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Information paper on EN 15378 Heating systems in buildings - Inspection of boilers and heating systems

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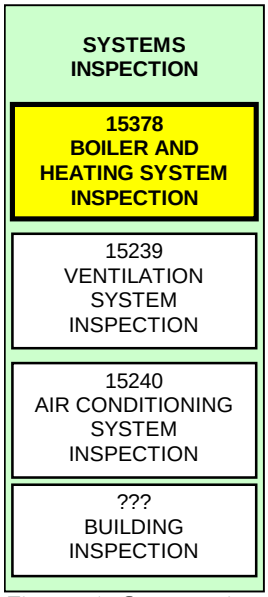

Figure 1: Systems inspection is covered by 3 standards in the EPBD package.
Building inspection has not been considered yet

Existing buildings and systems have the most important impact on energy consumption. Identifying the weak points of energy consuming systems (screening) and highlighting possible improvements (tailored information) is the first necessary step to improve the energy performance of existing heating systems. These are the main goals of inspection. Standards are useful to define a common frame for inspection in order to give advice to the Member States to fulfil the requirements of article 8 of the EPBD.

The standard EN 15378 contains a well defined basic procedure but allows a high flexibility, too. A lot of practical procedures are given, ready to be assembled according to national inspection classes.

This paper gives a short introduction to CEN standard 15378 about inspection of boilers and heating systems. It contains explanations on the inspection procedures and the related calculation methods with details on the links with the other CEN standards of the heating system series

The EN standard 15378 successfully passed the formal vote in June 2007.

1 > Scope of the standard

This standard has been organized according to the requirements of EPBD specified at article 8, option a), which requires two types and levels of heating system inspections:

- a "regular" inspection of boilers;
- a "one-off" inspection of the entire heating system.

Regular inspection is meant to be repeated periodically and is restricted to the boiler.

One-off inspection is extended to the entire heating system and includes an assessment of boiler efficiency and sizing. It is explicitly intended to be the basis for advice to the user on possible energy performance improvements.

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

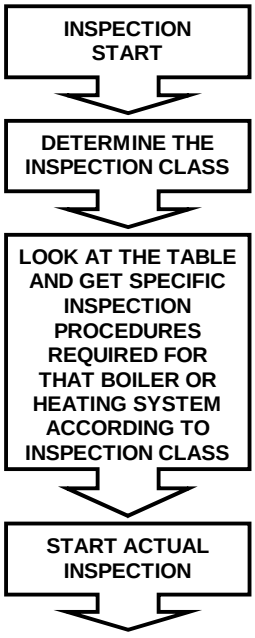

Figure 3: Inspection classes allow to adapt inspection requirements to type and size of boiler or heating system

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.

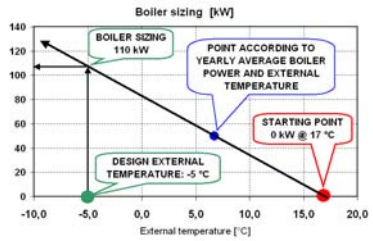

Figure 8: The energy signature method allows a simple check of boiler sizing. Yearly consumption and yearly average temperature data is in most cases enough to get a correct sizing of the boiler.

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.

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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

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