e.g., 2-speed fan with manual activation in the kitchen)

Whenever several controls parameters (see §I.3.12) are combined (e.g., relative humidity and CO_2), the resulting airflow rate to be considered (minimum, maximum or average of the controls outputs) shall be specified.

In addition, whenever the control involves a sensor, the provisions specified in A.3.9 apply.

A.3.6 Supply ventilation units

This section applies to unidirectional ventilation units dedicated to air supply in residential applications as follows:

- single room application where one supply ventilation unit (ducted or non-ducted) is required for each habitable room;
- multiple rooms application where :
  - a single, ducted, unit provides centralised whole dwelling ventilation;
  - several single room supply ventilation units (ducted or non-ducted) installed in the habitable rooms ensure the whole dwelling ventilation through internally mounted air transfer devices.

A.3.6.1 Aerodynamic characteristics

For supply ventilation units, no certification programme is available to this day so it is mandatory to justify the values. The following data:

- Air flow/pressure/power input curves,
- Air volume flow supplied by each terminal device (reference)
- Air volume flow supplied by each terminal device (maximum)
- Effective (total) power input (reference flow rate)
- Effective (total) power input (maximum flow rate)

shall be extracted from a test report complying with the requirements exposed in §II.2.1.2, in which case the data shall have been measured and be presented in accordance with test standard

EN 13141-11:2015, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 11: Supply ventilation units".

A test report shall be provided as rating evidence.

Curves justified by a test report ("justified values") will be downgraded when running the computational kernel by:

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the fan electric consumption to obtain the EE indicators as explained in C.1.2.2.

A.3.6.2 Controls

The fan control mode (speed or flow rate) shall be specified.

The fan set point(s) (speed or flow rate) can :

- be fixed (e.g., single speed)
- be driven by a specific control to be described in the tool (e.g., 2-speed fan with manual activation in the bedroom)

Whenever several controls parameters (see §I.3.12) are combined (e.g., relative humidity and CO_2), the resulting airflow rate to be considered (minimum, maximum or average of the controls outputs) shall be specified.

In addition, whenever the control involves a sensor, the provisions specified in A.3.9 apply.

A.3.7 Ducted mechanical bidirectional ventilation units (including heat recovery) for single family dwellings

The declared data shall mention the following:

- Heat exchanger reference(s) / manufacturer(s)
- Fan reference(s) / manufacturer(s)
- Filter classes on supply and exhaust side

A.3.7.1 Performance data

The following characteristics:

- declared maximum air volume flow
- air flow/ pressure/power input curves,
- internal leakage,
- heat exchanger efficiency (temperature ratio),

shall be measured and the results presented according to standard

- EN 13141-7:2010 "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 7: Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings".

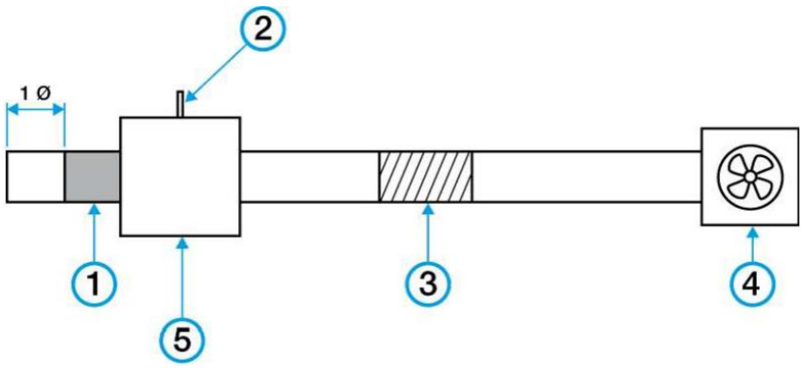
For certified ventilation units (ECP-RAHU or NF205), the aforementioned characteristics will be taken as is (no modification).

Exhaust and supply fan curves justified by a test report ("justified values") will be downgraded when running the computational kernel by:

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the fan electric consumption to obtain the EE indicators as explained in C.1.2.2.

In the case of justified values and if the control involves a flow regulator (see §I.3.22) integrated to the ventilation unit, an additional test report characterizing the flow rate response is requested. The test shall be conducted in accordance with standard :

- EN 13141-2:2010 "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 2: Exhaust and supply air terminal devices", in which case the test set-up represented on Figure 3 is to be used.



1	BVU under test	2	Static pressure tap	3	Flow meter	4	Fan
5	Expansion chamber of dimensions (height, width and depth) ≥ 60 cm						

Figure 3 : EN 13441-2 test set-up for bidirectional ventilation unit integrated regulator (source: NF205)

Internal leakage values justified by a test report ("justified values") will be downgraded by -2 percentage-points.

Heat exchanger efficiency values justified by a test report ("justified values") will be downgraded by - 10% (relative).

A.3.7.2 Controls

The fan control mode (speed or flow rate) shall be specified for each side (supply and exhaust).

The fan set point(s) (speed or flow rate) can :

- be fixed (e.g., single speed)
- be driven by a specific control to be described in the tool (e.g., 2-speed fan with manual activation in the kitchen)

Whenever several controls parameters (see §I.3.12) are combined (e.g., relative humidity and CO_2), the resulting airflow rate to be considered (minimum, maximum or average of the controls outputs) shall be specified.

In addition, whenever the control involves a sensor, the provisions specified in A.3.9 apply.

A.3.8 Non-ducted mechanical bidirectional ventilation units (including heat recovery) for single room

The declared data shall mention the following:

- Heat exchanger reference(s) / manufacturer(s)
- Fan reference(s) / manufacturer(s)
- Filter classes on supply and exhaust side

A.3.8.1 Performance data

For non-ducted BVU, no certification programme is available to this day so it is mandatory to justify the input data. Thus, the following data :

- air flow/ pressure/power input curves,
- internal leakage,
- heat exchanger efficiency (temperature ratio),

shall be extracted from a test report complying with the requirements exposed in §II.2.1.2, in which case the data shall have been measured and the results presented according to standard

- EN 13141-8:2014, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 8: Performance testing of non-ducted mechanical supply and exhaust ventilation units (including heat recovery)".

A test report shall be provided as rating evidence.

Curves justified by a test report ("justified values") will be downgraded when running the computational kernel by:

- decreasing the airflow rate to obtain the IAQ indicators as explained in C.1.1
- increasing the fan electric consumption to obtain the EE indicators as explained in C.1.2.2.

Internal leakage values justified by a test report ("justified values") will be downgraded by -2 percentage-points.

Heat exchanger efficiency values justified by a test report ("justified values") will be downgraded by - 10% (relative).

A.3.8.2 Controls

The fan control mode (speed or flow rate) shall be specified for each side (supply and exhaust).

In addition, whenever the control involves a sensor, the provisions specified in A.3.9 apply.

A.3.9 Sensors

The relationship between the detected parameter and the signal generated by the sensor must be unambiguously described by the manufacturer, including the corresponding uncertainty intervals.

Besides, the technical file provided by the manufacturer shall specify :

- the measurement reporting interval (e.g., 60s for a CO_2 sensor), whenever appropriate,
- the sensor response time (e.g., 210s for a CO_2 sensor)
- the long-term stability of the sensor (e.g., ±20 ppmv/year for a CO_2 sensor; ±0.25%RH/year for a RH sensor).

A sensor which is not properly described will not be considered.

A sensor with measurement reporting interval and/or sensor response time higher than 5 minutes (300 seconds) will not be considered.

A.3.9.1 Sensor tested separately

When the sensor is tested separately from the component it controls, the corresponding input data (CO_2 thresholds, humidity levels, etc.) justified by a test report ("justified values") will be downgraded when running the computational kernel (except for presence sensors, see below).

This can be applied to a remote sensor or to the sensor module of an integrated sensor (as supplied before assembly with the ventilation component it is intended to actuate or dismantled from the assembly if necessary).

The following provisions apply:

- CO_2 sensor

  Tests shall be conducted as per Appendix E.

  Test report(s) must be provided as evidence.

  As no certification of CO_2 sensors is available so far, the performance data shall be impacted as indicated in Appendix (see §C.2).

- RH sensor

  Tests shall be conducted as per Appendix F.

  Test report(s) must be provided as evidence.

  As no certification of RH sensors (sensor non-integrated to the humidity sensitive component) is available so far, the performance data shall be impacted as indicated in Appendix (see §C.2).

- Temperature sensor

  Tests shall be conducted as per Appendix G.

  Test report(s) must be provided as evidence.

  As no certification of temperature sensors is available so far, the performance data shall be impacted as indicated in Appendix (see §C.2).

- Presence (or movement) detector
  - Optical presence (or movement) sensors located in toilets (or bathroom with toilet)

  For optical presence (or movement) sensors located in toilets (or bathroom with toilets), the presence detection will be considered in the simulation without conditions.

  - Optical presence (or movement) sensors not located in toilets (or bathroom with toilet)

  For optical presence (or movement) sensors (ceiling only) that are not located in toilets (or bathroom with toilets), it is mandatory to provide a test report and the following applies:

    - The test shall be conducted according to the test method detailed in Appendix H;
    - The detection rate must comply with the requirements defined in Appendix H. Otherwise, the presence (or movement) detection will not be considered in the simulation.
    - Besides, if the presence (or movement) sensor enables to activate a timer, represented by a complementary airflow rate Q_{timer} for a period of time t_{timer}, the detection rate compliance with the requirements defined in Appendix H is also the condition for the consideration of the timer. Otherwise, the timer will not be considered in the simulation.

- VOC sensors used as presence detectors

  VOC sensors used as presence detectors will be considered as a manual control (i.e., activated manually 50% of the time by the dwelling occupants) in the simulation.

A.3.9.2 Sensor tested together with the controlled component(s)

Sensors can also be tested together with the component they actuate, in which case the downgrade (see §A.3.9.1 and §C.2) does not apply.

The relationship between the measured parameter and the response of the actuator (flow rate plotted according to the measured parameter) shall be verified by a test conducted according to:

- EN 13141-9 for RH sensors actuating humidity-controlled air inlets (see §A.3.2.1(b));
- EN 13141-10 for RH sensors actuating humidity-controlled exhaust valves (see §A.3.3.1(b));

For RH sensors actuating ventilation components other than air inlets or exhaust valves, appropriate test methods should be defined in cooperation with testing laboratories. Until such test methods exist, the sensors are to be tested separately and provisions of §A.3.9.1 apply.

For CO_2 sensors and temperature sensors, appropriate test methods should be defined in cooperation with testing laboratories. Until such test methods exist, the sensors are to be tested separately and the provisions of §A.3.9.1 apply.

Test report(s) must be provided as evidence. If the test report does not meet the criteria (see §II.2.1.2) the manufacturer will have the choice between

- either submitting a new test report to be reviewed as extra (see §III.1.3.1);
- or seeing the downgrade applied as for separate tests (see §A.3.9.1 and §C.2).

A.3.10 Filters

It is to be noted that particulate matter are not addressed in the current version of this document and that the corresponding indicator will be introduced in a future version (see §I.2.1).

Until then, filter classes (ISO Coarse, ISO ePM_{10} ; ISO $ePM_{2.5}$; ISO ePM_1) are requested to be declared for information purposes in accordance with standard

- Eurovent 4/22:2015, “Industry Recommendation for Residential Air Filter Performance measurements” which is based on
  - ISO 16890:2016 (series), “Air filters for general ventilation”

A.3.11 Air extraction cooker hoods

The operation of an extraction cooker hood physically connected to the ductwork can be represented in the computation kernel by a boosted flow rate. This flow rate is to be defined in the exhaust ventilation unit description.

A test report shall be provided as rating evidence to ensure consistency with the regular operation of the exhaust ventilation unit.

APPENDIX B. FORMS

B.1 Submittal for certification by Manufacturer

Information to be provided by Manufacturer.

B.1.1 Form IAQVS-1: Performance data and technical description of ventilation system components submitted for certification

The declaration file (form IAQVS-1) to be filled in shall be sent by EUROVENT CERTITA CERTIFICATION to:

- applicants who have signed the license agreement,
- participants on an annual basis (before 31st of January of each calendar year).

A template is available for information and upon request.

B.2 Result forms

CERTIFICATION PROGRAMME FOR INDOOR AIR QUALITY AND ENERGY EFFICIENCY OF VENTILATION SYSTEMS

RESPONSE FORM AFTER RESULTS RECEPTION
This response form shall be sent back by e-mail to EUROVENT CERTITA CERTIFICATION within four (4) working weeks maximum. Without news from you within this delay, the certified ratings will be published.

Date : _______________ Name : __________________________________ Signature :

According to the technical certification rules of the IAQVS programme, you are asked to select one of the following alternatives :

☐ **GO. Publication of the certified ratings on www.eurovent-certification.com for the declared system.**

☐ **NO GO. No publication of the obtained ratings. Request for an extra run, i.e., with a modification of a component feature on the same system. Evidence of the (absence of) impact of the modification on the performance ratings must be provided (additional element(s) assessment).**

☐ **NO GO. No publication of the obtained ratings. The system originally declared is withdrawn from the certification application. Submission of a new system. The full process starts over (desk study + simulation).**

APPENDIX C. METHODOLOGIES

C.1 Methodology for the downgrading of justified values

Whenever the performance data is justified by a test report instead of being certified (see §II.2.1.2), the values issued from the test report have to be downgraded as follows.

C.1.1 Downgrading procedure for determination of IAQ indicators : reduced airflow rate (air inlets, air terminal devices, ventilation unit)

One simulation with reduced airflow rate is run to obtain the IAQ indicators.

The airflow rate values issued from the test report are decreased as follows:

$$Q_{v_{input\_IAQ}} = Q_{v_{TR}} \times 0.9$$

where

Q_{vinput_IAQ} is the airflow rate value used as input in the IAQ simulation

Q_{vTR} is the airflow rate value issued from the test report

Note: When applying to the ventilation unit fan curve, the pressure and consumption values remain unchanged for this simulation.

Only the IAQ indicators are retained from this simulation.

C.1.2 Downgrading procedure for determination of EE indicators

C.1.2.1 Increased airflow rate (air inlets, air terminal devices)

For air inlets and air terminal devices, one simulation with increased airflow rate is run to obtain the EE indicators.

The airflow rate values issued from the test report are increased as follows:

$$Q_{v_{input\_EE}} = Q_{v_{TR}} \times 1.1$$

where

Q_{vinput_EE} is the airflow rate value used as input in the EE simulation

Q_{vTR} is the airflow rate value issued from the test report

Only the EE indicators are retained from this simulation.

C.1.2.2 Increased fan consumption (ventilation unit)

For ventilation units, one simulation with increased fan consumption is run to obtain the EE indicators.

The fan consumption values issued from the test report are increased as follows:

$$P_{E_{input\_EE}} = P_{E_{TR}} \times 1.1$$

where

P_{Einput_EE} is the fan electrical consumption value used as input in the EE simulation

P_{ETR} is the fan electrical consumption value issued from the test report

The pressure and airflow rate values remain unchanged for this simulation.

Only the EE indicators are retained from this simulation.

C.2 Methodology for the downgrading of performance values when the sensor is tested alone

Whenever the sensor is not tested together with the component it actuates (see §A.3.9.1), the performance data have to be downgraded as follows:

- The threshold(s) are offset to represent a “delay”. The offset magnitude is:
  - For CO_2 sensors
    - +10% on the CO_2 concentration thresholds [ppmv] (IAQ calculation)
    - -10% on the CO_2 concentration thresholds [ppmv] (EE calculation)

- For RH sensors
  - +10% (relative) on the relative humidity thresholds [%] (IAQ calculation)
  - -10% (relative) on the relative humidity thresholds [%] (EE calculation)
- For temperature sensors
  - +1°C on the temperature thresholds [°C] (IAQ calculation)
  - -1°C on the temperature thresholds [°C] (EE calculation)

- This downgrade occurs on top of the other applicable downgrading procedures (see §C.1).

Examples :

For a CO_2 sensor, a threshold of 1000 ppmv will be replaced respectively by a value of 1100 ppmv for the IAQ indicators simulation and a value of 900 ppmv for the EE indicators simulation.

For a RH sensor, a threshold of 50%RH will be replaced respectively by a value of 55%RH for the IAQ indicators simulation and a value of 45%RH for the EE indicators simulation.

For a temperature sensor, a threshold of 16°C will be replaced respectively by a value of 17°C for the IAQ indicators simulation and a value of 15°C for the EE indicators simulation.

C.3 Methodology for the aggregation of Indoor Air Quality indicators

C.3.1 Formaldehyde sub-indicators aggregation

The simulation outputs comprise two sub-indicators for formaldehyde :

- a short-term sub-indicator ($IFOR_{st}$)
- a long-term sub-indicator ($IFOR_{lt}$)

The short-term and long-term sub-indicators for formaldehyde are aggregated into one single indicator using the average of both values:

$$IFOR = average(IFOR_{st}; IFOR_{lt})$$

C.3.2 Indoor Air Quality global indicator

A global Indoor Air Quality indicator (IIAQ) is defined as the average of the following indicators:

- Carbon dioxide (CO_2) concentration indicator (ICO_2)
- Air relative humidity (RH) indicator (IH_2O)
- Formaldehyde concentration indicator (IFOR), see §C.3.1

Thus

$$IIAQ = average(ICO_2; IH_2O; IFOR)$$

Note: An indicator for particulate matters will be introduced in a second step (see §I.2.1) and considered in the calculation of IIAQ.

APPENDIX D. SPECIFIC LABEL

The Certification Manual general specifications (minimum size, fonts, colours, etc.), about energy efficiency labels apply, unless otherwise specified in paragraphs D.1 and D.2 below.

D.1 Label content

The following specific provisions prevail over the general ones :

- The label header shall include the statement :"Indoor Air Quality & Energy Efficiency" in the dedicated area (see Figure 4).
- The label shall provide the following detailed information (see Figure 4):
  - Dwelling size range expressed in range of habitable rooms (see §I.3.23) number ("From N to M habitable rooms") with N and M comprised between 1 and 7
  - Climate (cold; average or warm) with corresponding icon
  - Fan electric consumption (E_{fan}), expressed kWh/annum (see §I.2.2)
  - Heat loss induced by air renewal ($E_{heating}$), expressed kWh/annum (see §I.2.2)
  - Radar chart representing the individual IAQ indicators (see §I.2.1 and §C.3) and their respective icons
  - IAQ grade scale from 0 to 5 with corresponding colour code (see §D.2)
  - Individual IAQ grades : ICO_2, IH_2O and IFOR (see §I.2.1 and §C.3)
  - Global IAQ grade (see §C.3)
  - Statement explaining that "Particulate Matters will be integrated in a future revision"

D.2 IAQ grade scale

The IAQ indicators are expressed by individual grades from 0.0 to 5.0 (see §I.2.1).

The following colours are associated to each grade step:

- Darker blue (C100 M60 Y20 K10 - R0 G92 B141) for 5.0
- Blue (C86 M44 Y8 K2 - R3 G121 B177) from 4.0 to 4.9 included
- Green (C70 M0 Y87 K0 - R76 G184 B92) from 3.0 to 3.9 included
- Yellow (C0 M10 Y100 K0 - R255 G221 B0) from 2.0 to 2.9 included
- Red (C0 M100 Y100 K0 – R255 G0 B0) from 1.0 to 1.9 included
- Brown (C50 M100 Y100 K10 - R115 G0 B0) from 0.0 to 0.9 included

The scale represents the grade 5 at the top and the grade 0 at the bottom to enhance the understanding that 5 stands for good IAQ and 0 for bad IAQ.

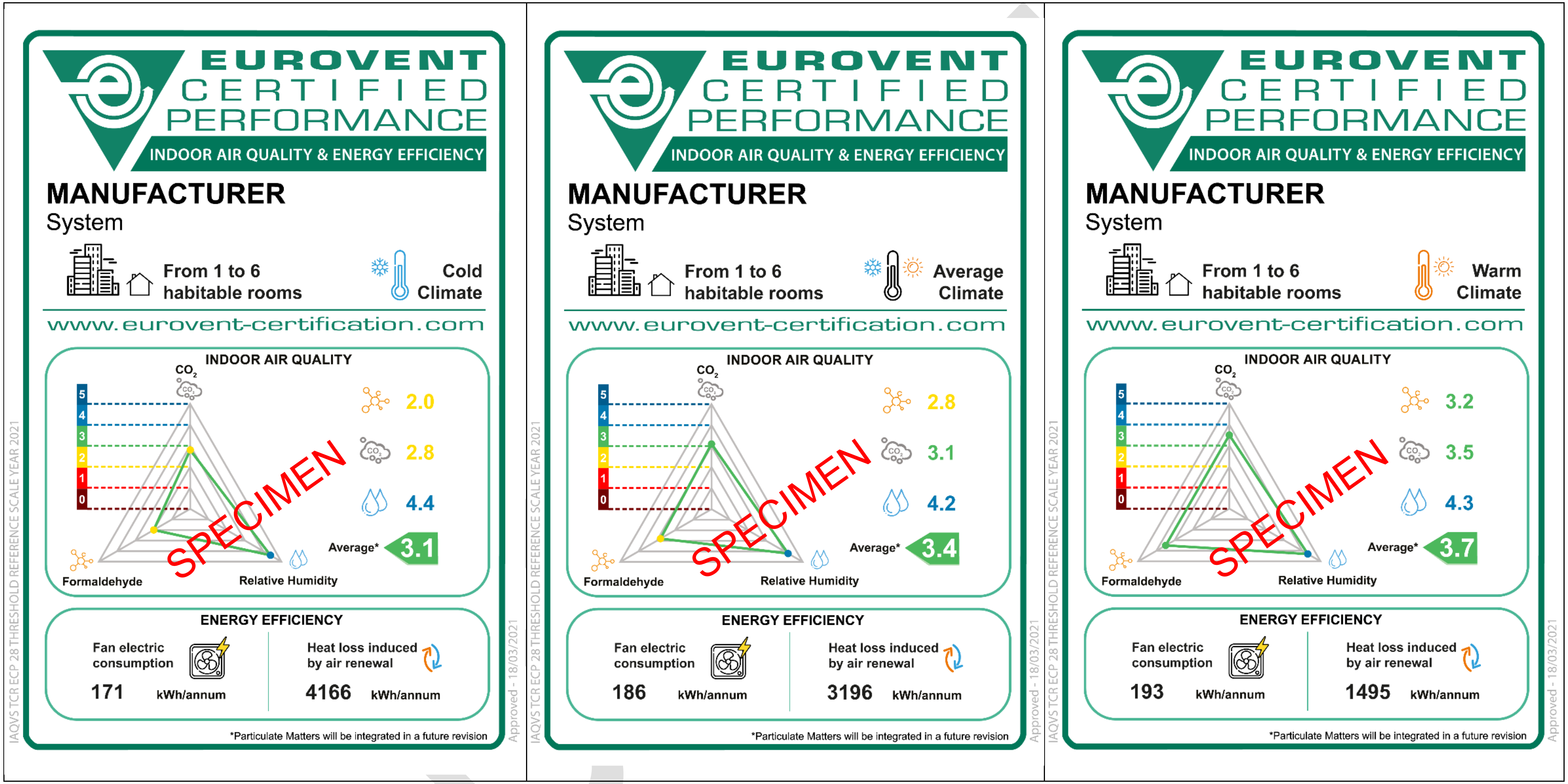


Figure 4 : Examples of IAQVS label obtained for a given ventilation system for cold/average/warm climates

APPENDIX E. TEST METHOD FOR CO_2 SENSORS

E.1 General

The CO_2 sensor must be characterized by an ISO 17025 accredited laboratory (see II.2.1.2) in a CO_2 controlled box or chamber, in accordance with the test method described in E.2.

The purpose of the test is to determine the response of the sensor for different CO_2 concentrations in order to check its linearity and to know its calibration curve.

E.1.1 Scope

This test method applies to CO_2 sensors used to control the modulation of the ventilation rate of a room according to its occupation.

These sensors determine the CO_2 concentration in the air.

They deliver an analogue signal, proportional to the CO_2 concentration. They are designed for the range of concentrations likely to be encountered in buildings, i.e., from 0 to a few thousand ppmv (e.g., 0-2000 ppmv is a common range).

These sensors are intended to be installed in a room or in an air flow stream (e.g., on a room wall, in a ventilation exhaust duct or in an exhaust ventilation unit).

E.1.2 Normative references

The test method described in the following paragraphs is derivated from:

- Revision 1 (October 2009) of the CSTB document “Modalités d'instruction des Avis Techniques sur les systèmes de modulation de débit de ventilation dans le tertiaire, Annexe A – Méthodologie d’essais des capteurs de CO_2”[6]

E.1.3 Terms and definitions

The terms and definitions given in EN 12792:2003 apply (see also I.3).

E.1.4 Symbols and abbreviations

The symbols and units given in EN 12792:2003 and the symbols and units given in Table 5 apply.

Table 5 : Symbols and units

Term	Symbol	Unit
Minimum CO_2 concentration of sensor operating range	$[CO_2]_{min}$	ppmv
Maximum CO_2 concentration of sensor operating range	$[CO_2]_{max}$	ppmv

E.2 Test procedure

E.2.1 Test installation and conditions

E.2.1.1 Test chamber

The sensor is placed in a chamber where the CO_2 level can be monitored in the concentration range necessary for the qualification of the sensor. The test chamber shall be controlled in CO_2 concentration, humidity and temperature, representing indoor conditions defined by the manufacturer’s technical file.

The CO_2 sensor must be located away from intake/exhaust ducts, windows and doorways, and in any case less than 3.5 m from the floor.

[6] This reference standard applies to Non-dispersive infrared (NDIR) sensors. It is to be noted that the derivated test method presented in Appendix E applies not only to NFDIR but to all CO2 sensors technologies present on the market.

The chamber volume must be sufficient to accommodate the sensor(s) under test. The chamber volume and how the CO_2 concentration is established and maintained must be such that the CO_2 concentration is stable in the vicinity of the sensor(s) under test. Stability and uniformity of [CO_2] should be achieved.

A single chamber can be designed to accommodate several sensors simultaneously.

E.2.1.2 Test ambient conditions

The ambient conditions present during the tests such as temperature and barometric pressure must be recorded. They should be consistent with the sensors operating range defined in the manufacturer's technical file.

The relative humidity (RH) in the chamber must be set at 50% and it must not vary by more than ±2% RH points during the test. If this RH level is not consistent with the CO_2 sensor operating range defined in the manufacturer's technical file, then a more suitable relative humidity level, necessarily comprised between 25 and 75%, will be defined for the test and recorded.

The test chamber pressure must be close to the atmospheric pressure (i.e., 1013.25 hPa at sea level) and in any case it shall be comprised between 860 and 1060 hPa. Unless the CO_2 sensor is already fitted with a built-in barometric pressure sensor which automatically compensates the pressure effect, the CO_2 readings shall be compensated as per §E.2.3.4.

The air ambient temperature in the chamber must be 20°C. This temperature must not vary by more than ±1K during the test.

The air velocities in the vicinity of the sensor must be low and remain lower than 1 m/s at all times.

E.2.1.3 Uncertainties of measurement

The uncertainty of the measurement instruments shall enable to comply with the following measurement uncertainties:

- The temperature must be measured with an uncertainty of less than ± 0.5 K.
- The relative humidity must be measured with an uncertainty of less than ±2%-points.
- The barometric (ambient) pressure must be measured with an uncertainty of less than ± 100Pa.
- The CO_2 concentration shall be measured with an uncertainty lower than Max [50 ppmv; 0.05 [CO_2]].
- The air velocity shall be measured with an uncertainty lower than ±0.1 m/s.

E.2.2 Simulation of room occupancy

The room occupancy is simulated by injecting a mixture of carrier gas (N_2, clean air) and diluted gas (CO_2) in the chamber where the CO_2 sensor under test is placed.

In order to obtain the desired CO_2 concentrations, the injection of this gas mixture into the test chamber is controlled by mass flow controllers. The clean air used as carrier gas can be reconstituted from nitrogen and oxygen cylinders.

The diluted gas comes from a reference CO_2 bottle, pure or mixed with nitrogen, with known CO_2 concentration. This concentration shall be certified by the supplier of the bottle (Certified Gas Mixture[7]).

The concentrations are calculated from the mass flow rate measurements of the carrier gas and diluted gas. The mass flow meters must be adapted to the nature of the gas and to the flowrates passing through them. All connections and flowmeters must be made of inert materials (no reaction whatsoever with CO_2).

[7] Certified and validated by direct analytical comparison with level-1 traceability Primary Reference Materials under ISO 17025 Calibration Laboratory Accreditation with independent assessment of compliance by recognized governmental body under ILAC (International Laboratory Accreditation Cooperation) MRA (Mutual Recognition Agreements) such as COFRAC in France or ENAC in Spain (see https://ilac.org/ilac-mra-and-signatories/)

The CO_2 concentration of the mixture is obtained by the relationship below.

$$C_{mix} = C_{ref} \cdot \frac{Q_{md}}{Q_{md} + Q_{mc}}$$

Where

C_{mix} is the CO_2 concentration of the mixture

C_{ref} is the CO_2 concentration of the diluted gas

Q_{md} is the diluted gas mass flow rate

Q_{mc} is the carrier gas mass flow rate

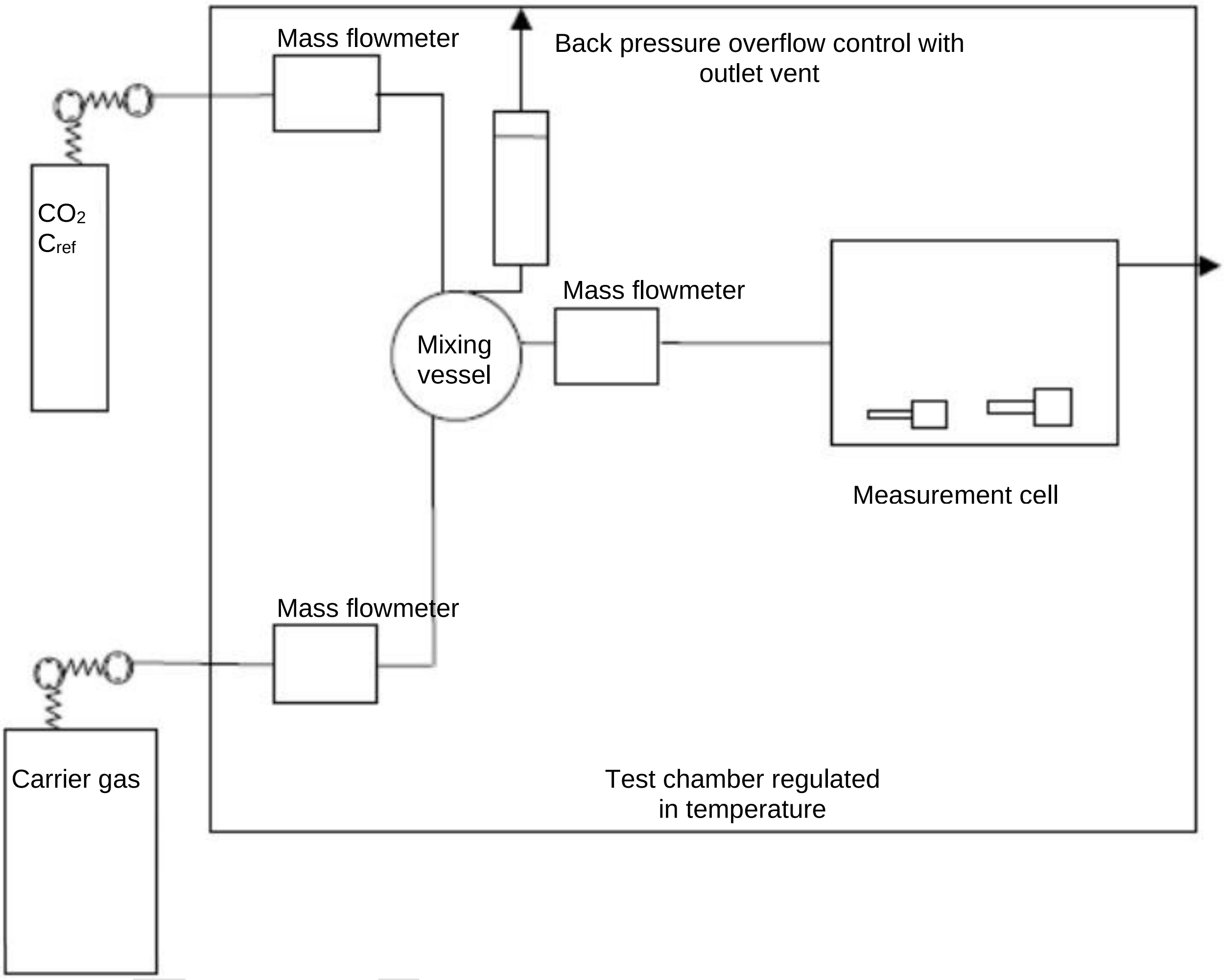


Figure 5: Example of test implementation -Schematic diagram

E.2.3 Test of CO_2 sensor accuracy

E.2.3.1 Test principle

The test consists of subjecting the sensor to several CO_2 concentrations and then evaluating the differences between the sensor response and the mixture concentration C_{mix}.

This mixture concentration has been set by the mixture of carrier gas and diluted gas described in E.2.2. It is calculated from the mass flow meters readings.

The range of CO_2 concentrations $[[CO_2]_{min};[CO_2]_{max}]$ applicable to the sensor shall be defined by the manufacturer's technical file.

NOTE: If $[CO_2]_{min}$ is lower than 500 ppmv, a minimum value of 500 ppmv will be considered for test conditions due to the difficulty of realisation.

The tests shall be performed with first an increase of CO_2 concentration from minimum to maximum then a decrease back (see step 7 in E.2.3.2). The measurements shall be done at minimum CO_2 concentration, in at least three CO_2 concentration levels regularly spaced in between minimum and maximum and then at maximum CO_2 concentration for the increasing cycle. The ventilation control thresholds (example : change of fan speed from speed 1 to speed 2 at 1300 ppmv) shall be tested in priority. If necessary, more points shall be tested to avoid steps of CO_2 concentration level ($\Delta[CO_2]$) larger than 250 ppmv. The repartition of the measurement points shall be equally distributed on the declared range.

Same points down to the minimum shall be measured while decreasing.

Each measurement (during both increase and decrease phases) will enable to evaluate the sensor response accuracy. The absolute deviation (see Table 6) between the analogue output value (converted in ppmv) and the CO_2 level setpoint (in ppmv) shall not exceed the measurement uncertainty ±100 ppmv.

The comparison between measurements at the same concentration levels (same setpoint of index k) done respectively during the increasing phase ($[CO_2]_{increase\_k}$) and during the decreasing phase ($[CO_2]_{decrease\_k}$) will enable to evaluate the reproducibility (precision) of the sensor response. The absolute deviation between the increasing CO_2 level and the decreasing CO_2 level for a same setpoint should not vary by more than ±100 ppmv.

Example:

The manufacturer declares a sensor operating range of [0;2000] ppmv with 0V = 0 ppmv and 10V = 2000 ppmv. The first regulation of the system (change of fan speed) is done when the CO_2 level exceeds 1300 ppmv so it is suggested to integrate this value in the list and to implement the 250- ppmv step from 500 ppmv to 2000 ppmv. That would be 8 points (500, 750, 1000, 1250, 1300, 1500, 1750, 2000) for the increase and 8 points for the decrease (same points but decreasing from 2000 to 500) so 16 testing points in total (see example on Table 6).

For setpoint 1000 ppmv the measurement uncertainty shall be lower than 50 ppmv (see §E.2.1.3) so the allowed deviation is 50+100 = 150 ppmv. Thus, the output value observed shall be comprised between 850 and 1150 ppmv included. Considering that the analogue output is 5.1V during the increase phase then the corresponding value in ppmv is 5.1*2000/10 = 1020 ppmv which is valid. If the analogue output is 4.5V during the decrease phase then the corresponding value is 900 ppmv, which is also valid from the accuracy point of view but not from the precision point of view (1020-900=120 > 100 ppmv).

E.2.3.2 Test operations

The test consists of the following operations:

1. switch on the sensor for at least 12 hours prior to the measurements start,
2. if necessary, adjust the sensor zero point by injecting pure nitrogen gas (N_2),
3. if necessary, adjust the sensor gain by injecting a concentration corresponding to approximately 90% of full scale and measure the response time T90 of the sensor at this level (for a concentration level between 500 and 1000 ppmv),
4. check the zero point by injecting pure nitrogen gas (N_2), if the sensor allows it[8],
5. if the zero point needs to be adjusted, check the gain,
6. prepare by dilution and inject the reference concentration levels into the test chamber,
7. carry out a series of measurements with increasing and then decreasing concentrations :

[8] Sensors with self-calibration, for example, must not be exposed to an environment with pure nitrogen, in which case a first calibration point is then carried out at the minimum concentration specified by the manufacturer.

For each concentration level, note after stabilisation the indication of the display (digital output) and electrical (analogue) output provided by the sensor.

The stability at a given level shall be satisfied with a fluctuation of ±20 ppmv.

The stable level shall be reached within 5 minutes after exposure to the reference concentration and maintained for 10 min to validate the outputs. Then the setpoint can be changed and step 7 is repeated for each setpoint until the increase and decrease phases are completed.

E.2.3.3 Results presentation

The test report shall include a table (see Table 6) presenting :

- the sensor response (analogue and digital output signal) as a function of the CO_2 concentration level (setpoint),
- the absolute deviation from the setpoint

for all the individual test points.

The test report shall also specify the 90% response time T90 measured at step n°3 (see E.2.3).

If the sensor documentation states that a pressure correction is to be applied, this must be mentioned in the test report.

Table 6: Example of CO_2 sensor accuracy test results table

Test point	Setpoint level	Analogue output (voltage)		Digital output[9]	Abs. deviation
	ppmv	V	ppmv	ppmv	-
Increasing levels					
1	500				
2	750				
3	1000	5.1	1020		+20
4	1250				
5	1300				
6	1500				
7	1750				
8	2000				
Decreasing levels					
9	2000				
10	1750				
11	1500				
12	1300				
13	1250				
14	1000	4.5	900		-100
15	750				
16	500				

[9] When available.

These results are used to plot the sensor calibration curve, obtained by linear regression from the test results (see Figure 6). The calibration curve is used to check the linearity of the signal delivered by the sensor and the deviations between its response and the calibration curve for different concentrations.

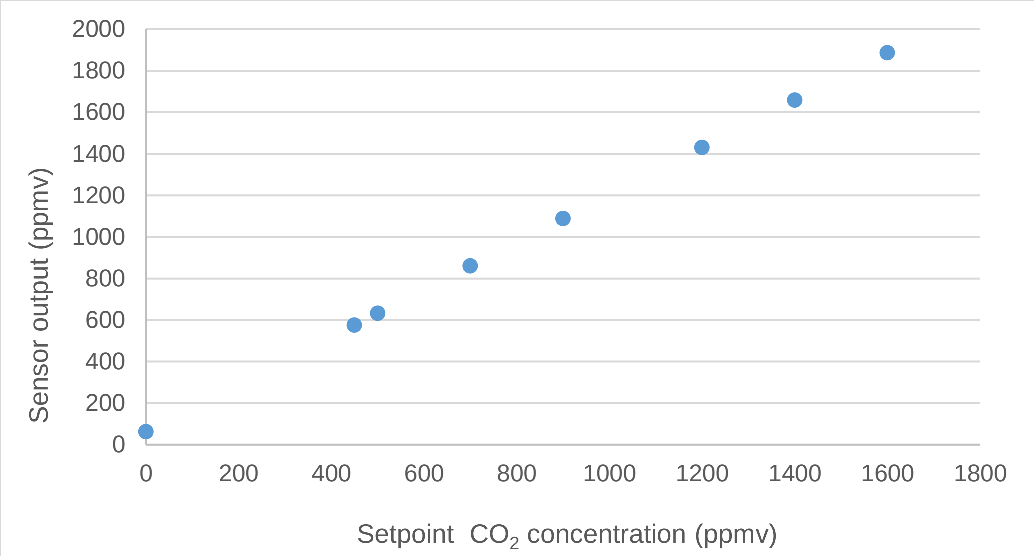


Figure 6 : Example of results presentation

E.2.3.4 Pressure compensation

When the CO_2 sensor does not compensate the pressure effect automatically, the CO_2 measurements should be corrected by one of the following means:

- entering the correct pressure settings for internal compensation (constant pressure conditions)
- programming the compensation into an automation system or PC (changing pressure conditions)
- correcting the measurements by calculation as follows:

$$[CO_2]_{corr} = [CO_2]_{meas} \times \frac{p_{amb}}{101\ 325} \times F_t$$

where

$[CO_2]_{corr}$ is the corrected CO_2 concentration in ppmv

$[CO_2]_{meas}$ is the measured CO_2 concentration in ppmv

p_{amb} is the ambient pressure in Pa

$F_t = 1$ if the CO_2 sensor already integrates temperature compensation

$F_t = \frac{293}{273 + \theta_{amb}}$ is a temperature factor which compensates the temperature effect otherwise

where

θ_{amb} is the ambient temperature in °C

E.2.4 Test of relative humidity influence

E.2.4.1 Test principle

The test consists of subjecting the sensor to relative humidities different from 50% and then evaluating the relative humidity influence on the sensor response.

The CO_2 concentration setpoint is to be selected among the list of setpoints defined in the frame of the CO_2 sensor accuracy test (see E.2.3). It is recommended to select a CO_2 level in the middle of the sensor's operating range (e.g., around 1000 ppmv for a [0;2000] ppmv range).

The relative humidity influence test consists in implementing the same operations as for the accuracy test (see E.2.3.2) but in a room where the relative humidity is not 50%. Also, step 7 is done for one single CO_2 level (no increase nor decrease).

The relative humidity influence test has to be done for the two (2) following relative humidities:

- 30%
- 70%

E.2.4.2 Results presentation

Table 7: Example of relative humidity influence test results presentation

RH	Setpoint level	Analogue output (voltage)		Digital output[9]	Abs. deviation
%	ppmv	V	ppmv	ppmv	-
30	1000				
70	1000				

APPENDIX F. TEST METHOD FOR RELATIVE HUMIDITY SENSORS

F.1 General

The relative humidity (RH) sensor must be characterized by an ISO 17025 accredited laboratory (see II.2.1.2) in a test box or chamber with controlled ambient conditions, in accordance with the test method described in F.2.2 .

The purpose of the test is to determine the response of the sensor for different RH levels in order to check its linearity and to know its calibration curve.

F.1.1 Scope

This test method applies to RH sensors used to control the modulation of the ventilation rate of a room according to its relative humidity level.

These sensors determine the relative humidity (RH) in the air.

They deliver an analogue signal, proportional to the RH.

These sensors are intended to be installed in a room or in an air flow stream (e.g., on a room wall, in a ventilation exhaust duct or in an exhaust ventilation unit).

F.1.2 Normative references

The test method described in the following paragraphs is derivated from:

- Revision 1 (October 2009) of the CSTB document "Modalités d'instruction des Avis Techniques sur les systèmes de modulation de débit de ventilation dans le tertiaire, Annexe A – Méthodologie d'essais des capteurs de CO_2"
- EN 13141-10:2008, "Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 10: Humidity controlled extract air terminal device";

F.1.3 Terms and definitions

The terms and definitions given in EN 12792:2003 and EN 13141-2:2010 apply (see also I.3).

F.1.4 Symbols and abbreviations

The symbols and units given in EN 12792:2003 and the symbols and units given in Table 8 apply.

Table 8 : Symbols and units

Term	Symbol	Unit
Minimum RH of sensor operating range	φ_{min}	% RH
Maximum RH of sensor operating range	φ_{max}	% RH

F.2 Test procedure

F.2.1 Test installation and conditions

F.2.1.1 Test chamber

The sensor is placed in a chamber where the relative humidity can be monitored in the range necessary for the qualification of the sensor. The test chamber shall be controlled in relative humidity and temperature, representing indoor conditions defined by the manufacturer's technical file.

The RH sensor must be located away from intake/exhaust ducts, windows and doorways, and in any case less than 3.5 m from the floor.

The chamber volume must be sufficient to accommodate the sensor(s) under test. The chamber volume and how the RH is established and maintained must be such that the RH is stable in the vicinity of the sensor(s) under test. Stability and uniformity of RH should be achieved.

A single chamber can be designed to accommodate several sensors simultaneously.

F.2.1.2 Test ambient conditions

The ambient conditions present during the tests such as temperature and barometric pressure must be recorded. They should be consistent with the sensors operating range defined in the manufacturer's technical file.

The relative humidity must not vary by more than ±2% RH points during the test (see F.2.2.2).

The test chamber pressure must be close to the atmospheric pressure (i.e., 1013.25 hPa at sea level) and in any case it shall be comprised between 860 and 1060 hPa.

The air ambient temperature in the chamber must be 20°C. This temperature must not vary by more than ±1K during the test.

The air velocities in the vicinity of the sensor must be low and remain lower than 1 m/s at all times.

F.2.1.3 Uncertainties of measurement

The uncertainty of the measurement instruments shall enable to comply with the following measurement uncertainties:

- The temperature must be measured with an uncertainty of less than ± 0.5 K.
- The relative humidity must be measured with an uncertainty of less than ±2%-points.
- The barometric (ambient) pressure must be measured with an uncertainty of less than ± 100Pa.
- The air velocity shall be measured with an uncertainty lower than ±0.1 m/s.

F.2.2 Test of RH sensor accuracy

F.2.2.1 Test principle

The test consists of subjecting the sensor to several relative humidity levels and then evaluating the differences between the sensor response and the applied RH level.

The range of RH levels [φ_{min};φ_{max}] applicable to the sensor shall be defined by the manufacturer's technical file.

NOTE: If φ_{min} is lower than 30%RH, a minimum value of 30%RH will be considered for test conditions due to the difficulty of realisation. Likewise, if φ_{max} is higher than 85%RH, a maximum value of 85%RH will be considered.

The tests shall be performed with first an increase of relative humidity levels from minimum to maximum then a decrease back (see step 6 in F.2.2.2). The measurements shall be done at minimum RH level, in at least three RH levels regularly spaced in between minimum and maximum and then at maximum RH level for the increasing cycle. The ventilation control thresholds (example : change of fan speed from speed 1 to speed 2 at 50%RH) shall be tested in priority. If necessary, more points shall be tested to avoid steps of RH level ($\Delta\varphi$) larger than 10%RH. The repartition of the measurement points shall be equally distributed on the declared range.

Same points down to the minimum shall be measured while decreasing.

Each measurement (during both increase and decrease phases) will enable to evaluate the sensor response accuracy. The absolute deviation (see Table 9) between the analogue output value (converted in %RH) and the RH level setpoint (in %RH) shall not exceed ±4%-points.

The comparison between measurements at the same RH levels (same setpoint of index k) done respectively during the increasing phase ($\varphi_{increase\_k}$) and during the decreasing phase ($\varphi_{decrease\_k}$) will enable to evaluate the reproducibility of the sensor response. The absolute deviation between the increasing RH level and the decreasing RH level for a same setpoint should not vary by more than ±4%-points either.

Example:

The manufacturer declares a sensor operating range of [0;100] %RH with 0V = 0% RH and 10V = 100 %RH. The first regulation of the system (change of fan speed) is done when the RH level exceeds 30%RH so it is suggested to integrate this value in the list and to implement the 10%RH step from 30%RH to 80%RH. That would be 6 points (30, 40, 50, 60, 70, 80) for the increase and 6 points for the decrease (same points but decreasing from 80 to 30) so 12 testing points in total (see example on Table 9).

For setpoint 50%RH the output value observed shall be comprised between 46%RH and 54%RH included. Considering that the analogue output is 5.1V during the increase phase then the corresponding value in %RH is 5.1*100/10 = 51%RH which is valid. If the analogue output is 4.6V during the decrease phase then the corresponding value is 46%RH, which is also valid from the accuracy point of view but not from the precision point of view (51-46=5 > 4%-points).

F.2.2.2 Test operations

The test consists of the following operations:

1. switch on the sensor for at least 1 hour prior to the measurements start,
2. if necessary, adjust the sensor zero point by setting the RH to 0%RH (dry air),
3. if necessary, adjust the sensor gain by setting the RH to approximately 90% of full scale and measure the response time T90 of the sensor at this level (30%RH ≤ φ ≤85%RH),
4. if the zero point needs to be adjusted, check the gain,
5. set the first RH level into the test chamber,
6. carry out a series of measurements with increasing and then decreasing RH levels :

   For each RH level, note after stabilisation the indication of the display (digital output) and electrical (analogue) output provided by the sensor.

   The stability at a given level shall be satisfied with a fluctuation of ±2%-points.

   The stable level shall be reached within 5 minutes after exposure to the relative humidity level and maintained for 45 to 60 min to validate the outputs. Then the setpoint can be changed and step 6 is repeated for each setpoint until the increase and decrease phases are completed.

F.2.2.3 Results presentation

The test report shall include a table (see Table 9) presenting :

- the sensor response (analogue and digital output signal) as a function of the RH level,
- the absolute deviation from the setpoint

for all the individual test points.

The test report shall also specify the 90% response time T90 measured at step n°3 (see F.2.2.2).

If the sensor documentation states that a pressure correction is to be applied, this must be mentioned in the test report.

Table 9: Example of RH sensor accuracy test results table

Test point	Setpoint level	Analogue output (voltage)		Digital output[10]	Abs. deviation
	%RH	V	%RH	%RH	-
Increasing levels					
1	30				
2	40				
3	50	5.1	51		+1
4	60				
5	70				
6	80				
Decreasing levels					
7	80				
8	70				
9	60				
10	50	4.6	46		-4
11	40				
12	30				

These results are used to plot the sensor calibration curve, obtained by linear regression from the test results. The calibration curve is used to check the linearity of the signal delivered by the sensor and the deviations between its response and the calibration curve for different levels.

[10] When available.

APPENDIX G. TEST METHOD FOR TEMPERATURE SENSORS

G.1 General

The temperature sensor must be characterized by an ISO 17025 accredited laboratory (see II.2.1.2) in a test box or chamber with controlled ambient conditions, in accordance with the test method described in G.2 .

The purpose of the test is to determine the response of the sensor for different temperatures in order to check its linearity and to know its calibration curve.

G.1.1 Scope

This test method applies to temperature sensors used to control the modulation of the ventilation rate of a room according to its ambient temperature.

These sensors determine the air ambient temperature.

They deliver an analogue signal, proportional to the temperature.

These sensors are intended to be installed in a room or in an air flow stream (e.g., on a room wall, in a ventilation exhaust duct or in an exhaust ventilation unit).

G.1.2 Normative references

The test method described in the following paragraphs is derivated from:

- Revision 1 (October 2009) of the CSTB document “Modalités d'instruction des Avis Techniques sur les systèmes de modulation de débit de ventilation dans le tertiaire, Annexe A – Méthodologie d’essais des capteurs de CO_2”
- EN 13141-10:2008, “Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 10: Humidity controlled extract air terminal device”;

G.1.3 Terms and definitions

The terms and definitions given in EN 12792:2003 and EN 13141-2:2010 apply (see also I.3).

G.1.4 Symbols and abbreviations

The symbols and units given in EN 12792:2003 and the symbols and units given in Table 10 apply.

Table 10 : Symbols and units

Term	Symbol	Unit
Minimum temperature of sensor operating range	ϑ_{min}	°C
Maximum temperature of sensor operating range	ϑ_{max}	°C

G.2 Test procedure

G.2.1 Test installation and conditions

G.2.1.1 Test chamber

The sensor is placed in a chamber where the temperature can be monitored in the range necessary for the qualification of the sensor. The test chamber shall be controlled in relative humidity and temperature, representing indoor conditions defined by the manufacturer’s technical file.

The temperature sensor must be located away from intake/exhaust ducts, windows and doorways, and in any case less than 3.5 m from the floor.

The chamber volume must be sufficient to accommodate the sensor(s) under test. The chamber volume and how the temperature is established and maintained must be such that the temperature is stable in the vicinity of the sensor(s) under test. Stability and uniformity of temperature should be achieved.

A single chamber can be designed to accommodate several sensors simultaneously.

G.2.1.2 Test ambient conditions

The ambient conditions present during the tests such as temperature and barometric pressure must be recorded. They should be consistent with the sensors operating range defined in the manufacturer's technical file.

The relative humidity (RH) in the chamber must be set at 50% and it must not vary by more than ±2% RH points during the test. If this RH level is not consistent with the temperature sensor operating range defined in the manufacturer's technical file, then a more suitable relative humidity level, necessarily comprised between 25 and 75%RH, will be defined for the test and recorded.

The test chamber pressure must be close to the atmospheric pressure (i.e., 1013.25 hPa at sea level) and in any case it shall be comprised between 860 and 1060 hPa.

The air ambient temperature must not vary by more than ±1K during the test.

The air velocities in the vicinity of the sensor must be low and remain lower than 1 m/s at all times.

G.2.1.3 Uncertainties of measurement

The uncertainty of the measurement instruments shall enable to comply with the following measurement uncertainties:

- The temperature must be measured with an uncertainty of less than ± 0.5 K.
- The relative humidity must be measured with an uncertainty of less than ±2%-points.
- The barometric (ambient) pressure must be measured with an uncertainty of less than ± 100Pa.
- The air velocity shall be measured with an uncertainty lower than ±0.1 m/s.

G.2.2 Test of temperature sensor accuracy

G.2.2.1 Test principle

The test consists of subjecting the sensor to several temperatures and then evaluating the differences between the sensor response and the applied temperature.

The range of temperatures [ϑ_{min};ϑ_{max}] applicable to the sensor shall be defined by the manufacturer's technical file.

NOTE: If ϑ_{min} is lower than +10.0°C, a minimum value of +10.0°C will be considered for test conditions due to the difficulty of realisation. Likewise, if ϑ_{max} is higher than +50.0°C, a maximum value of +50.0°C will be considered.

The tests shall be performed with first an increase of temperature values from minimum to maximum then a decrease back (see step 6 in §G.2.2.2). The measurements shall be done at minimum temperature, in at least three temperatures regularly spaced in between minimum and maximum and then at maximum temperature for the increasing cycle. The ventilation control thresholds (example : change of fan speed from speed 1 to speed 2 when outdoor temperature goes above +16.0°C) shall be tested in priority. If necessary, more points shall be tested to avoid steps of temperature ($\Delta\vartheta$) larger than 10.0°C. The repartition of the measurement points shall be equally distributed on the declared range.

Same points down to the minimum shall be measured while decreasing.

Each measurement (during both increase and decrease phases) will enable to evaluate the sensor response accuracy. The absolute deviation (see Table 11) between the analogue output value (converted in °C) and the temperature setpoint (in °C) shall not exceed ±1.0°C.

The comparison between measurements at the same temperature (same setpoint of index k) done respectively during the increasing phase ($\vartheta_{increase\_k}$) and during the decreasing phase ($\vartheta_{decrease\_k}$) will enable to evaluate the reproducibility of the sensor response. The absolute deviation between the increasing temperature and the decreasing temperature for a same setpoint should not vary by more than ±1.0°C either.

Example:

The manufacturer declares a sensor operating range of [0;50] °C with 0V = +0°C and 10V = +50°C. One of the regulations of the system (change of fan speed) is done when the outdoor temperature goes above +16°C so it is suggested to integrate this value in the list and to implement the 10°C step from +10°C to +50°C.

That would be 6 points (10, 16, 20, 30, 40, 50) for the increase and 6 points for the decrease (same points but decreasing from 50 to 10) so 12 testing points in total (see Table 11).

For setpoint +20.0°C the output value observed shall be comprised between +19.0°C and +21.0°C included. Considering that the analogue output is 4.1V during the increase phase then the corresponding value in °C is 4.1*50/10 = +20.5°C which is valid. If the analogue output is 3.8V during the decrease phase then the corresponding value is +19.0°C, which is also valid from the accuracy point of view but not from the precision point of view (20.5-19.0=1.5 > 1°C).

G.2.2.2 Test operations

The test consists of the following operations:

1. switch on the sensor for at least 1 hour prior to the measurements start,
2. if necessary, adjust the sensor zero point by setting the temperature to +0°C,
3. if necessary, adjust the sensor gain by setting the temperature to approximately 90% of full scale and measure the response time T90 of the sensor at this level (for a temperature between +10°C and +50°C),
4. if the zero point needs to be adjusted, check the gain,
5. set the first temperature level into the test chamber,
6. carry out a series of measurements with increasing and then decreasing temperatures :

   For each temperature, note after stabilisation the indication of the display (digital output) and electrical (analogue) output provided by the sensor.

   The stability at a given level shall be satisfied with a fluctuation of ±1K.

   The stable level shall be reached within 5 minutes after exposure to the temperature level and maintained for maintained for 45 to 60 min to validate the outputs. Then the setpoint can be changed and step 6 is repeated for each setpoint until the increase and decrease phases are completed.

G.2.2.3 Results presentation

The test report shall include a table (see Table 11) presenting :

- the sensor response (analogue and digital output signal) as a function of the temperature,
- the absolute deviation from the setpoint

for all the individual test points.

The test report shall also specify the 90% response time T90 measured at step n° 3 (see G.2.2.2).

If the sensor documentation states that a pressure correction is to be applied, this must be mentioned in the test report.

Table 11: Example of temperature sensor accuracy test results table

Test point	Setpoint level	Analogue output (voltage)		Digital output[11]	Abs. deviation
	°C	V	°C	°C	-
Increasing levels					
1	10.0				
2	16.0				
3	20.0	4.1	20.5		+0.5
4	30.0				
5	40.0				
6	50.0				
Decreasing levels					
7	50.0				
8	40.0				
9	30.0				
10	20.0	3.8	19.0		-1.0
11	16.0				
12	10.0				

These results are used to plot the sensor calibration curve, obtained by linear regression from the test results. The calibration curve is used to check the linearity of the signal delivered by the sensor and the deviations between its response and the calibration curve for different levels.

[11] When available.

APPENDIX H. TEST METHODS FOR PRESENCE SENSORS

The test method described in the following paragraphs is derivated from revision 1 (October 2009) of the CSTB document “Modalités d’instruction des Avis Techniques sur les systèmes de modulation de débit de ventilation dans le tertiaire. Annexe B – Méthodologie d’essais des capteurs de présence et de mouvements”.

H.1 Scope

The methodology described applies to optical presence or movement sensors (ceiling only).

It applies to sensors with a time delay in the range [5 min; 30 min].

H.2 Experimental set-up and test conditions

The area covered by the sensor is defined with the oscillating device (wide movement) developed during CETIAT and CSTB studies conducted for ADEME.

This horizontal device, located 80 cm from the floor, is composed of a heating element of section 10cmx15cm and thickness 2cm.

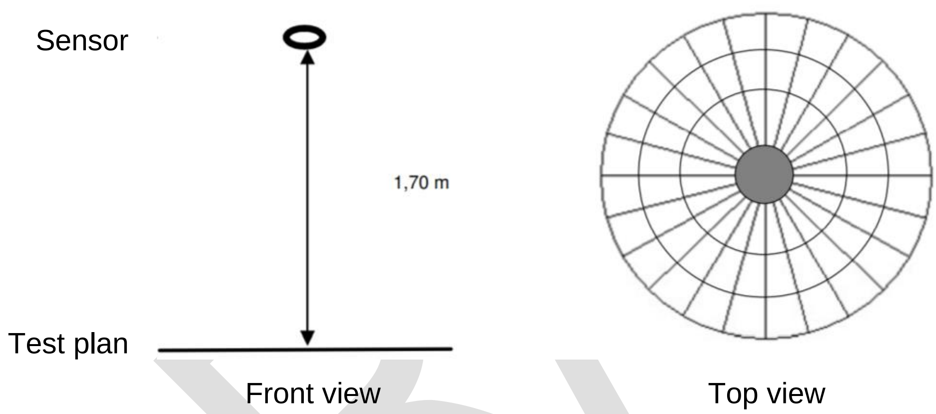


Figure 7 : Experimental set-up

During the test, the ambient air temperature must be between 20°C and 25°C and the temperature of the heating element must be maintained at 30°C+/-1°C.

The laboratory personnel must, at all times, position him/herself so that he/she is not detected. He/she must also ensure that there are no sources of heat projected onto the ground (e.g., due to sun rays).

The sensors must not be tilted by more than 5°.

The tests are conducted on a circle at least 1.70m in vertical projection from the sensor (see Figure 7) for rooms between 2.5 and 3.5m high. The measuring radii are taken with a maximum pitch of 15°degrees of angle over the entire range up to 3m and possibly tightened afterwards. The tests are carried out on concentric radii every 20cm from a radius of 60cm.

The results will be given as beam detection (0 = not detected and 1 = detected) and by angle (see Figure 8).

H.3 Definition of useful parameters to include in the test report

H.3.1 Detection rate

The detection rate (DR) is the percentage of the number of points detected in relation to the total number of points per radius (over 360°).

<u>Example</u>: On Table 12, there are 24 points per radius (corresponding to angles 0°, 15°, 30°, … , 345°) so if 11 points are detected for radius 60 cm then the detection rate for radius 60 is DR_{60} = 11/24 = 45.8% rounded to 46% (see also Figure 8).

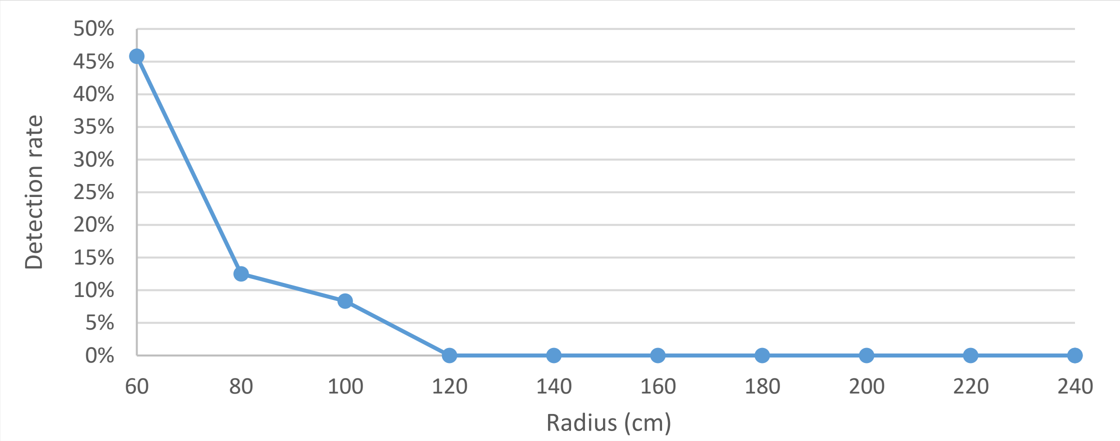


Figure 8: Example of detection rate curve for a presence sensor

H.3.2 Average detection rate

The average detection rate (noted M) is the average of the detection rates on the entire coverage area (see §H.3.4).

<u>Example</u>: On the example given on Table 12, the coverage area corresponds to the disc defined by a detection radius of 120° (see also §H.3.4 and §H.4). However, the coverage area is eventually reduced to a disc defined by radius 60° in order to comply with the requirements given in §H.5 so in this particular example M equals DR_{60} = 46% (see example of calculation done in §H.5).

H.3.3 45° quadrant detection rate

The detection rate per 45° quadrant is the number of points detected in a 45° quadrant divided by the total number of points in that quadrant.

<u>Example</u>: There are 3 points per 45° quadrant for each radius (corresponding to angles 0°, 15°, 30° for the first quadrant for instance). On Table 12, for the first quadrant of radius 60 cm (squares with pale blue background) we observe 2 detected points out of 3 so DR_{q1} = 2/3 = 66.6% rounded to 67%.

H.3.4 Coverage area

The coverage area is the disc defined by the detection radius, denoted Rd, determined according to the procedure described in H.4.

H.4 Test procedure

The procedure to be applied is a two-step process:

- calculation of the detection rate: calculate the detection rate for each radius (all angles combined),
- determination of the detection radius Rd: the sliding average of the detection rate over three consecutive points in radius (Rd-1, Rd, Rd+1) must be non-zero.

<u>Example</u>: On Table 12, the last sliding average which is different than zero is that of radius 120 so Rd = 120 cm. Indeed, we calculate:

$$Sliding\ average_{120} = \frac{(DR_{100} + DR_{120} + DR_{140})}{3} = \frac{(8+0+0)}{3} = 2.8\%\ rounded\ to\ 3\%\ (non-zero)$$

$$Sliding\ average_{140} = \frac{(DR_{120} + DR_{140} + DR_{160})}{3} = \frac{(0+0+0)}{3} = 0\%$$

H.5 Requirements

Presence sensors must meet the following two requirements (otherwise the detection radius will be reduced until these requirements are met):

- Criteria 1: The average detection rate over the entire coverage area (M) must be greater than 40% (M ≥ 40%).
- Criteria 2: The relative deviation between M and the 45° quadrant detection rate (M_q) must be strictly lower than 60%:

$$\frac{M - M_q}{M} < 60\%$$

Example: On the example given on Table 12, the coverage area corresponds to the disc defined by a detection radius of 120° (see also §H.3.4 and §H.4).

So, the average detection rate M would be calculated as follows:

$$M = \frac{(DR_{60} + DR_{80} + DR_{100} + DR_{120})}{4} = \frac{(46 + 13 + 8 + 0)}{4} = 17\%$$

This does not comply with criteria 1 so the detection radius is reduced to 100 but it is still not compliant (see “Criteria 1” section in Table 12) so it is reduced again until M ≥ 40%.

Criteria 1 is eventually met for:

$$M = DRaverage_{60} = \frac{(DR_{60})}{1} = DR_{60} = 46\%$$

Thus, the coverage area is reduced to a disc defined by radius 60° (i.e., Rd = 60°) and M equals DR_{60}.

The 45° quadrant detection rate is therefore determined for radius 60° with (see Table 12):

- DR_{q1} = 67% (see detailed calculation in §H.3.3);
- DR_{q2} = 33% ;
- DR_{q3} = 0% ;
- DR_{q4} = 0%;
- DR_{q5} = 33%;
- DR_{q6} = 33%;
- DR_{q7} = 100%
- and DR_{q8} = 100%.

So, the average of the 45° quadrant detection rate is :

$$M_q = \frac{(DR_{q1} + DR_{q2} + DR_{q3} + DR_{q4} + DR_{q5} + DR_{q6} + DR_{q7} + DR_{q8})}{8}$$
$$= \frac{(67 + 33 + 0 + 0 + 33 + 33 + 100 + 100)}{8}$$
$$= 46\%$$

So

$$\frac{M - M_q}{M} = \frac{46 - 46}{46} = 0\%$$

So, criteria 2 ((M-Mq)/M < 60%) is met.

H.6 Test results presentation

Table 12 is an example of test results table that can be included in the test report.

Table 12 : Example of test results table

	Radius (cm)												
Angle (°)	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**240**	**Nb* per angle**	**45° quadrant detection rate for radius 60****
0°	0	0	0	0	0	0	0	0	0	0	0	0	
15°	1	1	0	0	0	0	0	0	0	0	0	2	67%
30°	1	0	0	0	0	0	0	0	0	0	0	1	
45°	1	0	0	0	0	0	0	0	0	0	0	1	
60°	0	0	0	0	0	0	0	0	0	0	0	0	33%
75°	0	0	0	0	0	0	0	0	0	0	0	0	
90°	0	0	0	0	0	0	0	0	0	0	0	0	
105°	0	0	0	0	0	0	0	0	0	0	0	0	0%
120°	0	0	0	0	0	0	0	0	0	0	0	0	
135°	0	0	0	0	0	0	0	0	0	0	0	0	
150°	0	1	0	0	0	0	0	0	0	0	0	1	0%
165°	0	1	0	0	0	0	0	0	0	0	0	1	
180°	1	0	0	0	0	0	0	0	0	0	0	1	
195°	0	0	0	0	0	0	0	0	0	0	0	0	33%
210°	0	0	0	0	0	0	0	0	0	0	0	0	
225°	0	0	0	0	0	0	0	0	0	0	0	0	
240°	0	0	0	0	0	0	0	0	0	0	0	0	33%
255°	1	0	1	0	0	0	0	0	0	0	0	2	
270°	1	0	0	0	0	0	0	0	0	0	0	1	
285°	1	0	1	0	0	0	0	0	0	0	0	2	100%
300°	1	0	0	0	0	0	0	0	0	0	0	1	
315°	1	0	0	0	0	0	0	0	0	0	0	1	
330°	1	0	0	0	0	0	0	0	0	0	0	1	100%
345°	1	0	0	0	0	0	0	0	0	0	0	1	
Nb* per radius	**11**	**3**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Mq for radius 60****	**46%**
Nb* total		**16**											
					Criteria 1							Criteria 2	
Detection rate	**46%**	**13%**	**8%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**		
Sliding average		**22%**	**7%**	**3%**	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*			
Resulting radius				**120**								(M-Mq)/M	**0%**
M [60-120]				*17%*									
M [60-100]			*22%*										
M [60-80]		*29%*											
M [60]	**46%**												

*Nb = number of detected points

** The radius for which criteria 1 is met (M ≥ 40%)

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