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Technology Ventilation	Aspect Compliance frameworks	Country Belgium
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BELGIAN/FLEMISH EVALUATION SCHEME FOR VENTILATION SYSTEMS

Since many years, several monitoring studies have shown that the quality and compliance of installed ventilation systems can be low. The recently developed Evaluation scheme in Belgium tries to tackle this problem, thanks to the mandatory Ventilation Performance Report of all new ventilation installations, to be delivered by a Ventilation Reporter recognised by a Third-Party control organisation. This factsheet describes the approach of this scheme, including the penalty scheme and the role of the actors involved.

Residential buildings <input checked="" type="checkbox"/>	Non-residential buildings <input type="checkbox"/>	Specific buildings:
New buildings <input checked="" type="checkbox"/>	Existing buildings <input type="checkbox"/>	

Context

The installation of a **ventilation system** has been mandatory for new dwellings in Belgium since many years (since 1996 in the Walloon Region and since 2006 in the Flemish Region). The Energy Performance of Buildings (EPB) regulation includes minimum requirements in terms of installation of ventilation systems and in terms of minimum ventilation flow rates in order to ensure good indoor climate for the occupants of dwellings. This ventilation system can be naturally and/or mechanically driven, leading to 4 possible systems: natural supply and exhaust (system A), mechanical supply and natural exhaust (system B), natural supply and mechanical exhaust (system C), and finally mechanical supply and exhaust (system D). A minimum supply air flow rate of outdoor air is required for the living spaces such as the living room and the bedrooms; and a minimum exhausted air flow rate is required in the service spaces such as the kitchen, the bathroom, the toilet, and the laundry. However, the quality of the installed ventilation systems is often rather poor as shown by several monitoring projects. Moreover, the level of non-conformity is particularly high for ventilation in the EPB regulation.

On site monitoring showed for example too low ventilation flow rates, ventilation devices missing, too high electrical power consumption due to high pressure drops, noise production by mechanical ventilation systems or noise transfer from the outside environment by natural ventilation openings, etc. .

In the context of the EPB regulation in Belgium, an as-built report of the finalised building is required. The last years, there are still a few percent of new Flemish buildings receiving fines due to non-conformity to the requirements [2]. Most of the time, these non-conformities concern the ventilation systems. Examples of non-conformities of the ventilation systems are: missing transfer devices, missing supply or exhaust devices in some spaces, or too low flow rates.

This poor quality of the ventilation systems in dwellings could be explained, at least partially, because many people, professionals as well as clients, are not yet convinced of the need to ventilate. In contrast to the thermal comfort for example, the human perception is largely less sensitive to the indoor air quality. Therefore the need for a ventilation system is felt lower than the need for a heating system for example. Therefore, the investment in a ventilation system (natural as well as mechanical), in first order to ensure a good indoor climate and comfort, is perceived less directly useful and profitable compared to the investment in a heating system (clearly considered as necessary for the comfort) and in the insulation of the building (clearly considered necessary to limit energy use and cost).

To improve both the **compliance** and the **quality** of the installed ventilation systems, a scheme has been recently developed in the Flemish Region of Belgium in the context of the EPB regulation. This ventilation evaluation scheme is based on a reference document, describing performance criteria for the quality of ventilation systems, the STS-P 73-1 [1]. This scheme recognises Ventilation Reporters which are authorised to evaluate ventilation systems and who are recognised by a Third-Party control organisation.

The present document describes the principles of this scheme developed in Belgium, with its advantages and its pitfalls for possibly further implementation of similar schemes in other countries.

Objectives and scope of the scheme

Main objectives

This ventilation evaluation scheme addresses objectives at 2 different stages in the construction process.

- ✓ Before the construction works, this scheme provides the possibility to prescribe (e.g. in a tender) the performance criteria of the ventilation system, according to the reference document STS-P 73-1. These performance criteria can be requirements of the EPB regulation which are mandatory, but also criteria for higher quality levels which are not mandatory. See step (1) in Figure 1.
- ✓ After the construction works, this scheme imposes the evaluation of the ventilation system and the reporting of the real performances according to the reference document STS-P 73-1. This report is used as part of the EPB as-built report and can also be compared to the performance criteria prescribed before the works. This evaluation is carried out by a Ventilation Reporter who is recognised by a Third-Party control organisation. See step (2) in Figure 1.

Scope of the ventilation evaluation scheme

This evaluation scheme is mandatory in the Flemish Region in Belgium in the context of the EPB regulation for all new dwellings with building permit submission after January 1st 2016 (Phase I).

In this first Phase of the scheme, the reporting of all the performance criteria related to requirements in the EPB regulation and to input data for EPC calculation is required. It is planned to extend this mandatory scheme in the future to all the performance criteria described in the reference document STS-P 73-1 (thus also those for which there are no requirements in the EPB regulation, see below), but there is no concrete timing at the moment.

Beside this mandatory evaluation scheme of ventilation systems after completion of the works, the approaches and procedures available in this scheme can eventually be used in other context within a voluntary framework.

- ✓ The reference document STS-P 73-1 is public and available for free on the federal website. It can be used to prescribe, on a voluntary basis, the performance criteria for ventilation systems in any construction contract for dwellings.
- ✓ Moreover, a client or a contractor can eventually call a Ventilation Reporter recognised in this scheme to carry out the evaluation of a ventilation system outside the mandatory scope of the scheme. Comparison between the requirements in the tender or contract and the final performances as reported, can be used to evaluate the fulfilment of the contract.

Final objectives of the scheme

This scheme and the applied principles and approaches allow finally fulfilling the following more general objectives in the context of the EPB regulation:

- ✓ Checking the conformity of the installed ventilation systems according to the ventilation requirements in the EPB regulation (see above);
- ✓ Improving the compliance and the accessibility of input data for the Energy Performance Certificate (EPC), product and system data (thermal efficiency of heat recovery devices) as well as data related to the building execution (measured electrical power on the installed system), necessary for the EPC calculation (see also [3]). This is related to the specific control and penalty scheme of the EPB regulation in Belgium (see [5]).
- ✓ Improving the quality of the works providing the possibility to set performance criteria before the works and to evaluate them after the works thanks to objective performance criteria described in the reference document STS-P 73-1, for criteria not related to mandatory requirements.

Approach and procedure

Reference document STS-P 73-1

The reference document STS-P 73-1 on which this ventilation evaluation scheme is based defines and describes performance criteria for ventilation systems in dwellings (residential applications), but this document doesn't set any minimum requirements on them.

These criteria can be expressed in the format of a quantitative parameter or in the format of different classes corresponding to different quality levels.

- ✓ Example of quantitative parameter: the thermal efficiency for heat recovery devices expressed in percent and measured in accordance to the measurement method described in this reference document (and referring in this case to the measurement method required in the EPB regulation).
- ✓ Example of classes: the acoustical performances of the mechanical systems is described using the following classes (class 5 is the highest level of quality):
 - Class 5: High comfort according to the NBN S 01-400-11 (evaluation measurement)
 - Class 4: Normal comfort according to the NBN S 01-400-1 (evaluation measurement)
 - Class 3: Normal comfort according to the NBN S 01-400-1 (calculation)
 - Class 2: Conform to the criteria of the simplified determination method described in the STS-P 73-1
 - Class 1: Limited risk of discomfort according to the simplified prescriptions in the STS-P 73-1
 - Unclassified: Potential risk of discomfort

The criteria of this reference document include those related to the requirements in the PEB regulation (e.g. conformity to the required flow rates) and to the input data necessary as input for the EPC calculation (e.g. thermal efficiency of heat recovery devices). But there are also additional quality criteria for which there are no mandatory requirements, such as criteria related to the acoustical comfort (due to mechanical and natural ventilation systems), to the indoor air quality of the air intake, to the cleanliness of the system and ductworks, to the information for the users, etc..

It is particularly important to emphasise that the reference document STS-P 73-1 doesn't set any requirement as such. Examples:

- ✓ For the thermal efficiency of heat recovery devices, the document describes the definition, the measurement method and the way to express the performance, but no requirement, no minimum level is set forward for this performance criterion.
- ✓ For the acoustical performance of the mechanical systems, the document defines the classes, describes the criteria related to each classes, the methods of measurement and/or calculation if applied, but no requirement, no minimum class is required for this criterion.

The STS-P 73-1 also contains an annex about the organisation of the control scheme by a Third-Party organisation. This annex describes the objectives and requirements for the control scheme such as:

- ✓ To ensure the reliability of the performances reports of the ventilation installations;
- ✓ To ensure the confidence in the control scheme regarding all the parties involved in the construction process and regarding the authorities.
- ✓ In other words, the organisation of the scheme has to be carried out with the support and after consultation of all the stakeholders involved in the market including the authorities themselves.

Organisation of the control scheme by BCCA

The Belgian Construction Certification Association (BCCA) has developed such a control scheme for ventilation systems, based on the STS-P 73-1 and its annex about the organisation of the control scheme. BCCA is a Third-Party control organisation recognised by BELAC (Belgian Accreditation Body). The control scheme developed by BCCA has been carried out with the support and consultation of many stakeholders in the Belgian market such as associations of building contractors, associations of ventilation manufacturers, associations of EPB rapporteurs, regional authorities, etc.

BCCA is the Third-Party control organisation responsible for the organisation of the scheme described in this factsheet. The scheme described in the following paragraphs refers to those developed by BCCA based on the EPB requirements and on the STS-P 731.

¹ Belgian standard on acoustics in dwellings

Ventilation Reporter recognised by BCCA

To insure the reliability of the evaluation of ventilation systems, these have to be carried out in this scheme by recognised Ventilation Reporters.

To become a Ventilation Reporter, the candidate must pass an exam organised by the Third-Party control organisation. The theoretical exam takes place online and concerns the knowledge of the general principles of ventilation of dwellings, the content of the reference document STS-P 73-1, the EPB regulation and the EPC calculation, etc.. A second part of the exam is practical and concerns the capability to measure the mechanical ventilation flow rates and the electrical power.

The competences and the reliability of a Ventilation Reporter as an evaluator are inspected on a regular basis by BCCA within the scheme. These inspections by the Third-Party occur randomly for around 10 % of the evaluations carried out by the Ventilation Reporter. In practice, the Ventilation Reporter has to use a web application (currently under development) for the follow-up of all the evaluations he carries out.

- ✓ The date and place of a planned flow rate measurement of a ventilation system carried out on site have to be encoded in advance through the web application (currently under development).
- ✓ At the end of the flow rate measurement, the Ventilation Reporter has to send an SMS to the Third-Party. On a random basis, the Third-Party can come on site shortly after this SMS communication to inspect the work of the Ventilation Reporter.

If the correct work of the Ventilation Reporter cannot be confirmed during these random inspections by a Third-Party, consequences apply for this Ventilation Reporter (from increased inspection frequencies to discarding from the system, see below).

There are no pre-requirements to apply as Ventilation Reporter, but the candidate has to pass an exam (see above). Different kind of professionals can apply to become Ventilation Reporter, such as architects, ventilation installers, “EPB rapporteurs” (the person responsible for delivering the Energy Performance Certificate, see [5] for more details), etc. Neither there are requirements related to the independence between the Ventilation Reporter and the other professionals involved in a given project. The Ventilation Reporter for a given project can be the ventilation installer or the architect for the same project, provided that this Ventilation Reporter is recognised within this scheme. The capacity of the Ventilation Reporters should be ensured by the exams and the Third-Party inspections described above rather than by a requirement about the independence (which is very difficult to define).

Design of ventilation installation

A prerequisite for a high quality ventilation system is the availability of a proper design. A start to this design is the setting forward of the requirements, to which the installation should comply. These requirements are already partly provided into the pre-calculation of the EPC (e.g. ventilations system type, design flow rates, ...), required prior to the demand for a building permit. In the ventilation evaluation scheme, some additional information must be mentioned on the building permit plans, such as the position of the ventilation openings and the ductworks. The aim of requesting this information at the moment of the building permit is to raise awareness of the Building Contractor on the importance of the design of the ventilation system.

The overall scheme provides also the possibility, on a voluntary basis, to the Building Contractor to set additional performance criteria, according to the reference document STS-P 73-1, before the construction works start. The aim is here to set the desired criteria in an objective way and to fix them contractually between the Building Contractor and the ventilation installer.

Comparison between the requirements in the tender or contract and the final performances as reported, can be used to evaluate the fulfilment of the contract.

Ventilation Performance Report

The Ventilation Performance Report (VPV, Ventilatie Prestatie Verslag in Dutch) is the key element of this ventilation evaluation scheme (Figure 1).

This Ventilation Performance Report is mandatory in the EPB regulation (see above) and has to be delivered with the EPC (as-built performance) after the completion of the construction works.

The Ventilation Performance Report has to be carried out by an authorised Ventilation Reporter recognised within the scheme. This Ventilation Performance Report can be completed directly and on line via the web application (currently under development) within this scheme. This Ventilation Performance

Report is then used automatically by the “EPB Rapporteur” of this project (see [5]) to complete the EPC with the appropriate EPC input data. Within the EPC scheme in Belgium, there are then automatic control of the EPB requirements and automatic calculation of the penalties in case of non-conformity (see [5] for more details). This is also the case for ventilation aspects: e.g. non conformity of airflow rates may influence the EPC level or may lead to fines.

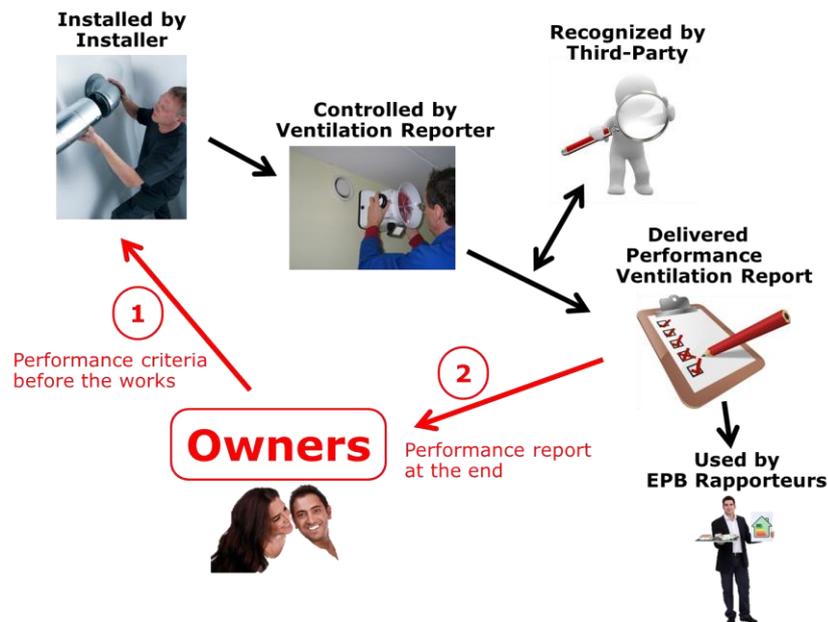


Figure 1: Principles of the evaluation scheme for ventilation in Belgium

Penalty scheme

Penalty to the Building Contractor

In case the Ventilation Performance Report (see above) reveals some non-conformities related to EPB requirements or to EPC calculation, there are penalties and fines foreseen for the Building Contractor (see [5]). In case the Building Contractor doesn't provide a Ventilation Performance Report at all, it is considered in the EPB regulation that there is no ventilation system in this project, which leads to a lot of non-conformities, and important fines. As explained in another factsheet [5], there is a specific control and penalty scheme for the EPB regulation in Belgium.

Penalty to the Ventilation Reporter

In case the random inspections of the Ventilation Reporters by the BCCA reveal some lack of reliability of the Ventilation Reporter because of incorrect ventilation evaluations and reports, some consequences apply to the Ventilation Reporter. Firstly, he or she is asked to correct the fault ventilation report and will be inspected for additional ventilation reports (increase of inspection frequency). Finally, in some cases, the Ventilation Reporters not delivering reports according to the defined quality can be excluded from the scheme: they are no longer recognised and they can no longer carry out evaluations of ventilation systems on site and deliver Ventilation Performance Reports.

Market acceptance of the approach

Because this scheme has been developed only recently, it is difficult to evaluate the market acceptance of this scheme.

The following elements could lead to better market acceptance of the scheme:

- ✓ This scheme focuses on the recognition of the Ventilation Reporters and on the report of all installed ventilation systems. In contrast to schemes focusing on the recognition of the installers themselves, this scheme is lighter and simpler, leading to a better acceptance by the professionals, at least the installers.
- ✓ Because the scheme is open to several professionals (installers, architects, EPB Rapporteurs, etc.), this scheme is quite open and not limited to certain professionals, leading to higher acceptance by the market.

- ✓ The criteria on which this scheme is based (described in the STS-P 73-1) are performance based criteria instead of descriptive criteria related to the means used. These performance based criteria give the freedom to the designers and installers of ventilation systems to choose the means they want to use to achieve the performance.

However, this evaluation scheme could lead to additional direct and indirect costs for the installation of ventilation systems by the Building Contractor, which could affect the market acceptance of the scheme. In order to increase the market acceptance of the scheme, the development of this scheme has been carried out in constant consultation with the building sector. At each stage of the development (publication of the STS-P 73-1, development of the approach for the inspections by a Third-Party, etc.), a large number of stakeholders has been consulted thanks to regular meetings.

Pros and cons of possible options

This evaluation scheme, with the mandatory Ventilation Performance Report to be done by Ventilation Reporters recognised by BCCA, can be seen as an intermediate approach between these 2 more extreme alternatives:

- ✓ Recognition of competent installers in order to ensure higher quality and compliance of installed ventilation systems, thanks to for example training and exam of the installers;
- ✓ Inspection of the conformity of all the installed ventilation system by a Third-Party control organisation or by the authorities themselves.

Compared to these alternatives, the developed scheme in Belgium presents several advantages as listed in Table 1.

To some extent, this scheme presents similarities with the Quality framework for reliable fan pressurisation tests described in another factsheet [4].

Option	Pros	Cons
Recognition of competent installers	<ul style="list-style-type: none"> ✓ Higher skills of the installers could lead to higher quality of the installed systems. ✓ The effort is not only focused on the end result but also on the improvement of the competence of the professionals and quality of the works at short term. 	<ul style="list-style-type: none"> ✓ Higher skills of the installers cannot be a guarantee of higher quality of the final result if there are no performance based evaluations at the end. ✓ The recognition of the installers can be a big challenge and it can take time to increase the skills of all the professionals. ✓ Such scheme is nearly not possible in a mandatory evaluation scheme; and equivalent voluntary schemes in other countries have shown low to very low penetration of the market.
Inspections of all the installed systems by Third-Party	<ul style="list-style-type: none"> ✓ The reliability of the inspections could be the highest in such scheme because of the higher competence, reliability and independence of Third-Party control organisations such as Notified Bodies. ✓ 100 % of the installed systems are inspected. 	<ul style="list-style-type: none"> ✓ The most important disadvantage of such scheme is the higher operational costs for all the parties involved: inspection of 100% of the installed systems by a Third-Party control organisation requires higher costs for qualifications of these organisations and for these inspections.
Mandatory evaluation by recognised Reporters (the scheme developed in Belgium)	<ul style="list-style-type: none"> ✓ Performance based evaluation of the end result. ✓ Lower cost compared to inspection of 100% of installed systems. ✓ See below for more details 	<ul style="list-style-type: none"> ✓ No direct guarantee of improvement of the quality and compliance of the works.

Table 1: Description of pros and cons of different options

Compliance concerns related to EP regulation

The following table shows whether the described scheme avoids or limits some of the most typical cases of non-compliance.

No reporting <input checked="" type="checkbox"/>	Wrong reporting <input checked="" type="checkbox"/>	Not meeting the performance requirements <input checked="" type="checkbox"/>
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Compliance concerns related to EP regulation

Financial aspects

In this scheme, there are direct costs to be supported by the Ventilation Reporter to be recognised in the scheme:

- ✓ Cost for the exams (theoretical and practical);
- ✓ Annual fixed costs: 200 EUR per company and 50 EUR per recognised person;
- ✓ Variable costs: 70 EUR per delivered Ventilation Performance Report.

But this scheme involves also indirect costs for the Building Contractors:

- ✓ The Building Contractor has to engage a Ventilation Reporter to carry out the mandatory evaluation of the ventilation system and the delivery of the Ventilation Performance Report;
- ✓ As a function of the desired performances and quality of the ventilation system, additional costs can apply for the design and installation of the system. Higher quality requires a higher price.

Overall evaluation

The pros and cons of the described scheme are summarised in Table 2. Overall, the scheme is considered clear and effective.

Pros	Cons
✓ The global scheme as well as the technical criteria are performance based. The means used to design and install the ventilation systems can be chosen freely.	✓ There is no direct guarantee to increase the quality and conformity of the installed systems, because there are no minimum requirements but only a report of the actual performances (good or bad).
✓ The scheme is a compromise between the schemes presented above, namely the recognition of competent installers and the evaluation of all installations by the authority itself or an independent Third-Party.	✓ There is no absolute guarantee that all the installed systems are correctly evaluated and reported because only a sample of the Ventilation Performance Reports are controlled randomly by BCCA.
✓ The principles of the scheme are simple and clear.	✓
✓ The scheme emphasises the responsibility of the different parties: the Building Contractor is free to pay for higher quality or not, the installers are free to propose higher quality of the works based on the common performance criteria, the recognised Ventilation Reporter is only responsible for the correct reporting not for the quality and compliance of the installed system itself.	✓
✓ The scheme should lead indirectly to higher quality and conformity of the installed systems, because the correct evaluation based on clear criteria can help the market to ask for higher quality and compliance.	✓

Table 2: Overall pros and cons of the approach

Level of complexity (dark orange = simplest)		Prerequisite: The scheme is closely related to the specific control and penalty scheme of EPB regulation in Belgium (see [5]) and is maybe difficult to replicate without such scheme.
Potential for replication (dark orange = best)		

A summary of hints and pitfalls for developing and implementing a control system including penalties is shown in Table 3.

Hints	Pitfalls
✓ The approach prevents fraud because the procedure is such that the Ventilation Reporter cannot take any advantage from a wrong reporting.	✓ Focus on the real technical performances and not too much additional administrative load.
✓ Coupling of the scheme with the EPB regulation and EPC: the Ventilation Performance Report is mandatory in EPB regulation and the fines in EPB regulation can apply.	✓ Integration of the different schemes and reportings (EPB, Ventilation, etc.): avoid the multiplication of the reports and reporting tools.
✓ Constant consultation of the sector is necessary to ensure the market acceptance of such scheme.	✓ Administrative load, complexity of the organisation of the scheme.
✓ Limited cost of the scheme thanks to random inspection (10% of the reports) and recognition of the reporters by Third-Party.	✓ Choice between a unique or several types of Ventilation Reporters (one per ventilation component: natural supply, transfer devices, mechanical system, etc.).
✓ Non-compliance regarding the EPB requirements leads to fines, but there are no obligations to correct the installation to make it conform.	✓ Timing of the inspections of the Ventilation Reporter on site by the Third-Party.

Table 3: Overall hints and pitfalls to avoid when developing such a scheme

References

- [1] STS-P 73-1 Systèmes pour la ventilation de base dans les applications résidentielles / Systemen voor basisventilatie in residentiële toepassingen
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