Overview of international protocols for the inspection of ventilation systems

VALÉRIE LEPRINCE – PLEIAQ
INSPECTION OF VENTILATION SYSTEMS IN NEW REGULATIONS IN EUROPEAN COUNTRIES

Number of protocols per country

Data
- **EPBD study** (Art. 19a) gathering and detailing **20 protocols** from **9 countries**

→ **European project** (2018 – 2019) : feasibility study to identify the need, possibilities and timeline for a possible introduction of inspection of stand-alone ventilation systems in buildings
  - Review of existing regulations, guidelines and standards
  - How to build an inspection scheme?
  - What could be other measures than inspection?
  - Impact analysis on 6 policy options

Feasibility Study EPBD Art. 19a
Existing regulations, standards and guidelines on the inspection of ventilation systems, and other relevant initiatives and projects

Final report
Reference: ENBR/C3/2018-447/05
Client: European Commission’s Directorate General for Energy

June 2019
Number of protocols per country

**Data**
- **EPBD study** (Art. 19a) gathering and detailing **20 protocols** from **9 countries**
- Additional reference: New guide to comply with Irish regulation (Part F)

1. **Types of buildings controlled**
   - Residential buildings
   - Residential and non-residential buildings
   - Health care facilities (Ontario)

2. **Number of protocols**
   - One protocol mandatory
   - No mandatory protocol

3. **Data**
   - 6 protocols: Legislation or regulation (mandatory)
   - 13 protocols: Guidelines (not mandatory)
   - 2 protocols: Standards (not mandatory)

4. **Note**: 29% of protocols are mandatory, this line corresponds therefore to « 100% of mandatory protocols »
Who is allowed to perform the inspection?

- System designer
- Independent inspector
- Installer
- Maintenance staff
- Other
- Not specified

Types of control

- Energy performance
- IAQ
- Acoustic
- Thermal comfort

Mandatory protocols
Non-mandatory protocols
Total mandatory protocols
Periodicity of inspection

Technical Questions – survey on 5 protocols

Who is in general doing the measurement?

How are non-conformities handled?

What if an air inlet is missing?
Technical Questions – survey on 5 protocols

**For a dwelling to be conform:**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Belgium</th>
<th>Denmark</th>
<th>Sweden</th>
<th>Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every ATD shall be conform</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The total flowrate shall be conform</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**For a non-residential building to be conform:**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Belgium</th>
<th>Denmark</th>
<th>Sweden</th>
<th>Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every room shall be conform</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Are there measuring tolerances?

<table>
<thead>
<tr>
<th>Tolerance</th>
<th>Belgium</th>
<th>Denmark</th>
<th>Sweden</th>
<th>Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15% for the flowrate, 10% or 5 Pa for the pressure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring accuracy according to SS-EN 16211</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Thank you to **BCCA & INIVE** for founding this study

and to the **survey respondents:**

Iain Walker, Marteen De Strycker, Simon Jones, Olof Nevenius & Ariane Lesage
On the 1st November 2019 the Department of Housing, Planning and Local Government (DHPLG) published updates to two Irish Building Regulations namely

- Part L - Conservation of Fuel and Energy - Dwellings
- Part F - Ventilation

In addition to the updated regulations, the DHPLG published updated Technical Guidance Document (TGD) Part L and Part F

Subject to transitional arrangements the updated regulations came into full effect 1st November 2020
Building Regulations updates

Under the Energy Performance of Buildings Directive 2010 (EPBD), Article 9 requires Member states to ensure that all new buildings are "Nearly Zero Energy Buildings" by 31st Dec 2020.

"Nearly Zero Energy Buildings" or NZEB equates to a Building Energy Rating (BER) of typically an A2.

NZEB in Building Codes

Building code requirements for new Dwellings (primary energy).

November 2021
Some impacts of Part L Dwelling & Part F 2019

TGD L Dwelling 2019
- BER A2 or Better
- Renewable Energy Ratio = 0.20
- MPEPC (0.3) and MPCPC (0.35) (equivalent to 70% Reduction on 2005)
- Upper Air permeability now 5 m³/(h.m²)
- Elemental backstop U-values improved
- All dwelling require an airtight test

TGD F 2019
- Air permeability index < 5 m³/(h.m²)
- Dwelling with < 3 m³/(h.m²) must have some form on mechanical extract ventilation i.e. natural ventilation will not be acceptable
- All ventilation systems to be validated by an independent competent person certified by NSAI or equivalent.

November 2021

Ventilation Heat Loss
Domestic Energy Assessment Procedure (DEAP) considers both designed and un-designed Ventilation Heat Loss when calculating the BER for a Dwelling

Un-designed
Air tightness Testing Scheme
70 NSAI Registered testers

Designed
This new scheme
Ventilation Validation Registration Scheme
Has been developed to drive compliance in this area

November 2021
NSAI has established a registration scheme that certifies an individual as a **competent independent third party** to validate that a ventilation system has been installed, balanced and commissioned to meet the minimum requirements of Technical Guidance Document F - Ventilation (2019) to the Irish Building Regulations.

Reference documents

NSAI Ventilation Validation Registration Scheme Master Document give guidance on the scheme requirements and design examples

I.S. EN 14134:2019, *Ventilation for buildings - Performance testing and installation checks of residential ventilation systems*

Department of Housing, Planning and Local Government (DHPLG) have published a guidance document on "Installation and Commissioning of Ventilation Systems for Dwellings - Achieving Compliance with Part F 2019"

BSRIA - Domestic Ventilation Systems, a guide to measuring airflow rates
Ventilations systems must be designed and commissioned to provide adequate and effective means of ventilation to satisfy the minimum requirements of TGD to Part F of the Irish Building Regulations.

This shall be achieved by:

(a) limiting the moisture content of the air within the building so that it does not contribute to condensation and mould growth, and

(b) limiting the concentration of harmful pollutants in the air within the building.

The primary purpose of a residential ventilation system is to supply air to and extract air from the rooms in a dwelling.

Ventilation Validation Registration Scheme

The NSAI Certified Ventilation validator will be expected to validate that a ventilation system has been installed, balanced and commissioned to meet the minimum requirements of TGD to Part F of the Building regulations.

- On arrival to a site, the Ventilation validator shall be presented with a ventilation design and installers commissioning certificate.

- The Ventilation validator will assess that the presented design will satisfy the minimum requirements of TGD to Part F.

- They shall then proceed to take measurements to establish that the commissioned system complies with the satisfactory presented design.

- The Ventilation validator will issue a "Ventilation validation Certificate"
Ventilation Validation Registration Scheme Development

During the development of the scheme, we made it a requirement that all instrumentation must be calibrated annually by an accredited laboratory such as INAB, UKAS or similar approved.

Despite having calibrated equipment, flow measurement reading on a control house varied greatly.

It was clear that operatives did not know how to correctly configure their equipment to record accurate reading.

Furthermore flow straightener were not being used.

Waterford and Wexford Education and Training Board NZEB

In recognition of the challenges facing the construction sector Waterford and Wexford Education and Training Board (WWETB) has developed a number of training courses which are designed to up-skill construction workers with knowledge of how to achieve the NZEB standard.

The WWETB National NZEB Training Centre is the first facility in Europe to offer a suite of trade-specific NZEB courses.

Training modules cover all trades including a course on Ventilation delivered in a purposed building facility in Enniscorthy.
Waterford and Wexford Education and Training Board
NZEB

Fundamental principles of ventilation systems

This 3 day course aims to provide participants with the principles and practices required to effectively design ventilation flowrates, install ventilation systems and commission ventilation systems, in accordance with Technical Guidance Document Part F 2019.

This course provides an excellent understanding of the fundamental principles of ventilation systems.

It is recommended that Ventilation validators attend this course.

Ventilation Validation Registration Scheme Development and WWETB

As mentioned previously operatives did not know how to correctly configure their equipment to record accurate reading.

To this end a "Proficiency testing unit" was built by Lindab and is located at WWETB.

The unit consists of two lines (line A and B) with a supply and extract grill on each line.

Each line contains a UltraLink flow monitor and a fan with 5 speed settings (4-20L/s).

Ventilation Validators must successfully complete and pass a proficiency test which establishes that they can measure flow rates accurately.
Typical designed ventilation approaches in Ireland

TGD to Part F 2019 gives guidance on minimum ventilation design for dwellings for Natural Ventilation with intermittent fans mechanical extract

Only suitable for dwelling air permeability index is greater than $3 \text{ m}^3/(\text{h.m}^2)$ and less than $5 \text{ m}^3/(\text{h.m}^2)$

Difficult to design for.

Passive Stack

Centralized Continuous Mechanical Extract Ventilation (CMEV)
Centralized Mechanical Ventilation with Heat Recovery (MVHR)

Let's consider a

Centralized Continuous Mechanical Extract Ventilation (CMEV)

or

Centralized Mechanical Ventilation with Heat Recovery (MVHR)

Take a

• 122 m²
• 3 bedrooms
• 2.4m floor to ceiling height
Centralized Continuous Mechanical Extract Ventilation (CMEV) or Centralized Mechanical Ventilation with Heat Recovery (MVHR)

TGD requires us to calculate the general supply ventilation rate.

- Occupancy
- 0.3 l/s per m² internal floor area

NSAI - MEV MVHR Design Sheet Issue 7th.xlsx November 2021

Dwelling address
Dwelling type
Total floor area 122.0 m²
Ventilation system
Date of test
Installer/builder (if applicable)
Validation certificate number
Air permeability < 5 m³/(h.m²)

Select rooms
Area
Height

Kitchen
No. 1

Utility room
No. 1

Bathroom/Ensuite (1)
No. 1

Sanitary accommodation (no bath or shower) (1)
No. 1

Bathroom/Ensuite (2)
No. 1

Living room (1)
No. 1
24 m²
2.4 m

Dining room
No. 1
10 m²
2.4 m

Playroom
No. 1

Study room
No. 1

Reception room
No. 1

Bedroom 1
No. 1
14 m²
2.4 m

Bedroom 2
No. 1
16.4 m²
2.4 m

Bedroom 3
No. 1
9.3 m²
2.4 m

Bedroom 4
No. 1

Bedroom 5
No. 1

Bedroom 6
No. 1


TGD F – 1.2.3.4:

General continuous supply ventilation rate of the dwelling is =

General continuous extract ventilation rate of the dwelling is =

Step 1 – General ventilation rate
Calculated general ventilation rate based on occupancy of the dwelling
Calculated general ventilation rate based on internal floor area of the dwelling

TGD F give minimum boost extract rate

Next we must establish the minimum boost extract ventilation rate.

In this example the General ventilation Rate < Overall Minimum boost extract rate

TGD F give minimum boost extract rate

Table 1: Centralized continuous mechanical extract ventilation systems

<table>
<thead>
<tr>
<th>Room</th>
<th>Minimum extract rate (l/s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Utility room</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Ensuite</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. The above are minimum boost extract rates and may need to be increased to a value to ensure the personal ventilation requirements are met.
2. As an alternative, an opening window provided for escape ventilation may be used on a to be extracted.

Table 2: MVHR systems

<table>
<thead>
<tr>
<th>Room</th>
<th>Minimum extract rate (l/s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Utility room</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Ensuite</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

As an alternative, an opening window provided for escape ventilation may be used on or to be extracted.

November 2021
**TGD to Part F 2019 - Ventilation**

- From above the General continuous supply ventilation rate of the dwelling is = 36.6l/s
- Supplies are into habitable room (except kitchen) with extracts from wet rooms.
- Upper table takes the total supply ventilation rate and redistributes that supply to the habitable rooms in the ratio of the volume of those rooms.
- The second table takes the base line extract rates from Table 1 or 2 and proportionately decreases (or increases) the base line extract rates to achieve a balanced ventilation system.

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**Sample Ventilation Validation Certificate**

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November 2021
Sample Ventilation Validation Certificate

Dwelling address
Cedarview House Type B
Semi-detached house
MVHR

Date of test
26.11.2019

Installer/builder (if applicable)
Mr AIVC Validator, 11/03/2021

Results

<table>
<thead>
<tr>
<th>Extract air</th>
<th>Measured extract air flow rate at trickle</th>
<th>Measured extract air flow rate at boost</th>
<th>Tolerance check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trickle</td>
<td>36.60 l/s</td>
<td>43.00 l/s</td>
<td>41.70 l/s</td>
</tr>
<tr>
<td>Boost</td>
<td>11.07 l/s</td>
<td>12.50 l/s</td>
<td>11.10 l/s</td>
</tr>
</tbody>
</table>

Tolerance

<table>
<thead>
<tr>
<th>Supply air</th>
<th>Measured supply air flow rate</th>
<th>Measured supply air flow rate at trickle</th>
<th>Measured supply air flow rate at boost</th>
<th>Tolerance check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricklere</td>
<td>15.97 l/s</td>
<td>14.88 l/s</td>
<td>12.97 l/s</td>
<td>11.07 l/s</td>
</tr>
<tr>
<td>Boost</td>
<td>6.52 l/s</td>
<td>5.55 l/s</td>
<td>4.34 l/s</td>
<td>4.50 l/s</td>
</tr>
</tbody>
</table>

Comment on design:
The design provided that the total measured supply was less than the target design supply. Therefore, the measured supply at trickle was 1.91 l/s, which is within the tolerance of the presented design trickle air flow rate of 0.4 l/s.

Overall comments:

1. The measured supply at trickle was 1.91 l/s, which is within the tolerance of the presented design trickle air flow rate of 0.4 l/s.
2. The measured supply at boost was 5.11 l/s, which is within the tolerance of the presented design boost air flow rate of 1.4 l/s.
3. The measured extract was 36.60 l/s, which is within the tolerance of the presented design extract air flow rate of 1.5 l/s.

Date of test
November 2021

Report print date & time
25/11/2021 12:58
Ventilation Validation Registration Scheme

Website

Thank You

November 2021
Inspection of ventilation systems in new regulation in Germany

AIVC & TightVent Webinar

Inspection of ventilation systems in new regulation in Germany

Dipl.-Ing. (BA) Dan Hildebrandt

November 30th, 2021

EnEV: Nov. 1st, 2020

GEG: Part 4, Chapter 3

§ 12 EnEV: Inspection of air conditioning systems

§ 74: Responsibility of the operator - Which systems are affected?

• All air conditioning systems (e.g. split systems/multi-split/VRV-systems) & combined air conditioning and ventilation systems with cooling capacity of > 12 kW and operation duration of more than 10 years (in residential buildings and non-residential buildings)

• Periodic inspection every 10 years (exception if main components, e.g. fan, compressor or heat exchanger were replaced → § 76 (moment of inspection))

• New in GEG: Systems with cooling capacity > 70 kW must be inspected according to inspection standard DIN SPEC 15240:2019-03 (part of German Annex of DIN EN 16798-17) !!

• Random inspections are permitted for > 10 similar systems with 10-70 kW cooling capacity in comparable buildings
Exemptions from inspection obligation

• Air conditioning or combined air conditioning and ventilation systems which are installed in non-residential buildings with a multi-functional system for building automation and control systems for energy use (energy management systems) → no specific definition on a basis of technical standards (e.g. DIN EN 15232-1, VDI 3814, ISO 50001 etc.) in GEG, but guideline GEFMA 124-5 (07-2021) and Supplement 1 to DIN SPEC 15240 (09-2021) give advice.

• Air conditioning or combined air conditioning and ventilation systems which are installed in residential buildings with an effective control and regulations system for the energy efficiency of all building systems with automatic information functions for the owner → no specific definition on a basis of technical standards (e.g. DIN EN 15232-1, VDI 3814, ISO 50001 etc.)

• Systems for process cooling only (industry, freezing rooms, server cooling)

• GEG § 5 principle of profitability (the invest for expenses must be achieved during expectable life time of components)

§ 75: Procedure and range of the inspection

• Technical inspection of the systems on site (measurement of air volume flows, operating performance of the fans, evaluation of room air flows, insulation, defects, hygienic aspects, cold water hydraulics, end devices, etc.)

• Assessment of the control or BMS (actual and target values temperatures, air quality values, humidity, operating times, switching thresholds, etc., trend evaluations BMS)

• Evaluation of component efficiency with determination of efficiency parameters (ERLT, EKK, EER, energy efficiency classes A-F), cooling load calculation and comparison, Documentation and summary of the results + proposals for measures to increase plant efficiency in inspection report with evaluation of cost efficiency or profitability assessment
Inspection of ventilation systems in new regulation in Germany

§ 77: Knowledge of the inspection staff

- All inspection staff must have a specific technical knowledge
- Persons with university degree in HVAC with at least 1 year experience of work
- Persons with university degree in Mechanical-, building, electrical or other technical Engineering with major in HVAC with at least 3 years experience of work
- Persons which own a HVAC company / master craftsman
- Persons with technical degree in HVAC
- Persons with an equal education from any member of the EU, contractual state of the European Economic Area or Switzerland

→ 2-day-seminars for inspections staff available, organized by associations e.g. FGK e.V., BTGA e.V.

§ 78: Inspection report and registration

- The inspectors have to write an report about the results and have to give cost efficient advices to improve the energy efficiency of the inspected system.
- The inspection report has to be signed by the inspector and send out to the operator / customer.
- The inspection report must be registered at Deutsches Institut für Bautechnik (DIBt), a technical authority. DIBt fulfils numerous public tasks in the field of construction on behalf of the 16 federal states and the Federation.
- The Inspector has to hand out the inspection report to one of the federal authorities, which is responsible for the execution of the GEG.
Current situation / Problems

- 250,000 to 420,000 ventilation systems > 12 kW
- 150,000 chillers with 272 kW average cooling capacity in existing non-res.-buildings by 2018 according to study of Schiller engineering, ILK Dresden, 2013, CCI 2018

- Only the inspection reports have to be registered, there’s no register of air conditioning / ventilations systems which have to be inspected according GEG
- No communication of the results after checking of the quality of the inspection report by the federal authority to the inspector or operator – just for statistic purposes
- The implementation of inspection results is voluntary – no mandatory measure for the operator, but funding programs for EE are available for residential and non-residential buildings
- Sometimes problems with the correct identification & number of reports/registration numbers of systems due to different years of construction, renovation, type of ventilation etc. → GEFMA 124-5
Thank you for your attention!

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AIVC – TIGHTVENT

Inspection of ventilation systems in new regulations in European countries

French Regulation RE2020

30/11/2021

Sandrine CHARRIER - Cerema

FRENCH REGULATION RE2020

New EP regulation:

• Energy and Environnental Performances Regulation RE 2020 (ex - Thermic Regulation RT2012)

• **Beginning:** January, 1st 2022

• Inspection of ventilation system is **mandatory** for a scope of buildings and ventilation systems
FRENCH REGULATION RE2020

Which kind of building or ventilation system is concerned by this requirement?

Buildings and ventilation system concerned by mandatory inspection of ventilation system:

- New residential buildings:
  - Single family dwellings
  - Multi family dwellings,
- And with mechanical ventilation system:
  - Either single exhaust ventilation system
  - Or balanced ventilation system.

➢ The majority of new residential buildings are equipped with a mechanical ventilation system

Who is allowed to perform the inspection (1/2)?

A qualified inspector:

- Qualification approved by the Ministry in charge of Building Regulations
- And who is:
  - either independant inspector, independant from client, system designer, installators
  - or the installer who is in the charge of the coordination of the whole building’s ventilation system (air inlet, air transfert, air outlet).

➢ Qualification scheme similar to the airtightness tester scheme.
Who is allowed to perform the inspection (2/2)?

To be qualified operator:

- **Train and validate final exam** of the training scheme approved by the ministry
  - theoretical and practical exam

- **Then**, obtain the qualification approved by the Ministry

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**FRENCH REGULATION RE2020**

**Type of control (1/5)**

- Mandatorires diagnostic and measurements introduced by the energy and environmental performances regulation (RE2020 Ventilation Protocol)

- 3 parts in the control:
  - **Pre-inspection**: analysis of documents and preparation of the in situ audit
  - **Ventilation diagnostic (in situ)**: diagnostic in situ
  - **Ventilation measurements (in situ)**: Flow rates and/or air pressures (for humidity DCV systems (demand-control ventilation))
FRENCH REGULATION RE2020

Type of control (2/5)

- **Pre-inspection**: analysis of documents and preparation of the in situ audit
  - Availability of studies documentation (design, calculations, …)
  - Ventilation system installed consistent with ventilation system used in the regulatory study (used in the Energy Performance calculation of the building)
  - Completeness of the ventilation system

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Type of control (3/5)

- **Ventilation in situ diagnostic**: verification of about 60 checkpoints on:
  - General
  - Ventilation unit
  - Ductworks
  - Air transfert
  - Air inlet
  - Air exhaust

- Completeness of the ventilation system
- General state of the ventilation system in regards with regulations
- Verification if each part of the system is:
  - Installed
  - Well installed (according to regulations) (accessibility for instance)
  - Works (mechanical systems)
FRENCH REGULATION RE2020

Type of control (4/5)

- Ventilation measurements:
  - Flow rates and/or air pressures (for humidity DCV systems (demand-control ventilation))
    - On every air outlet
    - Calibration is indicated in the regulatory protocol
    - Sampling
      - Of the ventilation units in the case of several buildings,
      - Of dwellings for ventilation units that serve more than 5 dwellings.
  - Ductwork airtightness only if the value introduced in the EP regulation is better than the default value.

Type of control (5/5)

- Mandatory checkpoints: around 60
- Optional checkpoints: around 50 (could be used for a label for instance)

Periodicity of the control
- Once, at the end of the construction
Non-conformity

- Non-conformity is written in the final document attesting the compliance with EP regulation (declaration)

Database

- Inspection and measures results are centralized and analysed in an online database (Ventilation National Observatory):
  - Secure login for inspectors, qualification organisations, Cerema
  - Public global statistics online

➤ In process. A first available version should be online in the summer 2022.

Thank you!

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