WHY IS IT IMPORTANT TO ADRESS MEASUREMENT QUALITY ISSUES IN STANDARDS? HOW STANDARDS CAN CONTRIBUTE

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Poor ventilation performance and/or combined thermal complains and disturbing noise levels: who is to blame?

- Designers (installers, consultants, producers) select and project ventilation products/systems
- Installers (contractors) install HVAC&R products as part of heating, ventilating, air-conditioning and cooling systems in buildings.
- Basis of selection are the product data from producer/supplier and building performance data (thermal & airtightness)
- Are these data well interpreted, reliable and applicable?

Poor ventilation performance: who is to blame?

- The building system or sub-system will only perform according the expectation and connected contract obligations if the product data and assumed boundary conditions are correct and complete.
- The boundary conditions:
  - airtightness of the building envelope
  - thermal performance of the building elements
- If at the end the building or installation doesn't perform according the agreed design specifications, who is to blame?
  - The designer because of a poor design?
  - The installer because of poor installation work?
  - The supplier of the integrated products because of poor performance of these products?
  - The building contractor/designer because of the leakage or poor thermal quality?

who is to blame?

- Often it is the installer -as he is in many cases the subcontracting party- and the last party finishing the system- who gets the blame.
- For the client this seems simple, the installer installs and should perform.
- As professionals we know that this may be client's logic, but is not always correct (or the entire story).
  - The (sub-)contracted installer may not be paid or responsible for the design.
  - Should he have checked the design or the correct performance of the products or building?
  - Is he to blame if trusting the inaccurate or not reliable product data or building performance?
  - How could an average installer ever win a dispute on this issue when opposing a specialized producer or main building contractor?

Guaranty performance:

Learn through inspection and measurements

- Inspection and measurements of the realised ventilation and air systems are an essential factor to guaranty the performance of the system in relation to the building properties.
- Airtightness of the building and air systems, measuring flow rates of ATD's, measuring noise levels of ventilation devices, checking location of ATD's, checking the airway path in order to be able to report the performance of the ventilation and air systems.

Assuring Quality in 3 steps

1. using reliable (certified) products and components is a first step
2. Checking if the designed and installed performance is reached is a **second step**
3. at the delivery point: prove with measurement results that the installation is designed, installed and performing as agreed or offered according possible regulations. Including test-reports and user-manuals

First step: Certification of ventilation products

- Product certification is a substantial step in the right direction. But are all certificates the same?
- With 3rd party certification where in-depended accredited certifiers declare that the specific declared product performance is according a specific, public available and by the accreditation body accepted, certification guide(s) and/or standard(s).
- In our EU-industry there are organizations, like EUROVENT-certification, facilitating this certification service on bases of accredited ISO17025 and EN45011 certification schemes. These accredited schemes, offer a maximal quality assurance level, they may also refer to accredited laboratories testing the products.

Next step: from Product to System Certification to assure the system performance

- A next step could be certifying the designer and installer according an EN45011 based certification scheme.
- This means that a contractor or client can choose for a certified installing company where the QA is guaranteed by the system that requires regular 3rd party checks of the projects of this certified supplier (installer etc.).
- These schemes are to be developed for specific application fields and refer to the relevant EN and ISO standards.
- They will also include the use of certified products. By using certified products the certified installer will focus on qualifying his own process.
- By using certified products he can trust the product certificates and doesn't have to check the quality of these products again.

Quality of the inspection at final delivery stage

- To be able to rely on these inspection and measuring services **we need to assure the quality of these processes.**
- We have to describe the measurement procedures and the inspection protocols
- and additional the **competence level of the qualified persons** performing these assessments.
- the requirements for **test-report** and **user-manuals**

Standards are the basis of certification or commission procedures

- This is why I want to say a few words on the standard development on products and system in Europe
- Among many two EU directives (basis for regulation in EU member States) are important for the ventilation industry and the designers and installers of residential ventilation systems

Do we have all standards required?

- standards describing protocols how to test products
- standards providing protocols how to measure in situ
- as you cannot measure every product or part of a system, protocols are needed to relay on for trust worthy sampling, offering the client reasonable security against acceptable costs.

Example: Checking air flow rate guidelines/standards for these measurement protocols are needed to avoid over-compensation.

- for low pressure systems, as in residential systems , pressure compensated measuring equipment will have a typical accuracy of 10%
- if checking requires that at least 90% of the required flow rate is statistical realised there is a danger that the installer will over-dimension the systems to avoid negative results

EN 16211:2011 Ventilation for buildings - Measurement of air flows on site – methods

- This standard applies to measurement of airflows on site. It provides the technician with a description of the methods, their protocols, and tables for noting measured and calculated values so that the necessary measurements are performed within the margins of stipulated method uncertainties.
- The in the standard referenced documents are indispensable for the application of the standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments)

EN 16211 refers to

- EN12599 *Ventilation for buildings - Test procedures and measuring methods for handing over installed ventilation and air conditioning systems*
- EN14277 *Ventilation for buildings – Air terminal devices – Methods for airflow measurement by calibrated sensors in or close to ATD/Plenum boxes*
- ISO 3966, *Measurement of fluid flow in closed conduits. Velocity area method using Pitot static tubes.*
- ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices. Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full.*
- ISO 5167-2 *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full-Part 2: Orifice plates*

EN 16211 refers to

- ISO 5167-3 *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full-Part 3: Nozzles and Venturi nozzles*
- ISO 5167-4 *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full-Part 4: Venturi tubes*
- ISO 5221, *Air distribution and air diffusion. Rules to methods of measuring air flow rate in an airhandling duct.*
- ISO 4053-1, *Measurement of gas flow in conduits -- Tracer methods -- Part 1: General*
- ENV 13005 Guide to the expression of uncertainty of measurement: *This Guide establishes general rules for evaluating and expressing uncertainty in measurement that can be followed at various levels of accuracy and in many fields - from the shop floor to fundamental research.*

Issues in EN16211 **Ventilation for buildings - Measurement of air flows on site – methods**

- Factors influencing measurements
- Sources of errors and uncertainties
- Gross errors , Systematic errors , Calibration, Uncertainties
- Measurement requirement using different devices
- Measurement uncertainty
- Standard instrument uncertainty, method, reading
- Different Methods for measurement of air flows in ducts, procedures, uncertainty,
- Methods for Supply ATDs (air terminal devices), Correction of measured values, Standard method uncertainty

some other relevant EN's

- EN 12097, *Ventilation for buildings Ductwork Requirements for ductwork components to facilitate maintenance of ductwork systems*
- EN 13779, *Ventilation for non-residential buildings Performance requirements for ventilation and room conditioning systems*
- EN 14134, *Ventilation for buildings Performance testing and installation checks of residential ventilation systems*
- EN 15232, *Energy performance of buildings Impact of Building Automation, Controls and Building Management*
- EN 15780, *Ventilation for buildings, Ductwork Cleanliness of ventilation systems*
- EN 13053: *Ventilation for buildings — Air handling units — Rating and performance for units, components and sections*
- EN12237: *Ventilation for buildings Ductwork - Strength and leakage of circular sheet metal ducts*
- EN15727*: Ventilation for buildings -Ducts and ductwork components, leakage classification and testing*
- EN1507*: Ventilation for buildings - Sheet metal air ducts with rectangular section - Requirements for strength and leakage*
- EN15251*: Indoor environmental input parameters for design and assessment of energy performance of buildings- addressing indoor air quality, thermal environment, lighting and acoustics*
- *EN13141-series : Performance testing of components/products for residential ventilation*
- *etc. etc. etc.*

The EPB Inspection standard: **Guidelines for inspection of ventilation and air conditioning systems**

(follow-up of the EN15239 & 15240)

- assessment of the air-conditioning efficiency and the sizing compared to the cooling requirements of the building;
- advice for the users on the replacement of air-conditioning systems or on other modifications to the airconditioning system;
- inspection of ventilation systems, and of the associated air distribution and exhaust systems taking into account: general indoor climate conditions to avoid negative effects such as inadequate ventilation;

This standard specifies the common methodology and the requirements for inspection of air conditioning systems in buildings for space cooling and/or heating and/or ventilation systems

from an energy use standpoint to fulfil the EPBD (the EU Energy Performance Buildings Directive) requirements and applies to:

- both residential and non-residential buildings equipped with:
  - air conditioning system(s) without mechanical ventilation; or
  - air conditioning system(s) with mechanical ventilation; or
  - natural and mechanical ventilation system(s).
  - fixed systems;
  - accessible parts that contribute to the cooling and mechanical ventilation services.
- is **also applicable** to some systems **not covered** by EPBD such as:
  - some systems not covered by the EPBD, such as fixed systems of less than 12 kW output;
  - ventilation-only systems

How to reach the required quality? Quality assurance of the:

- design including the correct building performance
- ventilation products and components
- installation works including setting controls and balancing
- final delivery including
  - test reports
  - user manual including required maintenance schedules

Process/product certification of installers

- A levelled playing field when offering projects
- QA and a clear complaint route for the client
- The result is a certified installation meeting the offered requirements
- For the installer: A 3rd party certification offers a learning curve, there is an immediate feed-back when faults are detected
- Commissioning schemes offer an alternative approach more focussed on the end of pipe approach and offer less learning opportunities

Commissioning the solution?

- Commissioning and retro-commission another route?
- ASHRAE Guideline 0-2005 defines Commissioning as:
- "A quality-focussed process for enhancing the delivery of a project. The process focusses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the owner's Project Requirements."

Commissioning the solution?

- In most cases this Commissioner, or as they say, the commissioning authority, is an independent entity not being the planner/designer/installer/tester/operator/maintainer.
- This may be a good solution for extensive complicated and sometimes risky projects, but seems overdone for the majority of Residential and Non- Residential Ventilation Systems.
- An EN45011 product/process certification scheme seems more attractive, for lower costs and achievable for the majority.

Developing product and system standards, relation ECO-design / EPBD

- Implementing the EU ECO-design Directive requires an upgrade or development of ventilation products standards.
- Product TC's have to be aware that the performance data should be suitable for the system performance description under the EPBD.
- The availability of these standards will make the further development of product and system certification schemes possible.

The ECO-design and EPBD connection may challenge the Standard developers

- Product TC's (at CEN or ISO level) may have a first priority for just specifying these data needed to compare products in doing so the market seems well regulated.
- System designers need more information, not always visible in the current product declarations,
- If not regulated in a standard or EU regulation, they have to rely for these data on the producer self-declaration and additional product documentation.
- Product Certification will become more welcomed by the system designer/installer if a more complete product declaration is supported.
- One should not expect that the TC, responsible for the product standard, will add this information without a clear push of the market including the regulators.

Regarding ECO-Design Mandate 495

- The calculation procedures to asses the energy performance of ventilation related products shall be based on the EPB standards
- This possible **overlap** with EPBD work may lead to confusion in the process of revising the current set of CEN EPB standards if product standard developers use a different approach
- CENTC156 WG's working on the current EPB revisions and extension of the ventilation standards are aware of this issue and will report possible constraints.

Summary

- Certification and/or Commission protocols are needed for QA of (residential) ventilation systems
- Developing and harmonised product and system standards on (residential) ventilation systems is urgent
- Although many existing standards offer guidance: Standard protocols for testing ventilation and air systems in situ at point of delivery, may not completely be covered by the current standards.