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Ventilation for buildings - Energy performance of buildings - Guidelines for inspection of air-conditioning systems

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Ventilation for buildings - Energy performance of buildings - Guidelines for inspection of air-conditioning systems

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Foreword

This document (prEN 15240:2005) has been prepared by Technical Committee CEN/TC 156 "Ventilation for buildings", the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

Introduction

Article 9 of the Energy Performance of Buildings Directive (abbreviated as EPBD) requires the introduction of “measures to establish a regular inspection of air conditioning systems of an effective rated output of more than 12 kW”. The inspection is to include “an assessment of the air conditioning efficiency and the sizing compared to the cooling requirements of the building”. Advice is also to be provided to the users on “possible improvement or replacement of the air-conditioning system and on alternative solutions”.

Therefore, it is not the intention to have a full audit of the air conditioning system but a correct assessment of its functioning and main impacts on energy consumption, and as a result determine any recommendations on improvement.

Article 2 of the EPBD 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.”

The inspection described here is therefore intended to include all types of comfort cooling and air conditioning systems that provide a total cooling output for the building above the specified 12 kW which is in turn taken to mean the rated cooling capacity of the included refrigeration systems. The term “air conditioning system” is used to represent any of the systems described below, which may heat and cool, and includes the associated water and air distribution and exhaust systems that form a necessary part of the system. It also includes the controls that are intended to regulate the use of these systems. It excludes mechanical ventilation systems that provide no mechanical cooling and components that, although they may be co-located in air conditioning systems, are dedicated to providing heating duty only. prEN EPBD WI 30 gives details for inspection of ventilation systems, and of the associated air distribution and exhaust systems.

Air conditioning systems can be described and classified as follows

1. Air-to-air systems

- These are single or multi-split systems, in which one or more units containing the refrigeration and heat rejection equipment are located outdoors and are connected to one or several cooling indoor units. The discharge of conditioned air can be free delivery or through a duct.
- Roof-top units are packaged units that also ensure the ventilation of the air conditioned space by providing a mixture of recycled and fresh air to the evaporator.
- Package air conditioning units are used for the cooling of process (close control or control cabinet AC)

2. Air-to-water systems

These are generally package systems that provide chilled water to fan coil units or chilled floors and/or ceilings. They are called liquid chilling packages or chillers.

3. Water-to-air systems

- They can be individual units where the heat source is any water source as lake, seawater or ground water. The air distribution can be free delivery or through a duct.
- The so-called "distributed" or "water loop" systems consist of a series of individual heat pumps located in the treated spaces. These are linked by a common water circuit to a central boiler and to an outdoor heat rejection plant. The aim of the system is to provide heat recovery between units operating in the cooling mode and units operating in the heating mode.

  NOTE. Care has to be taken to ensure that the water used does not cause corrosion or sedimentation within the system.

4. Water-to-water systems

These are similar to air-to-water systems but the heat source is water instead of air.

The heat source can be water from the ground water, lake, seawater or other sources. The water-to-water system can also be linked to a cooling tower or dry cooler for the heat rejection. In both cases water treatment is needed.

5. Centralised systems

The system combines an air handling unit with the boiler and the refrigeration equipment that feed the heating and cooling coils respectively. This system generally ensures the ventilation, the air cleanliness and the control of temperature and humidity.

6. Solar energy systems

These are systems where the heat source of the refrigeration equipment is the heat from solar collector panels (Absorption systems; Trombe Wall, Solar stacks; PVs: Thermal Storage; Phase change)

1 Scope

This European Standard describes the common methodology for inspection of air conditioning systems in buildings for space cooling and or heating from an energy consumption standpoint. The inspection can consider for instance the following points to assess the energy performance and proper sizing of the system:

— System conformity to the original and subsequent design modifications, actual requirements and the present state of the building.

— Correct system functioning.

— Function and settings of various controls.

— Function and fitting of the various components.

— Power input and the resulting energy output.

It is not intended that a full audit of the air conditioning system is carried out, but a correct assessment of its functioning and main impacts on energy consumption, and as a result determine any recommendations on improvement of the system or use of alternative solutions.

NOTE Provision of adequate ventilation and system balancing are dealt with in prEN EPBD WI 30

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1886, *Ventilation for buildings — Air handling units — Mechanical performance*

EN 12599, *Ventilation for buildings — Test procedures and measuring methods for handing over installed ventilation and air conditioning systems*

EN 12792, *Ventilation for buildings — Symbols, terminology and graphical symbols*

EN 13779, *Ventilation for non-residential buildings — performance requirements for ventilation and room-conditioning systems*

EN 14511-1, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling — Part 1: Terms and definitions*

prEN EPBD WI 5, *Inspection of heating systems*

prEN EPBD WI 20/21, *Ventilation for buildings — Calculation methods for energy requirements due to ventilation-systems in buildings*

prEN EPBD WI 22, *Calculation methods for energy Efficiency improvements by the application of integrated building automation systems*

prEN EPBD WI 30, *Inspection of Ventilation Systems*

3 Terms and definitions

This clause presents the vocabulary used in this standard.

For the purposes of this Standard, EN 14511-1 together with the following definitions apply:

3.1
air conditioning system
a combination of all components required to provide a form of air treatment in which temperature is controlled, possibly in combination with the control of ventilation, humidity and air cleanliness

3.2
effective rated output for a building
sum of the individual rated cooling capacities of the included refrigeration systems in the building. The individual cooling capacity of a refrigeration system is the sum of nameplate ratings of the refrigeration units in the system, tested in standard conditions according to EN 14511

3.3
inspector
a person who has appropriate training or practical experience in energy inspection of air conditioning systems and associated regulations for energy, safety and health

3.4
building system control
the measures taken in ensuring the system operates in accordance with the specified conditions

3.5
commissioning
the sequence of events that ensure the building and the HVAC system are functioning in accordance with the design parameters

3.6
design criteria
a set of descriptions based on a particular environmental element such as indoor air quality, thermal and acoustical comfort, energy efficiency and the associated system controls to be used for assessing the plant operation

3.7
control parameters
the set values of the internal environmental conditions

3.8
design documentation
written descriptions of the essential design elements of the plant

4 Energy impacts of air conditioning, justification of inspection and improvements

Saving energy for air conditioning (cooling mode) are be based on the following:

1) Reduction of the cooling needs of the building
2) improving the system efficiency on the various stages :
    a. emission
    b. distribution
    c. generation.

According to Article 9 of the EPBD, advice is also to be provided to the users on “possible improvement or replacement of the air-conditioning system and on alternative solutions”.

In the inspection, attention should be paid also on the possibilities to save energy by other measures than those related to the system. Recommendations should, whenever appropriate, pay attention to these issues. Some of these are described in more detail in annex D. This chapter and annex D address mainly the cooling issues. Ventilation issues are presented in prEN EPBD WI 30, and heating issues in prEN EPBD WI 5.

5 Inspection methodology

The inspection shall begin with examination of the relevant design and system documentation and visual checks as far as possible to ensure that the equipment described is present and according to system specification. If the documentation is not available, then an additional part of this procedure is to locate the equipment and assemble a minimum portfolio of relevant documentation.

The minimum content for the information that should be available in readiness for the inspection is listed in annex A..

Report whether there is evidence of a regular inspection and maintenance regime carried out by recognised competent organisations. Comments on the frequencies and scope of maintenance of the air conditioning systems shall be covered in relation to national requirements and good practice, e.g. industry guidelines, This, and the dates of most recent maintenance may be referred to during the 'physical' inspection.

Where there is clear evidence that a good practice program of maintenance is being carried out, then certain aspects of the inspections described in this standard could be simplified or reduced.

When checking the performance of different parts of an air-conditioning system, the measurement methods employed will assist subsequent follow-ups. To make this possible, the instructions for each measurement method shall be followed and, if necessary, instruments for the measurements be calibrated.

Compare system sizes with likely loads. Annex B contains also simple procedures for assessing whether refrigeration systems and air supply systems are likely to be oversized.

Estimate the Specific Fan Power of the air movement systems whenever relevant, from the installed fan capacities and the flow rates, checked according to EN 12599, noted in the commissioning records. Check compliance to the target values specification according to EN 13779

(NOTE. extended table and annex on Specific Fan Power in prEN 13779 revision)

5.1 Pre-inspection and document collection

5.1.1 Documents

5.1.1.1 General

Prior to inspection the design criteria, system characteristics and the operational regime shall be determined. All available original documentation relating to the building and the installed systems shall be collected and assessed. Additional documentation, if it exists, indicating any modifications or alterations to the building, the systems or the use since the original documents, shall also be obtained and assessed.

5.1.1.2 Original design documentation.

The original design documents, which define design internal and external dry and wet bulb temperatures together with design occupancy, lighting loads, equipment loads and building loads such as solar and transmission, shall be checked against the present use.

5.1.1.3 System characteristics.

Working or as installed drawings shall be checked against the actual installation.

An equipment list shall be obtained or prepared.

The control diagram shall be checked.

If available, the commissioning data shall be obtained from the commissioning agent and checked against the present system.

5.1.1.4 Building and system operation and control regime.

The inspector shall determine the operational periods of the building and system, as well as the control zones and method of control throughout the building.

The inspector shall assess the maintenance records for the system and for individual items of the system.

The inspector shall check the building and system log book.

5.1.2 Building and system survey

Should insufficient or inadequate documentation be available to properly determine any of the requirements in 5.1.1, the inspector shall carry out a survey of the areas missing from the documentation. The inspector shall then determine, by calculation if necessary, the information required to assess the energy performance of the present system against the original design.

5.1.3 Subsequent inspections.

NOTE The documentation listed above and any survey or calculations carried out during the initial (first) pre-inspection should be filed so that they are available for subsequent inspections of the building and systems

5.1.4 Advice in case of outdated, incomplete or missing documentation

In existing buildings the design and system documentation may be incomplete or even missing. The existing documentation may be partly outdated, due to undocumented changes in the use, loads, construction elements or building services systems during the building's lifetime.

In these cases, the lacking or outdated documentation shall be identified (use the checklists given in Annexes A and B whenever relevant), and the inspector shall provide the user advice on how to develop a plan to complete the documentation, including a schedule ending up to full evaluation of the documentation, which may take place either before or during the next full inspection.

5.2 Methodology

5.2.1 Inspect refrigeration equipment

Plant environment: If installed as separate plant, inspect the general state of the refrigeration equipment and the space immediately around it. If the area is not clear and clean then it is unlikely that maintenance operations are regularly carried out. Does the area near the equipment (wherever installed) show signs of staining which may indicate refrigerant leakage. If present, check whether any attention to this is noted in the maintenance records.

Compressors: Locate the relevant refrigeration compressors. These are normally in the plant room (some centralised systems), in outdoor units (split and multi-split systems, and unitary air-cooled chillers) or in individual room units (distributed reversible systems). Check that these can be brought into operation.

Recording of measurements: Recording of any measurement available on the site can help in checking the functioning of the equipment, such as:

— suction and discharge pressure of compressor(s)

— refrigerant temperature at the inlet of the compressor / outlet of evaporator

— power input to the equipment

Generally these measurements are available on large units, either on the unit or via the system management for default detection.

Operating temperatures: In operation a temperature difference across the refrigeration compressor should be observed. Compared with the ambient temperature in the plant room (or indoors or outdoors), one side of the refrigeration circuit should become cold and the other warm while the compressor is working. These temperature differences should be apparent when flow and return water pipe work or refrigerant pipes to and from the refrigerant plant are touched or, better still, the temperatures measured using one or two surface temperature probes. If, while the refrigeration plant is operating, the flow and return appear to be at the same temperature, or warmer than the surroundings, then it is likely that the equipment has lost its refrigerant charge.

Refrigerant charge: If the refrigeration equipment includes a readily visible liquid sight glass, to show the state of the refrigerant in the system, this should be observed while the equipment is operating. If there is a reasonable difference between flow and return temperatures, but gas bubbles can be seen passing through the sight-glass, or a distinct liquid level line can be seen across the sight glass, then it is likely that there is and insufficient refrigerant charge in the system.

Refrigerant leak test
If any regulation requires periodic leak detection and repair, the inspector shall examine the documentation. In case there is no regulation, the refrigerant leak detection shall still be considered from the energy point of view.

Checking of the insulation of the refrigerant lines
A good insulation, especially on multi-split systems where lengths of refrigerant lines can be considerable, can have a great importance on the system energy efficiency of the system.

Vibrations and noise level
Too high vibrations and noise level of the equipment can be representing of an abnormal functioning of the unit. Refrigeration lines of split systems and air ducts shall also be checked.

5.2.2 Inspect for effectiveness of outdoor heat rejection

Locate and check the condition and operation of the outdoor heat rejection units.

If the heat rejection equipment is in an enclosure, check that this does not obstruct the flow of air to and from the equipment, and that there are adequate openings for the free passage of air into and out of the enclosure. Check that the openings are not themselves obstructed either by proximity to adjacent structures, or by damage or by debris build up.

Check that all heat exchanger surfaces are free from debris and grease and that the fins are undamaged.

Check for oily staining on direct expansion heat exchanger surfaces that might indicate refrigerant leakage. If present, check if this is noted in the maintenance records.

In operation, ensure the correct rotation and control of heat rejection fans.