QUALICHeCK Towards better quality and compliance

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Technology	*Aspect*	*Country*
Ventilation and airtightness	Compliance frameworks	France

DUCTWORK AIRTIGHTNESS IN FRANCE: REGULATORY CONTEXT, CONTROL PROCEDURES, RESULTS

*Ductwork airtightness is an input parameter in the French energy performance calculation method for new buildings (RT 2012) which influences the energy performance rating. If the ductwork airtightness class used in the calculation is better than the default value (2.5*class A), the ductwork airtightness has to be justified in accordance with a third-party testing scheme operational since 2014. Furthermore, there is a minimum ductwork airtightness requirement set to leakage class A if the building applies for the Effinergie+ or BEPOS labels. Field data collected through the testing scheme suggest that awareness is slowly growing as the leakage class distribution has shifted towards tighter systems compared to previous data.*

Residential buildings ☑	Non-residential buildings ☑	Specific buildings: ……
New buildings ☑	Existing buildings ☐	

Context

The French energy performance regulation for new buildings has been updated in depth 5 times since its first introduction in 1974. With regard to building airtightness, an important step was the 2005 Energy Performance regulation (EP regulation), which introduced a significant reward on the overall building energy performance assessment when justifying a better-than-default value for the air permeability of the envelope. Since 2012, professionals have to comply with mandatory limit values for building airtightness for residential buildings, and to justify compliance according to schemes developed since 2006 to secure the reliability of airtightness measurement and reporting. This has led to positive results on the market (see QUALICHeCK fact sheet #01 and #07, [4][7]).

Concerning ductwork airtightness, this subject has drawn comparatively less attention although it is also considered as an input parameter in the French EP calculation since 2000. Besides, unstructured feedback from the field suggests that much progress is possible to reduce considerably the permeability of ductwork systems both in a concern of energy conservation and indoor air quality. This is the reason why measures have been progressively introduced since 2013 to push better ductwork airtightness.

Objective and problems addressed

Duct leakage is known to be detrimental to energy performance and indoor climate [1][3]. In order to limit the negative effects of leaky duct systems, French authorities developed an approach to improve ductwork airtightness which builds on the success and lessons learnt from the envelope airtightness approach, including mandatory justification of the airtightness level achieved with third-party testing, unless the default value is used. The ultimate objective of these ductwork airtightness requirements is to boost the market similarly to what happened with the envelope airtightness market as described in fact sheet #07 [7].

Approach to overcome identified problems

Regulatory background and Effinergie labels

In the EP regulation, a default value for ductwork leakage class can be used based on leakage classes defined in EN standards 12237 and 1507, corresponding to 2.5*class A. Since the 2012 EP regulation, if a better-than-default class is used, it must be justified. Furthermore, the Effinergie+ and BEPOS-Effinergie labels [6], firmly based on the current regulation, require justifying achieving ductwork leakage class A as minimum. Figure 1 gives an overview of the evolution of the requirements since 2000. Note that both residential and non-residential buildings are concerned.

The Effinergie+ and BEPOS labels are meant to experiment requirements for the next updates of the regulation, similarly to the past BBC-Effinergie label (based on the 2005 EP regulation) which has been very popular and useful to tune the requirements of the 2012 EP regulation.

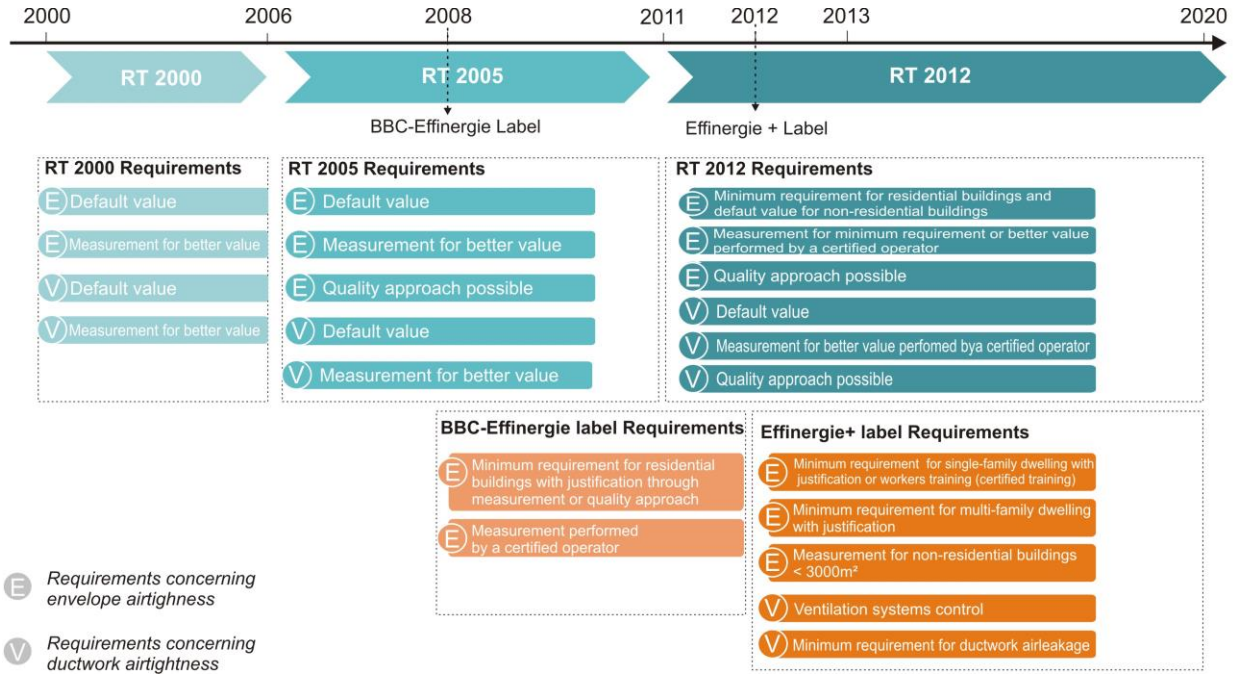


Figure 1: Evolution of French requirements on envelope and ductwork airtightness since 2000 for residential and non-residential buildings

Justification of airtightness level with competent testers

The current French EP regulation gives two options to justify using a ductwork airtightness class different from the default value as input in the EP calculation. The class achieved can be justified:

- ✓ Either with a ductwork airtightness measurement, performed by a certified tester;
- ✓ Or by the application of a certified quality management approach (QMA) on ductwork airtightness, that allows to test only a sample of buildings. Although a similar QMA option is popular for envelope airtightness (see fact sheet #01, [4]), it was never used in practice for ductwork airtightness and is under revision; therefore, it will not be developed in this fact sheet.

In both cases, ductwork airtightness tests must be performed by a third-party tester, qualified by the certification body Qualibat. To be qualified, a tester has to:

- ✓ Undergo a qualifying State approved training;
- ✓ Pass the training examination (the theoretical part, with a State-approved multiple choice questionnaire; and the practical part, with a test performed in situ with a certified tester),
- ✓ Justify sufficient testing experience.

Once qualified, every tester is subjected to yearly follow-up checks, organised by the certification body. The follow-up checks include an analysis of some reports to verify its compliance with applicable standards and guidelines.

The certification body can control the testers based on the documentation sent every year, but also on site, in particular, in case of complaints or doubts about their work. Those checks can lead to de-qualification.

The competent tester scheme started in 2014. As of January 2017, 49 testers have been qualified by Qualibat.

Test protocol and reporting

Tests have to comply with the European standards EN 12237, EN 1507, EN 13403 and EN 12599, and the French technical report FD E 51-767. For the Effinergie labels, testers have to comply with the Effinergie measurement protocol as well, and soon the Promevent protocol [6]. Whenever a test is performed, either for a certified QM approach or for a systematic test, it must be performed after any works that could impact the final ductwork airtightness. FD E 51-767 specifies the reporting format. The report specifies if the ductwork airtightness complies with the input class used in the EP calculation. A new version of FD E 51-767, modified to ease the measurement and avoid damage to the ductwork when preparing the section under test, should be soon published.

Note that qualified testers are required to fill in a database with all test results and provide this database to the certification body every year for the follow-up of their certification.

Market acceptance of the approach

As of January 2017, around 172 multi-family buildings (representing more than 550 dwellings), 9 non-residential buildings and 423 single-family dwellings have obtained an Effinergie+ label, and there are even more running for it. This label seems to drive an important part of the ductwork airtightness measurement market. Around 30% of the measurements collected in a database through the competent tester scheme (see Figure 2) were marked “Effinergie+”. The share of Effinergie+ label building in this database may be actually greater since for more than half of the measurements, this field is not filled. For both single-family houses and multi-family buildings, most measured ductwork meet leakage class A (respectively 64% and 54%), but few meet a better class (see Figure 3). Non-residential buildings ductwork systems seem tighter: 48% of them meet class B. In summary, the results collected show a slow but clear drift towards better performance compared to previous measurement campaigns [1][3].

Note, however, that there are two significant differences with the approach to envelope airtightness, which might influence the impact of this approach to ductwork airtightness:

- ✓ The link between the required fan flow rate and fan performance to meet the required airflow rate at the air terminal device despite leakage has to be done manually. If not properly done, the reward for a better-than-default class can be in some cases significantly underestimated
- ✓ There are at present no central government subsidies to encourage the adoption of the label Effinergie+ or BEPOS requirements.

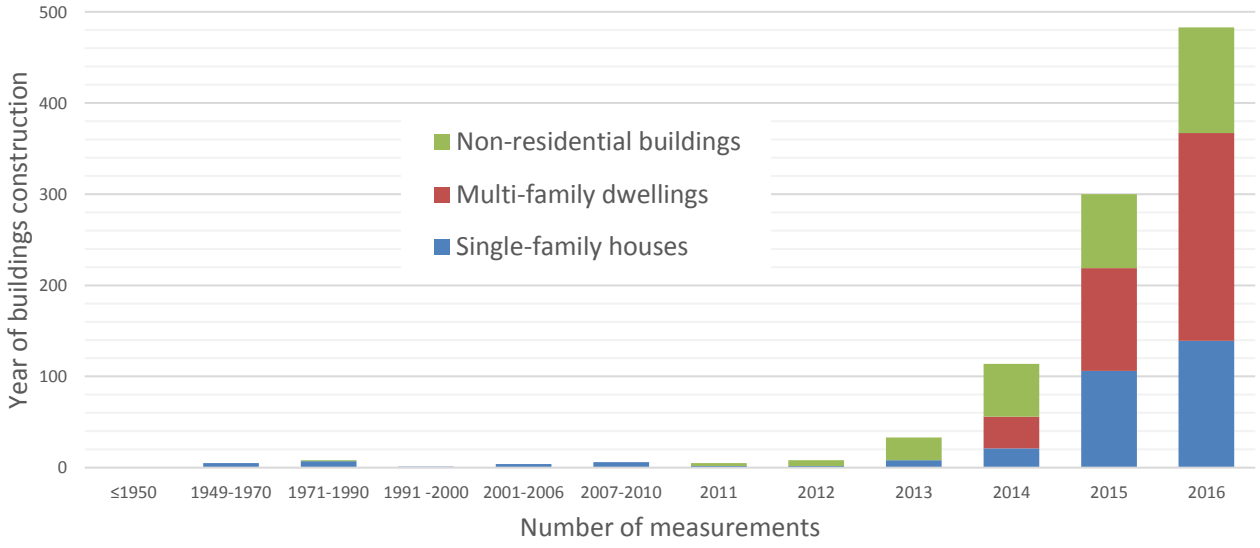


Figure 2: Number of ductworks airtightness measurements depending on the construction year and the use of the building

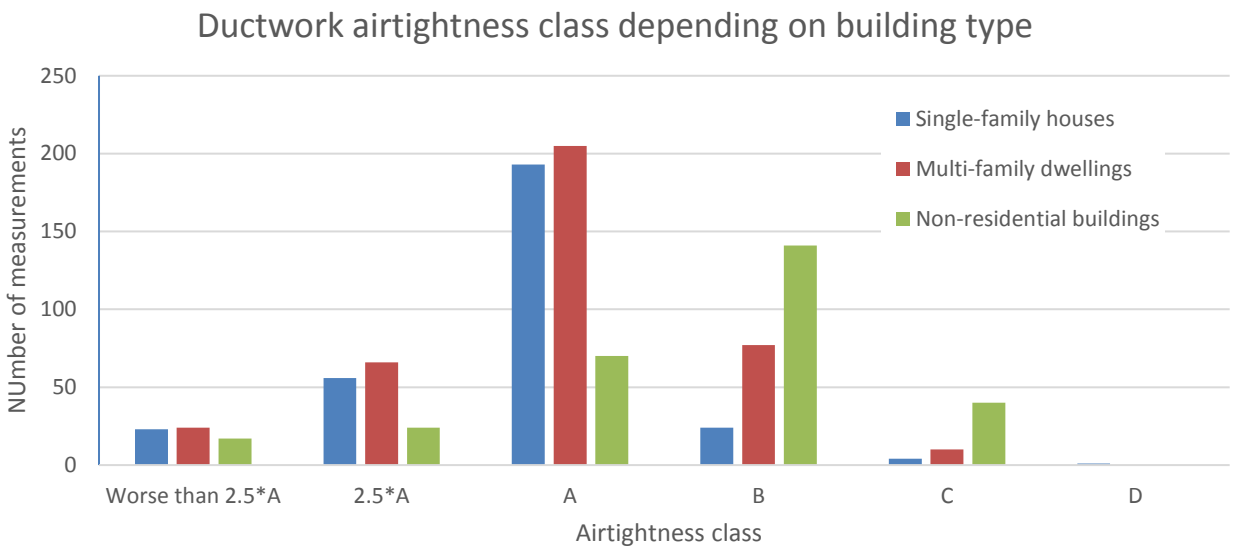


Figure 3: Specific ductwork airtightness measured class depending on the building type

Pros and cons of possible options

This part summarizes options that could or that have been considered, related to ductwork airtightness. They are similar to those presented in QUALICHeCK fact sheet #07 for envelope airtightness. Nevertheless, this analysis should be read bearing in mind that we have limited feedback from the field on the implementation of this approach.

Default class versus mandatory requirement for justification

For envelope airtightness, the BBC-Effinergie label gave a limit value and imposed a justification for residential buildings (see Figure 1), which has induced better envelope airtightness values in the field. As presented in fact sheet #07 [7], trends between periods requiring testing only when choosing a better-than-default value versus a minimum requirement are difficult to analyse given the relatively small samples. Furthermore, the context is quite different for ductwork airtightness because of the lack of subsidies and reward in case of better-than-default class. Nevertheless, the French State decided to duplicate the same approach for ductwork airtightness, and the preliminary assessments of the market acceptance and field data are positive, although the trends need to be confirmed and amplified.

Compel airtightness justification with better-than-default class

Justifying better-than-default class is likely sensible in all contexts to ease compliance checks. If this is not required, to check this input data, the control body would have to test by itself that the claimed ductwork airtightness level is actually achieved.

Qualification required for testers

Justifying ductwork airtightness (whether on systematic testing or partly on sample testing) raises the issue of the reliability of the measurement. To address this question, the French government decided to set up a competent tester scheme and to require testers to be qualified for the test to be acceptable for justification. This process applied for envelope airtightness and it was found useful given the success rate of applicants [7] and improvements observed in the testers' practice. Relying on existing standards alone without a specific scheme to train and follow-up testers seems risky.

Third-party check versus self-control

The present French approach requires third-party testing both for systematic tests and for tests performed with a QMA. Although it seems legitimate to have trust in the result, several issues should be considered:

- ✓ it implies extra costs for the owner;
- ✓ the tester is under pressure to please his client;
- ✓ this "third-party" requirement can be by-passed by creating a testing company which is legally independent, although under the authority of the same person(s) in reality;
- ✓ it requires enough independent testers available to match the demand.

In addition, experience on envelope airtightness has shown that professionals have made significant progress by implementing self-check procedures.

Private or public scheme owners

Should schemes be managed by private bodies or by public authorities? The answer will of course strongly depend on the context, including financial and human public resources available. In the French context, the schemes developed to certify testers and quality management approaches were first managed by public authorities to allow the government to test the schemes and make them evolve to meet their needs before transferring them to private bodies, when the number of applications became incompatible with public resources. Although successful in the French context, this approach may not be relevant in other regions.

Regulation requirement versus label requirement

The success of BBC-Effinergie label on envelope airtightness was based on the fact that the label was a) firmly based on the EP regulation; b) set as a pre-condition for subsidies; and c) a strong point for marketing lower energy bills and lower environmental impacts. These three aspects were likely key in the success of the label, although voluntary, with candidates often willing to do their best to obtain good results. This experience has been a strong basis to set the 2012 EP regulation requirements. For ductwork airtightness, conditions b) and c) are not as strong drivers because there is at present no national subsidy scheme and because some limitations in the EP calculation underestimate in many cases the energy impact of poor ductwork airtightness. Nevertheless, although the scheme is recent, the first market feedback shows a positive trend which need to be confirmed and amplified.

Option	Pros	Cons
✓ Default class (versus minimum requirement)	✓ Easier acceptance by stakeholder	✓ Better-than-default class are not rewarded enough in the EP calculation
✓ Compel airtightness justification with better-than-default class	✓ Pre-condition to undertake compliance checks	✓ Cost of the justification
✓ Mandatory qualification for testers	✓ Increases reliability of airtightness test results	✓ Cost for testers ✓ Cost scheme development and operation
✓ Measurement by an independent third-party (versus self-control)	✓ Increases confidence in test results	✓ Cost for the building professionals/owner ✓ Professionals learn with self-checks ✓ Need to have a matching number of independent testers available ✓ Testers may be independent on paper but not in practice
✓ Label requirement (versus regulation requirement)	✓ Enables experimenting new types of requirements and market acceptance.	✓ Regulation compels professionals to adapt and comply with requirements with no learning period
✓ Private scheme owner (versus public scheme owner)	✓ Easier to deal with human and financial resources to match large demand	✓ Beginning by a public entity enables to test the process and to make it evolve progressively, with experience ✓ Applications through public entity can be free of charge

Table 1: pros and cons of various options

Compliance concerns related to EP regulation

No reporting ☑	Wrong reporting ☑	Not meeting the performance requirements ☑

Compliance concerns related to EP regulation (see QUALICHeCK terms and definitions)

In the French EP calculation, ductwork airtightness is an input data as a leakage class. In the calculation kernel, it is converted into an airflow rate, which enters into account for the heating and cooling needs and for the fan energy use calculation.

The qualification scheme reduces the risk of wrong reporting in the EP calculation due to unintentional mistakes (lack of competence). The compliance checks based on the requirements of the energy regulation further reduce this risk, together with the risk of no reporting or not meeting the airtightness performance requirements.

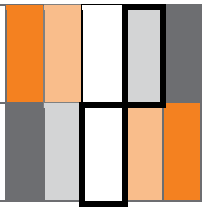
Overall evaluation

The ductwork airtightness scheme in the French EP regulation has just started in 2014 to put more emphasis on the significant impact of duct leaks on the energy performance and indoor climate, and thereby avoid negative effects of building airtightness improvements without appropriate ventilation provision.

The approach developed firmly builds on the success of the regulatory and voluntary approach to building airtightness requirements reported in previous fact sheets, yet with significant differences. The approach to ductwork airtightness is based on:

- ✓ a voluntary option to value ductwork airtightness in the EP rating, with a default value in the calculation software which can be changed to a better-than-default value;
- ✓ the requirement to justify for a better-than-default ductwork airtightness value either with systematic testing or with the implementation of a certified quality management approach;
- ✓ the development of a competent tester scheme, to secure appropriate testing and reporting;
- ✓ the development of scheme for quality management approaches as alternate ways to justify for a given ductwork airtightness level. Unlike for envelope airtightness, this scheme was never used in practice for duct systems and is under revision.

Preliminary feedback for the application of this approach shows a positive trend, with a clear shift of ductwork systems towards tighter classes. This trend needs to be confirmed and amplified.

Level of complexity (dark orange = simplest)	
Potential for replication (dark orange = best)	

Prerequisites
Strong political will to improve ductwork airtightness

Hints	**Pitfalls**
✓ Detail and consolidate technical standards ✓ Encourage (subsidies, reward in the EP calculation) the better-than-default-class ✓ Gradual introduction of the requirements: first in a label, and then in regulation ✓ Gradual introduction of the control processes: first headed by authorities, and then by better-dimensioned private bodies	✓ Resources to define specify the measurement standards to ease their application ✓ Resources for processes ✓ Resources to specify and control processes (reliability of the scheme), including ways of justification

Table 2: Overall hints and pitfalls to avoid when developing such an approach

References

[1] Andersson, J. 2013. Quality of ventilation systems in residential buildings: status and perspectives in Sweden. In edited proceedings of the AIVC- TightVent international workshop, Brussels, 18-19 March 2013, ISBN 2-930471-43-3, INIVE, Belgium. pp. 159-166.

[2] Arrêté du 24 mars 1982 relatif à l'aération des logements. Official Journal of the French Republic of 27 March 1982, modified 15 novembre 1983.

[3] Carrié, F. R., Andersson, J., Wouters, P. 1999. Improving ductwork—A time for tighter air distribution systems. Air Infiltration and Ventilation Centre, Coventry, UK. 126 p. ISBN 1 902177 10 4.

[4] Carrié, F.R. and Charrier, S. 2015. Building regulations can foster quality management — the French example on building airtightness. QUALICHeCK fact sheet # 01, available at http://qualicheck-platform.eu/wp-content/uploads/2015/02/QUALICHeCK-Factsheet-01.pdf

[5] Carrié, F.R., Charrier, S., and Bailly, A. 2015. Regulatory compliance checks of residential ventilation systems in France. QUALICHeCK fact sheet # 06, available at http://qualicheck-platform.eu/wp-content/uploads/2016/03/QUALICHeCK-Factsheet-06.pdf

[6] Carrié, F.R., and Dervyn, Y. 2016. The Effinergie approach to ease transitions to new regulatory requirements. QUALICHeCK fact sheet # 45, available at http://qualicheck-platform.eu/wp-content/uploads/2017/02/QUALICHeCK-Factsheet-45.pdf

[7] Charrier, S., Bailly, A., and Carrié, F.R. 2015. Building airtightness in France: regulatory context, control procedures, results. QUALICHeCK fact sheet # 07, available at http://qualicheck-platform.eu/wp-content/uploads/2016/03/QUALICHeCK-Factsheet-07.pdf

[8] Charrier, S., Ponthieux, J., Huet, A. 2014. The Airtightness Quality Management Approach in France – Assessment after more than Five Years of Operation. International Journal of Ventilation. ISSN 1473-3315. Vol. 13(2), pp. 125-140.

[9] Effinergie +. 2014. Règles Techniques applicables aux bâtiments neufs faisant l'objet d'une de demande de label Effinergie+, Validées par le CA du 3 juin 2014. (http://www.effinergie.org/images/BaseDoc/1066/20140603_r%C3%A8gles_techniques_Effinergie+_V5.pdf)

[10] Effinergie +. 2015. Protocole de contrôle des systèmes de ventilation des bâtiments demandant le label effinergie +, Version 3 – Mai 2015. (http://www.effinergie.org/web/images/permea/20150512_protocole_contrôle_ventilation_V3.pdf)

[11] RT 2012. 2010. Arrêté du 26 octobre 2010 relatif aux caractéristiques thermiques et aux exigences de performance énergétique des bâtiments nouveaux et des parties nouvelles de bâtiments. Official Journal of the French Republic of 27 October 2010.

[12] RT 2005. 2006. Arrêté du 24 mai 2006 relatif aux caractéristiques thermiques des bâtiments nouveaux et des parties nouvelles de bâtiments, Official Journal of the French Republic of 25 May 2006.

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