Energy Performance of Buildings

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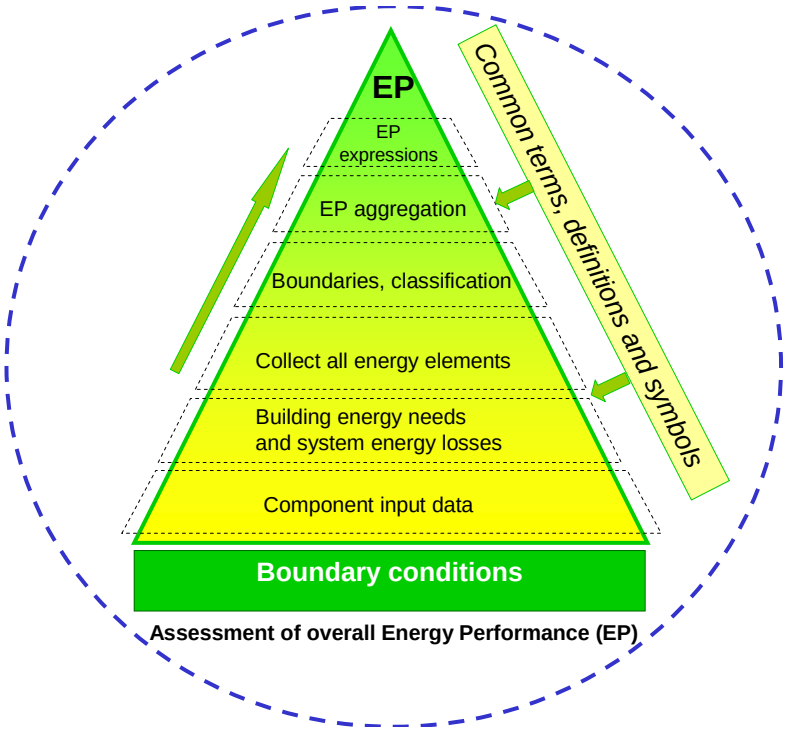
BOOKLET 5

Compilation of Information Papers introducing the CEN standards concerning Inspection of Systems for Heating, Air conditioning and Ventilation



IEE-CENSE

Leading the CEN Standards on Energy performance of buildings to practice
Towards effective support of the EPBD implementation and acceleration in the EU Member States

Intelligent Energy Europe

BOOKLET 5

Compilation of Information Papers introducing the CEN standards concerning Inspection of Systems for Heating, Air Conditioning and Ventilation

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General introduction

The aim of the CENSE project is to support the EU Member States and other target groups in gaining awareness and achieving effective use of the European (CEN) standards that are related to the EPBD.

These standards were successively published in the years 2007-2008 and are currently either already being implemented or will soon be implemented in many EU Member States.

The European Commission, DG TREN and DG Enterprise, gave Mandate 343 to CEN. It ordered CEN to develop a methodology for calculating the integrated energy performance of buildings in accordance with the terms set forth in Directive 2002/91/EC (Energy Performance of Buildings Directive-EPBD).

Access to this methodology in the form of European Standards makes it possible to coordinate the various measures for improving the energy efficiency in buildings that are used in the Member States. It will increase the accessibility, transparency and objectivity of energy performance assessment in the Member States (as mentioned in recital (10) of the EPBD).

The role of the EPBD-CEN standards is to provide a common European concept and common methods for preparing energy performance certification and energy inspections of buildings. However, the implementation of these CEN standards in the EU Member States is far from trivial: the standards cover a wide variety of levels and a wide range of interlaced topics from different areas of expertise. They comprise different levels of complexity and allow differentiation and national choices at various levels for different applications.

One of the main activities in the CENSE project is *"to communicate the role, status and content of these standards as widely as possible and to provide guidance on their implementation".* To fulfil this task many so called Information Papers have been published with background and practical information related to the CEN standards developed in the framework of the EPBD. The Information Papers of each work field in the energy building sector are compiled in a Booklet as present. This Booklet is part of a series consisting of the following volumes:

Booklet 1: Overall Energy Performance of Buildings

Booklet 2: Building Energy Performance

Booklet 3: Heating Systems and Domestic Hot Water

Booklet 4: Ventilation and Cooling Systems

Booklet 5: Inspection of Systems for Heating, Air Conditioning and Ventilation

In each booklet the Information Papers are clustered to the specific appliances, systems, calculation methods, etc. Additional to each Information Paper a PowerPoint presentation is at disposal for dissemination and training purposes. All these documents and more information, like a database with frequently asked questions, are separately available on the CENSE website: ***http://www.iee-cense.eu/***

A second major activity in the CENSE project is "*to collect comments and good practice examples from EU Member States aiming to remove obstacles and to collect and secure results from relevant SAVE and FP6 projects*". This feed back aimed to produce recommendations to CEN for a "second generation" of CEN standards on the energy performance of buildings. Several reports from questionnaires and workshops, draft recommendations, etc. were gradually made available on the CENSE website for comment: ***http://www.iee-cense.eu/***.

All final products from the project will be available at the website before the end of May 2010.

The consortium of the project consists of thirteen partners (from nine different countries) who are all experts and active in CEN-EPBD. They combine this expertise with knowledge and experience of implementation at the national level.

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*: Project coordination

Collaboration has been established with the following European umbrella (mainly branch) organizations, such as CEN BT/TC 371, EuroAce, EURIMA, EHI, REHVA, EUROVENT, ESTIF, Euro Heat & Power and ECOS (see website for details).

Cluster: Inspections of technical building systems

Introduction

EPBD articles 8 and 9 deal with inspections of technical building systems or their parts.

EPBD article 8 requires Member States to either

- lay down the necessary measures to establish a regular inspection of boilers fired by non-renewable liquid or solid fuel of an effective rated output of 20 kW to 100 kW; or
- take steps to ensure the provision of advice to the users on the replacement of boilers, other modifications to the heating system and on alternative solutions which may include inspections to assess the efficiency and appropriate size of the boiler.

Information paper P 109 describes briefly the contents of EN 15378.
According to the EPBD article 8 requirements, EN 15378 defines two separate procedures for boiler (regular) inspection and heating system (one-off) inspection. The basic procedures are in the normative part of the standard and specify which aspects have to be addressed in an inspection.
Since it was very hard to reach consensus on the level of detail of inspections (EPBD directive itself allows for alternative approaches) alternative and/or optional partial inspection procedures and measurement methods for boilers and heating system have been detailed through annexes. Existing national standards may also be referred for specific inspection items.
A method is given (inspection classes) to specify Inclusion/omission/alternatives of individual inspection items as well as border lines between classes. This calls for a national annex. If no specific national annex is available, default tables and inspection classes are given.
This standard is not designed to provide a full energy audit of the heating system. However the methodology of this standard can easily be extended to collect the required on-site information to support an energy audit.

EPBD article 9 requires the Member States to lay down the necessary measures to establish a regular inspection of air conditioning systems of an effective rated output of more than 12 kW.

Information papers P 115 and P 116 deal with standards for inspections for ventilation systems, EN 15239, and for air-conditioning systems, EN 15240. These two standards have the same structure, dealing with the phases of inspections (pre-inspection and document collection, and the main inspection on-site) with partly overlapping contents. This overlap was unavoidable because ventilation and air-conditioning may or may not be integrated in the same technical system. Because the EPBD addresses the importance of ventilation to provide an appropriate indoor air quality, a separate standard for inspection was drawn up to include also the "ventilation only" systems.

The cluster of inspection standards do not take any position to other system integration (heating, cooling, ventilation), but this question may be taken up in the revision of the standards. The Recast of the EPBD addresses some needs towards the merger or closer integration of different inspections. Both the existing and the Recast of the EPBD put the main focus on those technical building systems which on European scale have the major need for improvement – and therefore they do not cover all technical building systems, leaving possibilities to interpretations of what is included in mandatory inspections and what is not.

Information papers

IP 109: Information paper on EN 15378 Heating systems in buildings – Inspection of boilers and heating systems

IP 115: Inspection of air conditioning systems – EN 15240 for the application of EPBD Article 9

IP 116: Inspection of ventilation systems – EN 15239 for the application of the EPBD

Presentations

Besides Information Papers, corresponding presentations have been prepared to support communication about EN EPBD standards as well as lectures. Presentations often include notes to explain the slides and to support lecture preparation.
Presentations can also be downloaded freely from *http://www.iee-cense.eu/*

Figure 2 Inspection procedures should be adapted to the complexity and age of the building and heating system.

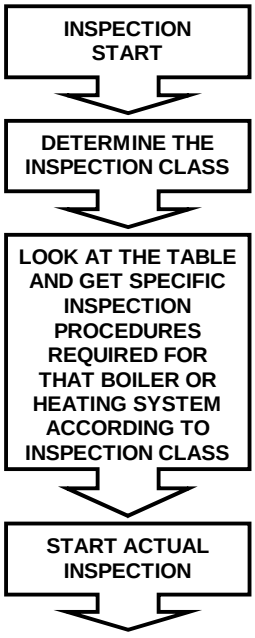

Figure 3: Inspection classes allow to adapt inspection requirements to type and size of boiler or heating system

Accordingly the standard defines two separate procedures for boiler (regular) inspection and heating system (one-off) inspection.

This standard covers boiler and heating systems inspection only (see figure 1):

- ventilation system inspection is covered by EN 15239;
- air conditioning inspection is covered by EN 15240.

Building inspection is not covered explicitly in the EPBD standard package.

This standard is not designed to provide a full energy audit of the heating system. However the methodology of this standard can easily be extended to collect the required on-site information to support an energy audit.

2 > Principle of the methods

The basic procedures to inspect boilers and heating systems are defined in the normative part of this standard:

- boiler inspection is defined in clause 5 of the standard;
- heating system inspection is defined in clause 6 of the standard.

Giving flexibility and possibilities to fine tune the procedure was a strong concern in writing this standard because:

- the same level of accuracy and details cannot reasonably be asked for the inspection of any kind and/or size of boiler and/or heating system;
- the borderline between "small" and "large" heating systems is different in the various countries;
- some countries have well established maintenance and inspection legal requirements and practices. They accept and/or desire detailed inspection but they would like to take into account work already done (example: getting data from maintenance reports instead of measuring again) or to incorporate in the EPBD inspection any specific additional requirement;
- on the other hand, some countries have no legal requirement about heating systems maintenance and inspection: thus asking too much could cause problems and rejection of the whole procedure;
- countries refer to different main properties to identify and classify boilers and heating systems: fuel power input/heat net power output, combustion efficiency/net efficiency, etc.

That's why the standard does not directly give the actual fully detailed procedure but requires that:

- "inspection classes" are identified at national level. Inspection classes may depend on any relevant parameter like size of the heating system, fuel used, individual/collective heating system, etc.
- Inclusion/omission/alternatives of individual detailed procedures (according to boiler or heating system inspection class) are specified according to the inspection class, through tables given in a national annex.

Example (see figure 3):

- any heating system inspection will start with the determination of the inspection class of the heating system;
- one necessary step in a heating system inspection is the heating system identification, as required by clause 6.3
- what to record as identification data of a heating system depends on its size and possible legal procedures and/or identification schemes in force in the specific country (like electric energy supply id-code, building register identification code, etc.) and will be found in a table in the national annex.

Fuel type			Gaseous and liquid	
Power		(ref. annex)	< 100 kW	> 100 kW
Combustion power	Measurement	M.1	Excellent	Suitable
	Maintenance data	M.2	Suitable	NO
Evaluation of energyware consumption		F	Optional	Suitable
Boiler basic settings and combustion efficiency	Measurement	C.1	Suitable	Suitable
	Maintenance data	C.2	Suitable	NO
Losses through the envelope (radiation losses)	Surface temperature	N.5.1.1	Optional	Optional
	Tabulated values	N.5.1.2	Optional	Optional
Losses through the chimney with burner off	Tabulated values	N.5.2	Optional	Optional
Total stand-by losses test	Tabulated values	N.5.3.1	Optional	Optional
	Stand-by operation	N.5.3.2	Optional	Optional
	Auxiliary heater	N.5.3.3	Optional	Optional
Boiler seasonal efficiency [a]	Database reference	N.1.1	Optional	Optional
	Default tables	N.1.2	Optional	Optional
	Boiler directive data	N.1.3	Optional	Optional
	Boiler cycling method	N.1.4	Optional	Optional
	Total stand-by losses	N.1.5	Optional	Optional
Controls settings verification		L	Suitable	Suitable
Boiler sizing check		O.1.3	Optional	Optional

Figure 4: Default inspection class table for boiler inspection using gaseous or liquid fuels.
Possible inspection items, methods and normative references (relevant annex of 15378 in the example) are listed on the left columns.
The two right columns specify which checks are required or optional.

Figure 5: Boiler inspection. Basic boiler setting may be checked with a simple flue gas analysis. A check of the set maximum power can also give useful information.

Paragraph 4.3 of the standard explains the "inspection classes" mechanism.

Annex A contains default inspection classes and tables. It is a complete set of common inspection classes and tables that can be used as a template (and an example) to define national classes.

Detailed procedures for most inspection items have been included in the informative annexes, ready to be referred to through inspection classes and tables. Annexes are a "toolbox" to complete the inspection procedure.

Each annex may include one or more procedures suitable to fulfil one inspection item. Again, in case of multiple options, which procedure to use for which inspection class will be stated in the inspection table.

Each annex also includes reference values (good practice data) and criteria to give suitable advice on the specific topic.

3 > Boiler inspection

Boiler inspection is defined in clause 5 of EN 15378.

Possible objectives of boiler inspection are:
- to verify if the boiler is set, operated and maintained correctly;
- to estimate the actual boiler energy performance;
- to support advice on possible boiler energy performance improvements.

Boiler inspection procedure includes the following steps:
- define the inspection class;
- identify the boiler;
- identify available documents;
- visual inspection to check for any evidence of wrong and/or dangerous situations ;
- check if the boiler provides the intended service;
- check proper setting and functionality of boiler controls;
- record available data (fuel, time, energy counters) to help create historical data;
- check if the boiler is regularly maintained;
- check boiler performance;
- report to user with optional advice.

Annex C provides procedures for the usual boiler checks that can be made in-situ: flue gas analysis, basic boiler setting check and combustion efficiency measurement. The procedure includes condensation latent heat recovery calculation for condensing boilers. The option to get data from recent maintenance report, if available, is mentioned as well.

Annex D provides an example of a complete boiler inspection report.

4 > Heating system inspection

Heating system inspection is defined in clause 6 of EN 15378.

The possible objectives of heating system inspection are:
- verify if the heating system is set, equipped, operated and maintained correctly with regard to energy efficiency;
- estimate actual heating system energy performance;
- support advice on possible heating system energy performance improvements.

Inspection procedures and optional measurement methods (if any) are specified separately for each subsystem of the heating system.

Figure 6: The real objective is to determine how much does this device run and, if it is too much, why.

Figure 7: Example of first rough operating energy performance assessment:
The reading is 62823 Stm³
Installation year is 1999
Reading year was 2006
Yearly consumption was 8974 Stm³ per year ≈ 86 MWh/year
Heated surface is ≈ 1200 m²
Heating performance is 71,7 kWh/m² per year

The procedure includes the following steps:

- define the inspection class;
- find or assemble required documentation to support inspection;
- identify the heating system;
- check if the heating system provides its intended service;
- check if the heating system is regularly maintained;
- check proper setting and functionality of heating system sensors, indicators and controls;
- check energy consumption level (in-use energy performance);
- inspect emission and control sub-system;
- inspect distribution sub-system;
- inspect generation sub-system;
- inspect DHW production system;
- check generation sub-system sizing;
- report to user with optional advice.

The Annexes of EN 15378 include many methodologies to be specified through inspection class tables. Within the standard, these annexes are listed in the order in which they are referenced in the text. In the following they are listed in a logical use (walk through the heating system) order.

Annex F gives methods to assess actual energy consumption for heating. It complements methodologies defined in EN 15603 – Annex B, like the energy signature method. The focus is on criteria to separate heating and non-heating (DHW and cooking) energy use and on giving references.
NOTE: Reducing the actual non-renewable energy consumption is the goal of the EPBD and of all work done on a heating system. A comparison between designed or expected values and actual ones is therefore of utmost importance.

Annex G is a simple annex dedicated to the emission subsystem. It is limited to criteria to check for overheating in the upper part of rooms with high ceilings.

Annex H gives a simple procedure to identify the level of indoor temperature control.

Annex I gives information on space heating distribution sub-system.

Annex J deals with domestic hot water (DHW). The focus is on the cause of the highest losses, like recirculation circuits.

Annex L deals with boiler controls setting.

Annex M is dedicated to burner power setting. One main concern with existing boilers is oversizing, which causes high stand-by losses. A simple option is to correctly set the actual burner power, which is not necessarily the maximum allowed.

Annex N is dedicated to seasonal boiler efficiency assessment. Several options are given:

- tabulated values;
- correction of boiler directive data using tabulated factors;
- adapted boiler cycling method (see also 15316-4-1);
- total stand-by losses method.

Information is given on how to determine the required loss factors either by measurement or by default tables.

Annex P contains an example of simple tables to assess generation efficiency, either for heating system service or for domestic hot water service.

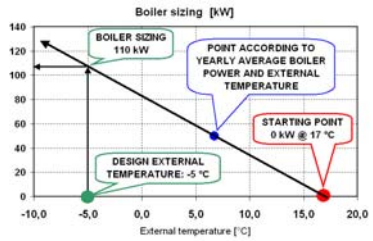

Figure 8: The energy signature method allows a simple check of boiler sizing. Yearly consumption and yearly average temperature data is in most cases enough to get a correct sizing of the boiler.

Annex O deals with the assessment of correct sizing of the generation sub-system. Several posibilities are identified:

- Heat load calculation;
- Energy signature method (EN 15603 - Annex B, see figure 8);
- Yearly fuel consumption;
- Installed heat emitters.

Annex E contains a list of the most common improvement actions, grouped by sub-system. They are intended to be used as reminder and check-list when drafting recommendation and advice. Further actions may be identified, and some of those listed may not be useful or suitable for the specific heating system. Similar information can be found in other standards of the EPBD package (EN 15240 – annex H, EN 15239 – annex J).

Annex K includes a sample heating system inspection report.

5 > FAQ

Why not a single finished procedure?

A unique step-by-step straightforward procedure would have required a lot of "if" and "in case of", considering the difficulties described in chapter 2. Nevertheless:

- the contents of chapters 5 and 6 is a couple of straightforward step-by-step procedures, respectively for boiler and heating system inspection;
- all "if" and "in case of" details are given through inspection classes and tables.

Are national annexes always required?

Not necessarily.

If no national annex is defined, annex A is a limited but complete inspection class set of tables. Nonetheless, using it as an example and/or template to develop a custom national annex is advisable.

Is this inspection method connected with calculation methods of EN 15316?

There is no explicit connection.

This inspection procedure is not meant to be a full energy audit or the basis for a complete renovation design. The expected result of the inspection process is an indication of whether there is a reasonable possibility that energy conservation measures colud be adopted. Then each improvement measure should be designed and implemented according to local regulations.

Of course, identification of the subsystems within efficiency tables or identification of suitable input for EN 15316 calculation methods is possible. For the generation subsystem, a method has been derived by modifying the boiler cycling method and using the same loss factors (see also 15316-4-1)

Can national methods be referred to through inspection classes tables?

Yes.

Many parts of the inspection process are not well covered yet. The intention is to collect experiences and suggestions and to include them in the next revision of the standard.

In the meanwhile it is important that a common frame is followed.

What about building inspection?

Building inspection is neither mentioned by the EPBD nor treated explicitly by the EPBD standards package.

Technically it is obvious that it should be covered as well. Any renovation or upgrade project should start with measures to reduce building energy needs, followed by suitable system improvements to reduce accordingly primary energy needs.

CENSE partners:
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Associated partners:
HTA Luzern (CH), BRE (GB), Viessmann (DE), Roulet (CH), JRC IES (EC)
Link: *www.iee-cense.eu*

Original text language: English

6 > References

1. EN 15378 Heating systems in buildings - Inspection of boilers and heating systems
2. EN 15603 Energy performance of buildings - Overall energy use and definition of energy ratings
3. EN15316-4-1 Heating generation subsystem

Disclaimer: CENSE has received funding from the Community's Intelligent Energy Europe programme under the contract EIE/07/069/SI2.466698.

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[European projects]

P115

13-06-2008

Inspection of air conditioning systems - EN 15240 for the application of EPBD Article 9

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This paper gives a short introduction to the CEN standard EN 15240 which deals with the application of Article 9 of the EPBD and guidelines to the inspection of air conditioning systems.

1 > Inspection of air conditioning systems: why?

Article 9 of the Energy Performance of Buildings Directive requires the Member States to put into place an inspection of the air conditioning systems.

> *"With regard to reducing energy consumption and limiting carbon dioxide emissions, Member States shall lay down the necessary measures to establish a regular inspection of air conditioning systems of an effective rated output of more than 12 kW.*
>
> *This inspection shall include an assessment of the air-conditioning efficiency and the sizing compared to the cooling requirements of the building. Appropriate advice shall be provided to the users on possible improvement or replacement of the air-conditioning system and on alternative solutions."*

2 > Scope of the standard

The inspection as described in the standard is intended to include all types of comfort cooling and air conditioning systems that provide a total cooling output of the building that is above the specified limit of 12 kW.

The standard provides no specific additional items for the inspection of air conditioning systems in heating mode.

In the standard, an air conditioning system is described as a combination of three subsystems, as follows:

- a cooling energy generation,
- a cooling energy distribution,
- a cooling energy emission,

each subystem including its controls.

More information can be found at the CENSE project website:
www.iee-cense.eu

Similar Information Papers on CENSE and/or other European projects can be found at the Buildings Platform website:
www.buildingsplatform.eu

EUROPEAN COMMISSION
Directorate-General for Energy and Transport

› **Cooling energy generation subsystem**
Subsystem where the cooling energy is generated by refrigeration units, such as chillers, absorption units, heat pumps, etc.

› **Cooling energy distribution subsystem**
Subsystem where the cooling energy is transported and distributed from the generation to the emission subsystems by a distribution medium, generally air, water or a refrigerant fluid.

› **Cooling energy emission subsystem**
Subsystem where the cooling energy is emitted to the space for which air is conditioned.

3 > What is an air conditioning system?

The Directive defines an air conditioning system as "a combination of all components required to provide a form of air treatment in which temperature is controlled or can be lowered, possibly in combination with the control of ventilation, humidity and air cleanliness."

All types of air conditioning systems having an effective rated output of more than 12 kW shall be considered for inspection according to Article 9 of the Directive. It should be also noted that

› the wording "…possibly in combination…" can be misunderstood to limit the inspection to the "generation part" of the system i.e. the refrigeration plant. The intent is, however, that the inspection has to cover the whole system including the distribution of cooling energy to the treated spaces and the system controls.
› the 12 kW limit is not originally intended to concern an individual system in a building, but the sum of the outputs of all systems within a building (or a zone in the building). However, there are different national interpretations.

Air conditioning in a building can be provided by different types of systems, centralised or decentralised. The system may or may not provide heating and/or ventilation in the building in addition to cooling.

4 > Guidelines for inspection of air conditioning systems

The objective of EN 15240 is to provide a methodology that could be applied during inspection, bearing in mind that it must include an assessment of energy performance as well as of the suitability of the air conditioning system for the building in question.

The inspection should apply to the cooling generation, distribution and emission subsystems, and to the controls that regulate the use of these systems.

The standard describes a common methodology for inspection of air conditioning systems from an energy consumption standpoint, one that is based on the following:

› system conformity to original design and subsequent design modifications;
› system conformity to actual requirements and use of the building,
› current operation of the system,
› function and setting of the various controls,
› function and fitting of the various components,
› power input and the resulting energy output.

The standard recommends defining inspection classes at a national level for which the minimum extent of the inspection will be specified.

These classes may be defined according to one or more of the following parameters:

> *usage of the building*
> *air conditioned area or volume*
> *type of air conditioning system*
> *nominal cooling capacity*
> *annual running time*
> *date of installation*
> *legal requirements*
> *system documentation*

General methodology

The general methodology as described in the standard intends to provide the inspector with guidelines for all the major items that must be inspected, for any building and any associated air conditioning system. Some items are general for all types of air conditioning systems, while others are specific to one type of air conditioning system. They are given by means of specific checklists of items to inspect.

The inspection is mainly based on examination of the existing documentation, on visual inspection and on some measurements where these are available and possible, including checking that there is good and regular maintenance of the equipment, that the controls are correctly set for the pattern of usage of the building (i.e. occupation duration) and that all components are functioning correctly.

Difficulties in the inspection of air conditioning systems may arise from lack of information on parameters such as temperatures, air or water flow rates and electrical consumption, variables that may be required to make a quantitative estimate of the air conditioning output and of the energy performance of the system.

Advice on alternative solutions and improvements

In addition to the inspection of the energy performance of the air conditioning system, advice is also to be provided to the users on *"possible improvement or replacement of the air-conditioning system and on alternative solutions".*

In formulating such advice, the following main impacts of the recommended improvements should be considered:

- adaptation to the actual use of the building,
- reduction of the cooling load of the building,
- improvement of the maintenance,
- improvement of the functioning of the system, subsystems and components,
- replacement of the whole system, subsystems or components

The advice should in many cases include measures such as retuning the air distribution duct system or the hydraulic system, and measures to increase the evaporation temperature and decrease the condensing temperature. However, providing adequate advice in these cases may often require so much measurement and analysis that it is far beyond the scope of an inspection.

5 > Informative annexes

A large part of the information is in the informative annexes.

Annex A gives examples of subsystems. The complete system is the sum of its subsystems

Annex B gives an example of a classification system for air conditioning systems, with three inspection classes

Annex C describes some features that affect the frequency and duration of an inspection.

Annex D presents a checklist for what information and documentation should be assembled prior to an inspection

Annex E describes recommendations for the extent of an inspection, in the form of a list of items in each inspection class. Examples are given for the subsystems defined in Annex A.

Annex F gives examples of checklists indicating observations and advisable actions, for all inspection items described in Section 4 of the main part of the standard.

Annex G gives an example of items to be included in the inspection report.

Annex H presents a few possibilities for saving energy for air conditioning – not only by improving the system efficiency, but also by reducing the cooling requirement of the building.

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[European projects]

P116

25-11-2008

Inspection of ventilation systems - EN 15239 for the application of EPBD

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More information can be found at the CENSE project website:
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Similar Information Papers on CENSE and/or other European projects can be found at the Buildings Platform website:
www.buildingsplatform.eu

This paper provides a short introduction to the CEN standard EN 15239 which deals with the application of Article 4 of the EPBD and guidelines to conduct the inspection of ventilation systems.

1 > Inspection of ventilation systems: why?

Article 4 of the Energy Performance of Buildings Directive requires the Member States to set energy performance requirements. These requirements :

> *"shall take account of general indoor climate conditions, in order to avoid possible negative effects such as inadequate ventilation, as well as local conditions and the designated function and the age of the building. These requirements shall be reviewed at regular intervals which should not be longer than five years and, if necessary, updated in order to reflect technical progress in the building sector.*

In view of the large impact of ventilation on the energy consumption of buildings, CEN has decided to develop a methodology concerning the inspection of ventilation systems, as has been done for air conditioning (as described in EN 15240) and for heating systems (as described in EN 15378), following the requirements of the articles 3, 8 and 9 of EPBD.

2 > Scope of the standard

EN 15239 describes how to prepare for an inspection, provides a methodology for the inspection, the requirements for the content of the report and advice for improvements.

The methodology addresses mechanical, natural and hybrid ventilation systems in relation to their energy consumption, for both residential and non residential buildings.

As defined in the scope, the inspection may include the following items:

The system performance and system conformity to the original design, system operation and building air tightness.

However, building air tightness is not really taken into account in the details of the standard itself, which focuses on the ventilation system description and operation. Similarly, window airing is only mentioned in annexes.

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The inspection methodology part of the standard defines the minimum requirements for any inspection based on the following items:

General approach
- Operation and maintenance instructions
- Air change
- Humidity
- Fans and air handling units
- Recirculated air
- Measurement methods

Mechanical exhaust and/or supply systems
- Visual inspection
- Measurements

Natural ventilation
- Visual inspection

Hybrid ventilation
- Visual inspection
- Measurements

It is not the intention of the standard to provide a full ventilation system audit and it therefore focuses on an assessment of its functioning and its impact on energy consumption. It includes recommendations on possible system improvements. If the standard is to be applied in the field of energy performance, it should be remembered that "*all inspection activities undertaken should be subject to compliance with all health and safety requirements for the persons involved*". These health and safety requirements are in general defined at national level, and are not part of the standard.

3 > Ventilation systems – how are they defined?

A ventilation system is designed to provide fresh air to the principal rooms, and/or to extract polluted air from service rooms. The ventilation system can be a part of an air conditioning system.

The system can be driven mechanically or by natural forces (wind and the stack effect). Hybrid systems are a combination of mechanical and natural systems. A ventilation system can be centralised or local.

A ventilation system is basically composed of:

- Air inlets.
- Air transfer between rooms (for centralised systems).
- Air outlets.
- Ducts.
- Air handling units or fans (mechanical) or cowls (natural).

The impact of any ventilation system on energy expenditure and IAQ depends on the airtightness of the building and on windows opening by occupants.

4 > Guidelines for inspection of ventilation systems

The objective of EN 15239 is to provide a methodology that could be applied during inspection, to obtain an assessment of its energy performance and its ability to provide acceptable indoor air quality to the building in which it is installed.

The inspection is based on a 2-phase approach:

1) Pre inspection and document collection:

This provides the designers' description of the ventilation system description and its operation, which provides a basis for the on-site inspection.

2) Inspection on site:

Based on Phase 1, the inspection will be carried out by:

- Visual inspection (presence of equipment, components…).
- Measurements (mainly airflows).
- Check of controls and settings.

General methodology

The general methodology as described in the standard is intended to provide the inspector with guidelines that specify the major items that should be inspected, for any building and any associated ventilation system.

A distinction is made between mechanical systems, for which airflow measurement can be part of the inspection protocol, and natural systems, where these measurements are of less interest as they depend strongly on current outdoor and indoor conditions. The inspection of natural ventilation systems must therefore be focused on visual inspection and on

the dimensional characteristics of the system (e.g. surface areas of openings).

The inspection protocol is described by means of specific checklists of items to verify.

The inspection is mainly based on examination of the existing documentation and visual inspection and on some measurements where available and possible. The difficulty in the inspection is to assess in an easy way such parameters as the duct air tightness, the electrical energy consumption of fans and the implementation of the control strategy (e.g. running during unoccupied periods in an office building)

For the actual running of the installations, the assessment of its energy performance must therefore be based mainly on checking that there is good and regular maintenance of the equipment, the correct settings of the controls for the pattern of usage of the building (i.e. duration of occupancy) and the good functioning of all its components.

Advice on alternative solutions and improvements

One of the results of an inspection of a ventilation system should be a list of proposals to improve its energy performance. The report of the inspection should be used as a basis for the proposals.

The advice for improvements form should contain:

- A section giving the adjustments to be made to ensure that the system performs in accordance with the design, i.e. correct levels of thermal comfort, IAQ and energy usage;
- A section giving proposals to improve the system in terms of energy impact, including their economic justification

5 > Informative annexes

A large part of the information is in the informative annexes.

Annex A gives an example of a description form for an installation that includes an Air handling unit (AHU)

Annex B gives an example of a data sheet report for a whole system

Annex C provides examples of selection criteria for air inlet/outlet airflow measurements

Annex D provides examples of time frequency inspection.

Annex E describes the main impact on energy consumption of the different kind of systems and of their main components.

Annex F completes Annex D taking into account the system and its susceptibility to drift, fouling or ageing and what proportion of the main components should be tested.

Annex G gives examples of class definition for potential use in the assessment methodology.

Annex H defines the list of items for a more detailed inspection with three possible levels A, B, C, from A (high level) to C (minimum acceptable. Even if only informative, this annex can be considered as the basis of the inspection methodology for practical use.

Annex I describes the pathway for the improvement process

Annex J provides examples of advice on improvements and presents a checklist for pre-inspection information and document collection

The main part of the **inspection report** shall include:

- The official designation of the property;
- The name of the owner of the building;
- The date of the performance checks;
- The measurements carried out;
- Comments on the faults that were identified;
- Advice to the property owner on improvements;
- A final comment about the performance of the system;
- The status of the person responsible for the inspection.

6 > References

1. EN 12599, Ventilation for buildings — Test procedures and measuring methods for handing over installed ventilation and air conditioning systems
2. EN 13779, Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems
3. EN 15240, Ventilation for buildings - Energy performance of buildings - Guidelines for inspection of air-conditioning systems
4. EN 15242, Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration
5. En 15378, Heating systems in buildings- Inspection of boilers and heating systems

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