Ventilation Ductwork Systems Certification for a Better Air Tightness

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ABSTRACT

The implementation of the Energy Performance of Buildings Directive 2010/31/EU recast puts increasing pressure to achieve better building and ductwork airtightness.

In this context, Eurovent Certita Certification decided to establish a new certification programme for **Ventilation Ductwork Systems**, opening a new chapter in the history of the **Eurovent Certified Performance** (ECP) certification mark, which concerned only products, not systems, until then.

To meet this challenge, Eurovent Certita Certification worked for one year with a dedicated committee gathering six major European manufacturers of **ventilation ducts and fittings.** The development of the programme also involved consultation of European testing laboratories. The resulting requirements and rules defined for the **DUCT programme** rely on **Ventilation ductwork system** (typical setup) **testing** and **production sites auditing**.

The scope of the programme covers rigid and semi-rigid ventilation ductwork systems divided into the following sub-programmes:

- Rigid metallic ductwork systems with circular cross-section (DUCT-MC);
- Rigid metallic ductwork systems with rectangular cross-section (DUCT-MR);
- Semi-rigid non-metallic ductwork systems predominantly made of plastics (DUCT-P);

Among other verifications, the performance testing on typical set-ups enables to validate the **airtightness class** declared by the manufacturer. The production site auditing enables to verify the manufacturing process steadiness. These two verifications combined ensure that the air tightness class claimed by the manufacturer can indeed be reached in practice.

The first certification of ventilation ductwork systems was granted by Eurovent Certita Certification in December 2017 as a new step towards good airtightness levels in buildings, contributing to the pursuit of nearly zero-energy buildings and improving indoor air quality.

KEYWORDS

Ductwork system, air tightness class, energy efficiency, Indoor Air Quality

1 INTRODUCTION

The Energy Performance of Buildings Directive (EPBD) recast published in 2010 (Directive 2010/31/EU) acknowledged that air tightness as an important role to play in the building energy consumption reduction [1]. With Nearly Zero-Energy Buildings as objective for new buildings, the directive is urging the whole building sector to consider it as a key parameter in the building conception.

In addition to the energy efficiency objectives, the buildings airtightness is an even more challenging topic for the construction sector professionals because poorly designed, "too airtight", buildings can compromise the Indoor Air Quality (IAQ), contributing to what is called the "sick-building syndrome".

However, when the building is properly conceived and equipped with an appropriate ventilation system, the airtightness actually leads to better IAQ levels and thermal comfort.

Within the building construction elements, the ductwork system is crucial to reach proper energy consumption and IAQ levels. Indeed, studies evidenced that excessive ductwork leakage have a huge impact on energy use and indoor air quality issues.

Besides the qualification of installers for an improved airtightness in-situ, the ductwork system intrinsic airtightness (resulting from the ductwork system constituting elements conception and manufacturing) appears to be of prime importance.

In this context of rising awareness regarding airtightness and IAQ as challenges for the construction sector, Eurovent Certita Certification decided to contribute by establishing a new certification programme for Ventilation Ductwork Systems.

2 AIRTIGHTNESS REGULATORY REQUIREMENTS

More and more countries consider air-tightness in their national regulations, however the focus is set at the building level and the ductwork contribution is rarely given its due weight.

Besides, when minimum requirements for building air-tightness exist, the rating justification is not always mandatory.

2.1 Airtightness requirements for buildings in European countries

An increasing number of countries include in their regulations either required or recommended minimum airtightness levels (see Figure 1). Even though mandatory testing is not systematic yet, it gradually came into force in countries such as France, Ireland or the United Kingdom (see Figure 2) and the list continuously increases.

As an example the French regulation (RT2012) introduced a minimum requirement for the building airtightness of all residential buildings and justification of the value is mandatory. For non-residential buildings, a default value is implemented for each building type and justification is mandatory to use a better value than the default one in the energy performance (EP) calculation. The building airtightness level is to be justified by means of airtightness testing by a qualified tester. If a certified quality management approach is applied only a sample of buildings is to be tested, otherwise testing is required for each building [2].

Figure 1 : Do minimum building airtightness requirements exist in EP regulation?[1]

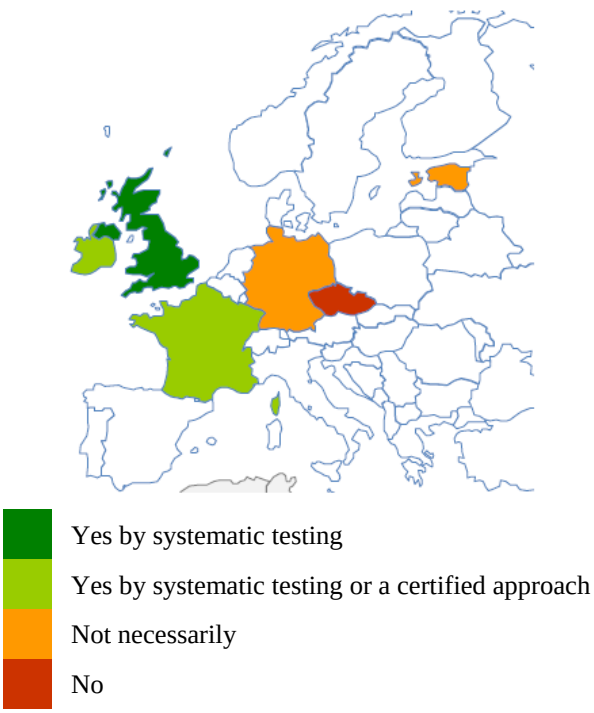

Figure 2 : Does compliance to this requirement need to be justified?

2.2 Airtightness requirements for ductwork systems in European countries

Scandinavian countries enhance airtight ductwork systems since the 1950s. For instance, in Sweden, the AMA (General Material and Workmanship Specifications) specification guidelines include tightness requirements since 1966. Since then, construction products manufacturers and installers have continuously cared for airtightness in their work and field measurements testify that Scandinavian countries reach very low air leakage in their ductwork installations [3].

In Europe, only the French (RT2012) and Belgian (EPB) regulations consider the ductwork airtightness as an input in the energy performance calculation. There is no minimum requirement but a good airtightness level, if justified, can reduce the calculated energy use. In Belgium the leakage flow according to standard EN 14134:2004[4] is applied whereas in France this is the airtightness class according to standard EN 12237:2003[5] which is used in the calculation.

3 MEASURING THE DUCTWORK LEAKAGE TO VERIFY THE AIRTIGHTNESS CLASS

Ductwork leakage can be measured in situ according to specific standards. This paper focuses of measurements that can be conducted in a test laboratory.

For metallic ducts with circular cross-section, the air-tightness classification goes from A (worst) to D (best) as shown in Table 1.

For metallic rectangular ducts a similar classification is defined in standard EN 1507:2006 [6]

[1] Source: Survey on building and ductwork airtightness requirements in Europe, Results obtained from 10 countries presented during TightVent Airtightness Association Committee-TAAC of January 2017

A leakage test is to be conducted according to EN 12237:2003 [5] or EN 1507:2006 [6] to verify the airtightness class rating.

For each test pressure p_t, the leakage factor f, ratio of the air leakage rate q_v (in m^3/s) observed during the leakage test and the ductwork surface area A (in m^2), shall be lower than the corresponding air leakage limit f_{max} which is calculated from the test pressure p_t as indicated in Table 1 below.

$$f = \frac{q_v}{A} \qquad (1)$$

Besides no damage shall be observed on the ductwork (deflection, hole, etc.). This double verification must be successful for ten test pressures in the pressure range corresponding to the class (for example that is [-750 Pa; +1000Pa] for class B) to consider that the tested ductwork complies with the airtightness class rating.

Table 1 Air tightness classification for metallic circular ducts according to EN 12237:2003[5]

Air tightness class	***Static gauge pressure limit (p_s) [Pa]***		***Air leakage limit (f_{max}) [$m^3 \cdot s^{-1} \cdot m^{-2}$]***
	Positive	Negative	
A (worst)	500	500	$0.027 \times p_t^{0.65} \times 10^{-3}$
B	1000	750	$0.009 \times p_t^{0.65} \times 10^{-3}$
C	2000	750	$0.003 \times p_t^{0.65} \times 10^{-3}$
D (best)	2000	750	$0.001 \times p_t^{0.65} \times 10^{-3}$

4 CERTIFYING AIRTIGHTNESS CLASS RATINGS

When it comes to ductwork systems intrinsic airtightness class, it is necessary to appeal to a third-party to get reliable ratings.

4.1 Third-party certification for a fair and objective comparison of the ratings

Third-party certification purpose is to make available reliable, comparable and transparent data.

As third-party certifier, Eurovent Certita Certification (ECC) has to fulfil impartiality, independency and integrity requirements. The ISO 17065 accreditation by national body COFRAC3[2] guarantees that these requirements are met and provides as a solid international recognition thanks to the EA[3]/IAF[4] agreements.

The certification process of a given Eurovent Certified Performance (ECP) programme is described in the dedicated documents which constitute a single, common baseline for the product evaluation rules and guarantee a fair treatment of the manufacturers. Indeed, these documents are public so any manufacturer can check that each of the certification process steps (product selection, testing, auditing, etc.) is conducted in accordance with the related procedure.

[2] COFRAC certificate n°5-0517. Accreditation scope available at https://www.cofrac.fr
[3] European accreditation http://www.european-accreditation.org
[4] International Accreditation Forum http://www.iaf.nu

To enhance an objective comparison, the certified data are quantifiable values expressed in specific units which are stipulated in the certification programme documents. Besides, the certified data is available on-line[5] 24/7, to anyone, without any registration or password.

4.2 The DUCT programme

The DUCT programme, into force since September 2016, opened a new chapter in the history of the Eurovent Certified Performance (ECP) certification mark, which concerned only products, not systems, until then.

To meet this challenge and ensure the programme content relevance, Eurovent Certita Certification worked for one year with a dedicated committee gathering six major European manufacturers of ventilation ducts and fittings. The development of the programme also involved consultation of European testing laboratories. The resulting rules are gathered in specific documents [7][8][9][10].

The scope of the programme covers rigid and semi-rigid ventilation ductwork systems divided into the following sub-programmes:

- Rigid metallic ductwork systems with circular cross-section (DUCT-MC);
- Rigid metallic ductwork systems with rectangular cross-section (DUCT-MR);
- Semi-rigid non-metallic ductwork systems predominantly made of plastics (DUCT-P);

The scope is restrained to ductwork systems made of elements (straight duct or fittings) fitted with an integrated sealing solution to guarantee a good level of intrinsic airtightness. Sealing solutions considered as suitable are listed in the rating standard of each sub-programme [8][9][10].

The product performance testing is conducted annually on a typical setup, common to all manufacturers of a given sub-programme, which varies from one year to the other. This typical set-up is defined by the DUCT project manager in accordance with the rules defined in the certification documents [7][8][9][10].

[5] http://www.eurovent-certification.com

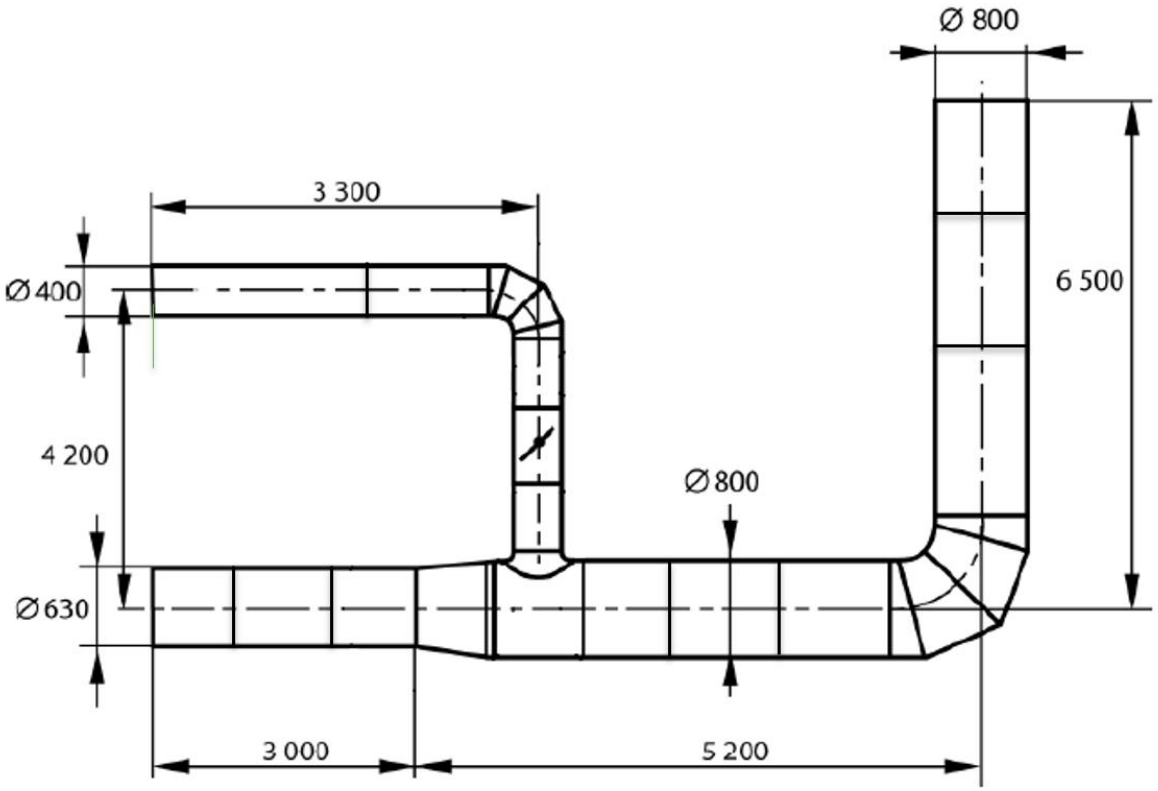

Figure 3 : Example of typical ductwork system suitable for DUCT-MC sub-programme testing. Source [11]

The test is conducted in accordance with EN 12237:2003 [5] for circular and semi-circular geometries (sub-programmes DUCT-MC and DUCT-P) or EN 1507:2006 [6] for ductwork systems of rectangular geometries (sub-programme DUCT-MR).

For the DUCT-P sub-programme, specific test pressures were defined by the Launching Committee as non-metallic ductwork products are not originally covered by EN 12237:2003 [5]. The certification documents will be updated according to upcoming unique test standard under preparation by CEN TC 156.

To ensure the performance ratings accuracy and reliability, the certification process relies upon product performance testing but also on production sites auditing which enables to verify that the tested object is representative of the whole production. Indeed, during the audit the auditor proceeds to the ductwork elements sampling and identifies them with his signature to guarantee that elements constituting the tested system are issued from regular production.

The audit is also the opportunity to verify key manufacturing requirements defined in the certification documents. For instance a dimensional check shall be performed regularly enough to guarantee a proper matching of the elements to be assembled.

Audits are conducted annually on a number of local workshops (manufacturing straight ducts only) and fitting factories specified in the operational manual [7] to verify that the requirements are met at all times.

4.3 How does the DUCT programme contribute to encourage better airtightness?

The goal of ECP mark is to verify the rating accuracy, not to influence the market. This is why a ductwork system with airtightness class A can be ECP certified just as well as a ductwork system with airtightness class D. However publishing certified ratings favours comparability of data so experienced showed for other certification programmes that the apparition of certified products on a market tends to raise the performance level.

Annual testing of the ductwork systems and auditing of production sites represent a great incentive for manufacturers to continuously improve their products, hence favouring better and better airtightness ratings.

The Eurovent Certified Performance (ECP) mark, is one the most renowned certification mark in the HVAC&R fields in Europe and beyond. It is estimated that 66% of HVAC&R products sold on the European market are ECP certified[6]. It is therefore expected that the international outreach of the ECP mark will encourage manufacturers to participate to the DUCT programme and thus prove their products ability to constitute ductwork systems compliant with the advertised airtightness class.

5 CONCLUSIONS

Air tightness is a key lever towards a better energy efficiency of the ventilation system and, by extension, of the building. Besides, it contributes in achieving better Indoor Air Quality levels.

Energy regulations and energy performance programmes are progressively becoming more stringent, putting increasing pressure for better air tightness levels and enhancing justification to prove compliance.

Certification of ventilation ductwork systems airtightness is a new step towards a better assessment of airtightness levels, contributing to the pursuit of Nearly Zero-Energy Buildings and improvement of the Indoor Air Quality.

6 REFERENCES

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[9]. Eurovent Certita Certification - RS-2C003MR (2016) – Rating Standard for the certification of Rigid Metallic Ductwork Systems with Rectangular Cross-section

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