

ABSTRACT: VENTILATION. 2006.

**The European Commission, Energy Performance of Buildings Directive,
and its
Ventilation Implications.**

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This paper considers the ventilation energy requirements of the EU Directive 2002/91/EC, [1] which EU member countries shall have implemented in their national legislation by the beginning of 2006. Unfortunately, in this document, industrial ventilation is not considered; nevertheless, an approach suitable for industrial ventilation is proposed.

The EU's energy consumption is estimated as being 20% higher than is economically justified. Case studies show that potential energy savings of 15-35% are possible with the correct approach. The directive aims to save annually an energy equivalent of at least 1% of the previous year's consumption. This providing an annual improvement in energy efficiency of 6% by 2012, also reducing CO₂ emissions to the requirements of the Kyoto protocol. To achieve this objective certain obstacles are considered.

The directive consists of a 23-paragraph introduction, followed by 15 articles, ventilation issues are dealt with in article 9.

The directive is linked to standardisation through CEN/TC 156, which deals with ventilation and energy issues. The individual standards of main interest in this are the guidelines for the mandatory Inspection and Testing of Air Conditioning and Ventilation Systems and Ventilation energy calculation methods. These issues, though useful for industrial ventilation applications, have shortcomings, as industrial pollutant concentrations and health effects are not considered.

Directive Article 7 requires energy performance certificates to be issued, creating many challenges relating to costs, competition, standard of experts, bureaucracy, comparability, target setting, cost effectiveness etc. The training of suitably qualified inspectors and independent experts is dealt with in Article 10.

Adequate energy statistics are freely available for domestic and commercial ventilation, but no known figures are accessible for industrial ventilation energy consumption. Development on the aims of the directive will overcome this short coming.

With modern industrial ventilation design methods, and energy efficient equipment, significant energy savings are possible.

1.0. Introduction.

Major changes regarding the use of energy are currently taking place within the European Union (EU). A new Directive to meet the requirements of the Kyoto protocol has been published in order to improve the energy performance of buildings. This applies to both new and, existing domestic and non domestic sectors.

In this paper, only the issues related to ventilation requirements and the external and internal environmental conditions with cost effectiveness in mind are covered

This Directive, the "Energy Performance of Buildings" (EPBD: - 2002/ 91/EC) [1] was launched by the European Commission on December 16th 2002. Under this directive, all 25 EU member states have had to prepare their own laws and regulations to meet the requirements of the directive by the 4th January 2006.

Energy consumption in the EU is estimated as being 20% higher than is economically justified. Case studies show that potential energy savings of 15-35% are possible, with the correct approach. The directive aims to save annually an energy equivalent of at least 1% of the previous year's consumption. This providing an annual improvement in energy efficiency of 6% by 2012, resulting in reduced CO₂ emissions.

In 2003, the then 15 Member States of the EU were about 20% on the way in meeting their 2010 Kyoto target in achieving an 8% decrease on the 1990 levels of greenhouse gas emissions. Had measures not been taken, these emissions are estimated to have been about 5% higher than they are today.

As the directive is mandatory for all member states; it has resulted in a frantic effort by all countries to produce a wide range of energy standards.

2.0. The Energy Performance of Buildings Directive (EPBD).

The directive consists of a 23-paragraph introduction, followed by 17 articles.

Briefly these articles cover the following issues:-

Article 1. The scope and objective of the document, its aims being to ensure free movement of products and provide environmental protection and improved security of energy supply it deals with .-

- Methods of calculation of the buildings integrated energy performance.

- Minimum energy performance of new buildings.

- Minimum energy performance of large existing buildings under major renovation
- energy certification of buildings.

- Energy certification of buildings

- HVAC plant inspection.

Article 2. The essential definitions and concepts involved in providing efficient environmental performance covering:-:

Buildings.

Energy performance of the HVAC and lighting plant relating to climatic aspects.

Energy performance certification of buildings

Combined heat and power.

Air conditioning systems.

Boiler systems.

Effective rated output.

Heat pumps.

Article 3. The Energy Performance Calculation method and the adoption of a methodology for Member States.

Article 4. Sets the energy performance requirements for buildings with certain exemptions.

Article 5. The energy saving measures necessary for new buildings having a useful floor area greater than 1000m² including:-

Minimum energy requirements of all new buildings.

Use of CHP.

Use of district heating or cooling.

Use of heat pumps.

Use of decentralised energy supply systems using renewable energy.

That new and existing buildings use a standard procedure for the calculation of energy performance for the ventilation, cooling, heating and lighting systems.

Article 6. Covers the minimum energy requirements of existing buildings having over 1000m² floor area that is under major renovation.

Article 7. This requires energy performance certificates to be issued relating to plant operation, creating many challenges relating to costs, competition, standard of experts, bureaucracy, comparability, target setting, cost effectiveness etc. Energy certification of all buildings valid for 10 years only.

Article 8. Deals with Boiler Inspection with the aim to reduce energy usage and CO₂ emission. Member States can either:-

Introduce mandatory regular inspection of boilers fired by fossil fuels that have an effective rated output > 20kW and of the heating systems of buildings more than 15 years old.

Provision of advice regarding the best practice for boiler maintenance, use and replacement.

Article 9. Inspection of air conditioning systems energy saving requirements in ventilation and air conditioning systems. Mandatory regular inspection of boilers (Article 8) over 20 kW and air conditioning plant over 12 kW, this will be almost relevant to non residential property. The associated inspection is to be carried out by competent persons.

Article 10. Training of suitably qualified inspectors and independent experts for the certification of buildings.

This issue presents major problems, as it is estimated that across the member states that some 20 000 inspectors are required for the commercial sector and 7000 for the domestic sector. The Directive requires all new and existing buildings to have an energy certificate available when they are constructed, sold or rented out. The Directive also stipulates that all buildings over 1000m², with either public sector occupiers or frequent public access must prominently display an energy certificate.

It is anticipated that building energy rating assessors will be drawn from existing building professionals (e.g. architects, engineers, surveyors, building services technicians) undergoing specialised Continuing Professional Development (CPD). It is estimated that the duration of the assessors' training course for residential buildings will be more than 1 week. Obviously, due to the complexity of non-residential buildings the training course will be longer.

The following buildings are exempt from the requirements of the EU Directive: -

- officially protected buildings and monuments.

- Places of worship.

- temporary buildings with a planned time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand and non-residential agricultural buildings which are in use by a sector covered by a national sector agreement on energy performance.

- Residential buildings which are intended to be used less than four months of the year.

- Stand-alone buildings with a total useful floor area of less than 50m².

As the Directive covers a vast range of buildings, implementing it in to the domestic and non-domestic sector will be extremely complex.

Article 11. Review of experience gained.

Article 12. Information by the Member States to inform building users of methods available to conserve on energy...

Article 13. Adaptation of the framework and review intervals.

Article 14. Committee assistance.

Article 15. Considers transportation.

Article 16. Entry into force of the mandate.

Article 17. Address to the Member States.

3.0. Supporting Standards.

Over the past decade considerable progress has been made in Europe, by CEN, (Comite Europeen de Normalisation) in the development of standards for heating, ventilation and air conditioning.

It is the CEN/TC 156 "Ventilation for Buildings" Standards that are related to our issue. It consists of the various working groups (WG) which have produced numerous standards in their respective topics.

WG 1. Terminology.

WG 2. Natural and Mechanical Powered Residential Ventilation.

WG 3. Ductwork.

WG 4. Air Terminal Devices.

WG 5. Air Handling Units.

WG 6. Design Criteria for the Indoor Environment.

WG 7. System Performance.

WG 8. Ventilation Test Procedures & Measuring Methods for Hand over.

WG 9. Fire Precautions for Air Distribution Systems in Buildings.

WG 10. Guidelines for the Inspection of Air Conditioning Systems.

WG 11. Guidelines for the Inspection of Ventilation Systems.

WG 12. Specification of Criteria for the Indoor Environment.

WG 13. Ventilation in Hospitals.

WG 14. Ventilation of Commercial Kitchens.

To deal with the rigid requirements of the mandate, new work items (WI) have become necessary within relevant CEN/TCs

In the case of CEN/TC 156, the following issues are being covered:-

WG7.WI...12. Dynamic Calculations, dealing with calculations of room temperatures and energy load for air conditioning systems. prEN 15243.

WG.7.WI. 18-19. Calculation of Air Flow. prEN 15242.

WG.7.WI. 20-21. Calculation of Ventilation Energy. prEN 15241.

WG.7.WI. 25. Revision of EN 13779 Ventilation for Non residential Buildings. Performance Requirements for Ventilation and Room Air Conditioning Systems.

WG 10. WI... 6. Inspection of Air Conditioning Systems Pr EN 15240 Inspection of Air Conditioning Systems This is related to Article 9 of the EPBD.

WG 11. WI...30. Inspection of Ventilation systems PrEN 15239 Guidelines to the Inspection of Ventilation Systems.

WG 12. WI. 31. Criteria for Indoor Environment. prEN 15251. .

Unfortunately the industrial ventilation field is dealt with in a very fragmented way in CEN, the nearest applicable being CEN/TC 156.

Other associated TCs that have been influenced by the directive are:-

TC /89. Thermal Performance of Buildings and Building Components.

TC 169. Light and Lighting.

TC 228. Heating Systems in Buildings.

TC 247. Building Automation, Controls and Building Management.

Further European work in the setting of Guidelines for Industrial Ventilation is carried out by:-

INVENT which was supported by the EU COST G3 Action.[2]

The Federation of European Heating and Air Conditioning Associations.

(REHVA). [3]

Some discrimination is necessary between residential and non-residential buildings and possibly within the diversity of non-residential buildings (e.g. hotels, offices, schools, retail, catering, and hospitals). Some countries exclude industrial applications completely from their National EPBD documentation,

Rather than getting deeper involved in the wide scope of the Mandate, the aspect to be considered is that of some of the issues involved in the Ventilation and Air Conditioning Inspection requirements.

4.0. Inspection of Ventilation and Air Conditioning Plant.

The aspects of inspection are common to Guidelines for the Inspection of Air Conditioning systems (prEN 15240, prepared by CEN/TC 156 WG 10).and. Guidelines

for the Inspection of Ventilation Systems. (prEN 15239, prepared by CEN/TC 156/WG 11).

To ensure the terminology and symbols used are common to all the documents. Both the above documents have as an introduction the common terms and definitions relating to those in CEN /TC 156 WG 1 document EN 12792. Note:prEN 15240 and prEN 15239, as well as all other standardisation projects within CEN/TC 156 under the EPBD Mandate, were on CEN Enquiry in 2005. During the time of writing of this paper, revision of the drafts is still going on taking into account a substantial number of comments from CEN member bodies. All presented features and extracts of the drafts are subject to change and are presented here for information only, not for further quotation or distribution.

4.1 Inspection Methodology.

Inspection starts with the examination of relevant documentation, followed by visual checks to ensure that the equipment specified is correctly installed.

If documentation is unavailable or is of poor quality, problems will be encountered in commencing the survey. The inspector shall carry out an assessment of the areas of missing, incomplete or outdated data, and deficiencies made good. The shortcomings shall be identified see Annexes A and B.

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

Report on evidence of a regular inspection and maintenance regime carried out by recognised competent organisations. Comment on the frequency and scope of maintenance of the air conditioning systems in relation to national requirements and good practice, e.g. industry guidelines.

This and the dates of most recent maintenance should be considered during the physical inspection.

Compare system plant sizes with likely loads. Annex B provides a simple approach for assessing whether the refrigeration system and air supply systems are oversized.

Assess the Specific Fan Power using installed fan capacities and flow rates, checked according to EN 12599; this is to be noted in the commissioning records.

The results are compared with the initial operating installation and its current energy use is to be followed, if necessary by calculation to determine if the energy performance compares with that of the original design.

The relationship of the internal and external design temperatures to the heat gains and losses and the fresh air requirements are to be compared. Any modifications made to these must be included in the future documentation.

The inspector is to agree the operating periods of the associated HVAC system, together with the control zones and control methods throughout the building.

The inspector is to suggest a suitable approach with a schedule of documentation, which may take place before or during the next full inspection. The information should provide at a minimum the following system characteristics.

- Type of air conditioning system installed.

- Its cooling and heat rejection capacity.

- Method of control.

- All operational and spares documentation.

- Building and HVAC log books.

The following provides a few areas to be investigated during the inspection of ventilation and air conditioning systems.

4.2 Ventilation Loads.

The recommended mechanical ventilation air flow rates, for domestic and commercial premises are covered in WI 30.

Where cooling systems are used in spaces with access to opening windows, the building owner / manager is to inform the occupants that windows should normally be closed (trickle vents should be open at all times) . The energy cost that open windows represent should be discussed with the occupants.

Consider installing interlocks between windows and cooling equipment.

Reduction in the input and extract fans air flow quantity can be achieved by improved design by considering:-

- Heat recovery and demand control ventilation.

- Reduction in the buildings cooling and heating requirements achieved by improved thermal insulation, solar protection and thermal mass considerations.

- Reduction in solar gain by window shading. **Note:** this may increase the lighting energy requirements.

Improving system efficiency by the correct control of emissions, distribution and generation.

Reducing infiltration and exfiltration.

Full use should be made of un-tempered 100% outdoor air when ever the air temperature is lower than the indoor air temperature.

Increasing the ventilation rate is advantageous in reducing the cooling load however the influence of this on fan energy requirements must be considered.

It is essential the outdoor air flow rate is maintained at the minimum hygienic value when its temperature is higher than the indoor air temperature, during times of building cooling.

As the heating and cooling overall efficiency is related to the operating characteristics and the selected methods of control this can be improved by considering and enlarging on the items covered in Table 1:

Emission	Distribution	Generation
Reduce the usage time.	Improving the quality of thermal insulation on plant, ductwork and pipe work	Ensuring the system is correctly sized, an oversized cooling system has a reduced performance.
If possible only use cooling when the indoor temperature exceeds 25°C.	Operate with an increased chilled water temperature (if possible).	Any savings made by solar and internal gain reduction, may result in an inefficient operating plant.
Reduce the latent energy requirements by using a higher cooling coil temperature.	Use variable speed motors to reduce pump and fan energy requirements.	Consider the influence of part load plant behaviour; these problems may be overcome by installing a water storage tank (buffer) between the distribution network and the generation system.
Ensure the heating and cooling plants are not operating against each other.	Switch off plant when cooling is not required.	The generation system should be closed off when cooling is not required.

TABLE 1. TYPICAL AREAS OF CONSIDERATION

Inspection requirements.

The inspection includes: -

Certification. The thorny problem of certification throughout the EU must be considered in full to ensure equal playing fields for all countries. The numbers of suitably qualified inspectors, who must be trained, presents a major problem. It has been estimated that to meet the inspection demands in the EU, some 20 000 experts are required for the commercial sector and 7000 for the domestic sector.

Existing Buildings/Installations Checks.

Poor plant operation may be due to many reasons, typical being:-

- Bad design/ installation/

- Control failure.

- Poor maintenance or modifications

- System not correctly designed or documented.

- Initial design documents should be available and must include any modifications made during the design/installation process.

- Installation and initial tuning:

 - Functional performances testing

 - System failures

 - Poor testing adjusting and balancing

 - Fault detection diagnosis can be performed at different levels of accuracy.

 - Building optimization, adaptation to changes in building uses or modifications

 - Provide advice on beneficial energy / operating improvements

 - Solar shading, fixed or movable.

 - Co-location and separate treatment of shared equipment

 - Consider repositioning heat generating plant away from general work areas, to external rooms where heat gains can be removed by opening windows or by simple extract ventilation.

Consider alternative cooling techniques.

Considerable savings are possible by the use of cooling towers for free cooling during the spring and autumn.

If combined heat and power systems are used, consider absorption cycle refrigeration.

Inspect Air Delivery and Extract Systems.

Check and record the frequency of filter changing or cleaning, and time since last service.

Ensure the differential pressure gauge fitted across the filter is operating.

Examine the condition of and effectiveness of heat exchangers.

Note the fan type and control methods used.

Locate the outdoor inlets and outlets.

Check and comment on obstructions or blockages to inlet grilles, screens and pre-filters,

Comment if inlets are in close proximity to local sources of heat, or to air exhausts.

Inspect Control System.

Trace and inspect the essential HVAC controls together with the suitability and location of their associated temperature sensors.

If the function of these is related to the Building Management System (BMS), the correct functioning should be demonstrated.

Re-evaluate documentation and / or the site layout to determine the heating and cooling control zones.

Relate the zoning arrangements to factors such as internal gain, orientation and solar gain.

Check the timing of on/off controls to ensure the correct clock settings and if they suit the requirements.

Energy Consumption Metering.

It is essential that energy metering is carried out with due care in a professional manner.

Energy input meters must be checked for accuracy.

If the energy consumption is recorded annually, it may be possible to determine from the rated input power the periods the plant has been in operation.

If meters are installed but no consumption records are available, the inspector should record and date all necessary meter readings.

This information should be given to the building owner or manager, and advised to record regular meter readings.

If no fixed metering is available, the building owner or manager should be recommended to install appropriate metering...

Reporting.

This includes details of the system/s inspected covering the physical description, inspected equipment inventory, plant location together with the frequency and duration of the inspections.

The inspection reports should be prepared and signed by the assessor and is to include:-

The address/ and other property details.

The buildings administrator.

Date and time of inspection.

Assessors name, affiliation, status and approval by which accreditation body.

List of the documents provided.

Documents to Include:-.

All measurements or calculations undertaken.

Systems operating efficiency specified and recorded.

Faults identified to be commented on and where suitable remedial action proposed.

Propose any improvements that can be made to the plants maintenance schedule.

Comment on the controls and control settings suggesting possible improvements.

Comment on the size of the installed system in relation to the thermal loads and propose improvements.

Suggest alternative solutions.

Summary of the findings and recommendations...

Inspection Frequency and Duration.

The frequency of inspections is specified by National Regulations, carried out during the cooling and heating season. The frequency depends on: building type, use and. plant components. Several EU Member States have planned to limit the mandatory inspection to a certain minimum. The standards, however, will leave the door open and give guidance to a more frequent and/or more extensive voluntary inspection.

The inspection assists the administrator on the best approach for improved system maintenance, setting its frequency and the necessary maintenance to overall energy use.

The time required for inspection obviously depends on the building system, size, age, building type, time since last inspection, quality of documentation and the standard of maintenance. This may vary from one day to many weeks and if it is necessary to shut the plant down.

Annex A of the prEN 15240 gives a checklist for pre inspection, while Annex B provides Informative advice from which a comprehensive inspection can be formulated. For complex systems further checks may be necessary.

The extracts from these Annexes are from the CEN enquiry stage and changes are now underway to incorporate the comments received.

Annex A (informative) Checklist of pre-inspection information.

Information required		Present Y/N
1	Itemised list of installed refrigeration plant >12kW rated output, with locations of the indoor and outdoor components of each plant.	
2	Description of system control zones.	
3	Description of method of control of temperature.	
4	Description of method of control of periods of operation.	
5	Records of maintenance to refrigeration systems, including cleaning indoor and outdoor heat exchangers, refrigerant leakage tests, repairs to refrigeration components or replenishing with refrigerant.	
6	Records of maintenance to air delivery systems, including filter cleaning and changing, and cleaning of heat exchangers.	
7	For relevant air supply and extract systems, commissioning results of measured absorbed power at normal air delivery and extract rates and commissioning results for normal delivered delivery and extract air flow rates (or independently calculated Specific Fan Power for the systems).	
8	An estimate of the design cooling load for each system (if available). Otherwise, a brief description of the occupation of the cooled spaces, and of power consuming equipment normally used in those spaces.	
9	Energy consumption counters; location, target values for consumption, records of consumption, compared measured vs. target consumption.	

Annex C (informative)

Example of categories of documentation and information about the system

Information required			Present Y/N
ESSENTIAL	CHK 1	Itemised list of installed refrigeration plant >12kW rated output, with locations of the indoor and outdoor components of each plant.	
	CHK 2	Description of system control zones.	
	CHK 3	Description of method of control of temperature.	
	CHK 4	Description of method of control of periods of operation.	
DESIRABLE	CHK 5	Records of maintenance operations carried out on refrigeration systems, including cleaning indoor and outdoor heat exchangers, refrigerant leakage tests, repairs to refrigeration components or replenishing with refrigerant.	
	CHK 6	Records of maintenance operations carried out on air delivery systems, including filter cleaning and changing, and cleaning of heat exchangers.	
	CHK 7	Records of calibration and maintenance operations carried out on control systems and sensors, or BMS systems and sensors.	
	CHK 8	Floor plans and schematics of air conditioning systems.	
OPTIONAL	CHK 9	For relevant air supply and extract systems, commissioning results of measured absorbed power at normal air delivery and extract rates and commissioning results for normal delivered delivery and extract air flow rates (or independently calculated Specific Fan Power for the systems).	
	CHK 10	An estimate of the design cooling load for each system (if available). Otherwise, a brief description of the occupation of the cooled spaces, and of power consuming equipment normally used in those spaces.	

ANNEX B. (INFORMATIVE).

Note:

The following represents a few of the typical proposals, intended to assist in the Inspection of Ventilation and Air Conditioning Plants.

Checklists indicating observations and appropriate actions or advice

1. Checklist for system documentation (5.1)

	Assessment topic	Advice
	Review available documentation.	If missing or unsatisfactory then certain basic information will need to be prepared. See separate checklist for preparation of information.
	Locate relevant plant and compare details.	Prepare revised information as necessary.
	Review current inspection and maintenance regime.	Recommend industry norm maintenance schedules.
	Compare system size with imposed cooling loads.	If oversized, recommend further investigation or replacement when appropriate.
	Estimate Specific Fan Power of relevant air movement systems.	If commissioning air flow and fan power rates are not available, recommend that these are measured and compared to current recommendations (see WI 20/21 and/or EN 13779), and if higher than recommended then seek for the reason during inspection.

2. Checklist for outdoor heat rejection equipment (5.2.2)

	Assessment topic	Advice
	Visual check of the condition and operation of outdoor heat rejection units.	Note whether units have adequate free access to outdoor air. Recommend removal of debris, or increasing openings in enclosures, as appropriate.
	Check for obstructions to airflow through heat rejection heat exchangers.	Recommend cleaning or repair as appropriate.
	Check for signs of refrigerant leakage.	Visual signs of refrigerant leakage should be noted and, if present, evidence of attention to any leakage sought. If this has not been attended to, then recommend prompt skilled maintenance.
	Check for the correct rotation of fans. If possible, observe the modulation of multiple fans in response to load changes.	Note whether fan rotates in the correct sense, and whether.

3. Checklist for air delivery systems in treated spaces (5.2.4)

	Assessment topic	Advice
	Review air delivery openings, grilles or diffusers, and route by which air is extracted from the spaces.	
	Review any evidence that occupants find the air delivery arrangement unacceptable.	If present, recommend more detailed assessment by ventilation specialist.
	Assess the positioning and geometry of air supply openings in relation to extract openings.	Note where there may be potential that air might short-circuit from supply to extract. If suspected, this might be checked visually using a smoke-pencil.

4. Checklist for air delivery systems in air handling units and ducts (5.2.5)

	Assessment topic	Advice
	Review filter changing or cleaning frequency.	Recommend adopting good practice industry guidance on cleaning and replacement if not in place.
	Assess the current state of cleanliness or blockage of filters.	Recommend replacement if appropriate, and adopting good practice industry guidance on cleaning and replacement.
	Note the condition of filter differential pressure gauge.	Recommend rectification if inoperable.
	Assess the fit and sealing of filters and housings.	Recommend skilled maintenance if visibly poorly fitted.
	Inspect heat exchangers for damage, or significant blockage by debris or dust.	Recommend cleaning or skilled maintenance as appropriate.
	In addition inspect refrigeration heat exchangers for signs of refrigerant leakage.	Visual signs of refrigerant leakage should be noted and, if present, evidence of attention to any leakage sought. If this has not been attended to, then recommend prompt skilled maintenance.
	Note fan type and method of air speed control.	Compare with current good practice and identify opportunities for improvement.

Certification scheme documentation.

The certification scheme applies to:

	Rent	Sales	Public buildings
Single family houses.			
Apartment block.			
Offices.			
Education buildings.			
Hospitals.			
Hotels and restaurants.			
Sport facilities.			
Wholesale and retail trade service buildings.			
Other types: give details.			

The following uses of energy are taken into account in the certification scheme:-

Space heating.	
Space cooling.	
Mechanical ventilation.	
Hot water.	
Lighting.	
Energy production, in particular by renewable sources and co-generation.	
Other: í í í í í í í í í í í í í í í í .	

The indicator represents:

Primary energy.	
Delivered energy.	
CO ₂ emission.	
Cost.	

The energy performance classes are the followings

Name.	Minimum.	Maximum.
A		
B		
C		
D		
E		
F		
G		
Others? give details.		

The certificate include recommendations chosen among the followings

Conclusion.

This paper is presented before approval of the standards to support the EPBD; hence it does not accurately reflect the final ideas.

From the above it will be appreciated that the new European EPPD presents major challenges to current work practices in the ventilation industry. Each of the above mentioned issues is capable of providing a paper in its own right.

Many of the issues covered above are applicable to the voluntary inspection of industrial ventilation systems.

REFERENCES.

[1] Directive 2002/91/EC of the European Parliament and of the Council 16th December 2002. Energy Performance of Buildings.

[2] EU COST G3 Action Leading to the publication of the Industrial Ventilation Design Guidebook Edited by Howard Goodfellow and Esko Tahti Academic Press.

[3] The Federation of European Heating and Air Conditioning Associations. (REHVA), are publishing application Guides on Ventilation.