ENPER-EXIST

Applying the EPBD to improve the Energy Performance Requirements to Existing Buildings – ENPER-EXIST

WP1: Usability of CEN Standards for existing buildings. An analysis

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ENPER-EXIST project information

The ENPER-EXIST project was initiated and is coordinated by the Centre Scientifique et Technique du Bâtiment (CSTB) in the frame of the Intelligent Energy Europe (EIE) programme in the part SAVE of the European Commission, DG TREN. It involves partners from 7 countries on the topic of energy performance standardization and regulation. Contract EIE/04/096/S07.38645. Duration: 01/01/2005 - 30/07/2007.

The Energy Performance of Building Directive (EPBD) sets a series of requirements specifically dedicated to existing buildings but the member states are facing difficulties to implement quickly these requirements. The main goal of the ENPER-EXIST project is to support the take off of the Energy performance of building directive (EPBD) in the field of existing buildings.

ENPER-EXIST has 4 main objectives:

1. To de-fragment technical work performed on existing buildings. Indeed actions already launched in CEN to apply the EPBD are de-fragmented but mainly focus on new buildings. On the other hand different projects on certification procedures are going on at the European level but are not coordinated.
2. To de-fragment work on legal, economical and organisational problems such as the analysis of certification on the market, the human capital and the national administrations.
3. To achieve a better knowledge of the European building stock.
4. To define a roadmap for future actions regarding existing buildings.

ENPER-EXIST uses an intensive networking of existing national and international projects to reinforce efforts to solve these issues. It works in close coordination with the Concerted Action set up by Member States to support the application of EPBD. The work program is split in 4 technical work packages in addition to dissemination and management activities.

WP1: Tools application
WP1 analyses how existing buildings are taken into account in technical tools such as CEN standards, national calculation procedures. Recommendations on how to improve the consideration of existing building are be defined.

WP2: Legal economical and organisational impact
WP2 analyses the impact of the certification procedures and regulations of existing buildings on the market, on the human capital and on the national administration. Surveys are carried out in the different member states and recommendations are drawn up.

WP3: Building stock knowledge
WP3 analyses the level of information available in each country regarding the existing building stock. A procedure enabling to refine this information and ways to use the certification procedure as a tool to collect data regarding this stock is developed.

WP4: Roadmap
An overview of possible legal measures for existing buildings is written. Indications are given about alternative strategies to improve on a wide scale the energy efficiency of existing buildings. Possibilities (including pro's and cons) to widen the scope of the EPBD in case of a future revision of the requirements of the directive are described.

A website, newsletters and workshops enable a strong interaction between ENPER-EXIST and different interest groups and a wide dissemination of ENPER-EXIST results. The workshops are organised with the different actors involved in the application of the EPBD.More information on the project website: www.enper-exist.com

Table of contents

ENPER-EXIST project information 3

Table of contents 4

Executive Summary 7

1. Introduction 12

2. prEN ISO DIS 13790 (WI 14) “Energy performance of buildings – Calculation of energy use for space heating and cooling” 14

- 2.1 Introduction 14
  - 2.1.1 Content of the standard 14
  - 2.1.2 Main output variables of the standard 14
- 2.2 Analyses of the standard 15
  - 2.2.1 Introduction 15
  - 2.2.2 Detailed simulation methods 15
  - 2.2.3 Monthly quasi-steady state calculation method and simple hourly calculation method 15
  - 2.2.4 Influencing factors and input parameters 16
- 2.3 Conclusions and recommendations 20

3. prEN 15242 (WI 18/19) “Ventilation for buildings – calculation methods for the determination of air flow rates in buildings including infiltration” 21

- 3.1 Introduction 21
  - 3.1.1 Content of the standard 21
  - 3.1.2 Main output variables of the standard 21
- 3.2 Analysis of the standard prEN 15242 22
  - 3.2.1 Introduction 22
  - 3.2.2 General comments 22
  - 3.2.3 Instantaneous (implicit) method: 22
- 3.3 Simplified (explicit) method: 26
- 3.4 Conclusions 26

4. prEN 15241 (WI 20/21) “Ventilation for buildings – calculation methods forenergy losses due to ventilation and infiltration in commercial buildings” 27

- 4.1 Introduction 27
  - 4.1.1 Content of the standards 27
  - 4.1.2 Main output variables of the standards 27
- 4.2 Analysis of the standard prEN 15241 28
  - 4.2.1 Introduction 28
  - 4.2.2 General comments 28
  - 4.2.3 Hourly or monthly or yearly method 28
  - 4.2.4 Statistical method 30
- 4.3 Conclusions 31

5. prEN 15316-3-2 (WI 11) “Domestic hot water systems. Part 3-2. Distribution” 32

- 5.1 Introduction 32
  - 5.1.1 Objective 32
  - 5.1.2 Method 32

5.2 Analysis of the standard 33
5.2.1 Introduction 33
5.2.2 Result Output variables 34
5.2.3 Hot water demand input variables 35
5.2.4 Parameter input for distribution pipe losses 36
5.2.5 Parameter input for distribution losses of circulation system (5.6) 42
5.2.6 Auxiliary energy 45
5.3 Conclusions and recommendations 47
5.3.1 Distribution pipe losses: 47
5.3.2 Circulation pipe losses 48
5.3.3 Auxiliary energy loss 48

6. prEN 15316-3-3 (WI 11) “Domestic hot water systems. Part 3-3. Generation” 50

6.1 Introduction 50
6.1.1 Objective 50
6.1.2 Method 50
6.2 Analysis of the standard 51
6.2.1 Introduction 51
6.2.2 Result output variables 52
6.2.3 Hot water demand input variables 53
6.2.4 Parameter input for storage heat losses (4) 54
6.2.5 Primary circulation pipes (5) 55
6.2.6 Heat generation losses 59
6.3 Conclusions and recommendations 62

7. prEN 15316-1 (WI 7) “Heating systems in buildings. Method for calculation of system energy requirements and system efficiencies. Part 1. General” 63

7.1 Introduction 63
Objective 63
7.2 Method 63
7.3 Analysis of the standard 64
7.4 Conclusions and recommendations 64

8. prEN 15193-1 (WI 13) Energy performance of buildings – Energy requirements for lighting – Part 1: Lighting energy estimation. 65

8.1 Introduction 65
8.1.1 Content of the standard 65
8.1.2 Main output variables of the standard 65
8.2 Analyses of the standard 66
8.2.1 Introduction 66
8.2.2 Metering 67
8.2.3 Quick method 67
8.2.4 Comprehensive method 67
8.3 Conclusions and recommendations 69

9. prEN 15316-4-1 (WI 9) “Space heating generation systems – Combustion systems” 70

9.1 Introduction 70
9.1.1 Content of the standard 70
9.1.2 Main output variables of the standard 70
9.2 Analyses of the standard 71
9.2.1 Introduction 71
9.2.2 Typology method: 71
9.2.3 Case specific boiler efficiency method 74

9.2.4 Boiler cycling method ... 76
9.3 Conclusions and recommendations ... 78

10. prEN 15217 (WI 1 + 3) “Energy performance of buildings – Methods for expressing energy performance and for energy certification of buildings” ... 79

10.1 Introduction ... 79
10.2 Respondents ... 80
10.3 Results in detail ... 81
10.3.1 Application domain of the scheme ... 81
10.3.2 Basis of the rating ... 82
10.3.3 Classification ... 84
10.3.4 Classification adaptation ... 86
10.3.5 Reference values ... 87
10.3.6 Certificate format ... 88
10.3.7 Recommendations ... 88
10.3.8 Experience with the certification scheme ... 90
10.4 Main results ... 91

Annex A: Comment sheets to CEN: prEN ISO DIS 13790 (WI 14) “Energy performance of buildings – Calculation of energy use for space heating and cooling” ... 92

Annex B: Comment sheets to CEN: prEN 15242 “Ventilation for buildings – calculation methods for the determination of air flow rates in buildings including infiltration” ... 99

Annex C: Comment sheets to CEN: prEN 15241 “Ventilation for buildings – calculation methods forenergy losses due to ventilation and infiltration in commercial buildings” ... 104

Annex D: Comment sheets to CEN: prEN 15316-3-3 “Domestic hot water systems. Part 3-3. Generation” ... 107

Annex E: Annexes of chapter 9 ... 109

E1. Typology method ... 110

E2. Case specific boiler efficiency method ... 116

E3. Boiler cycling method ... 122

E4. Explanation of terms used in this document ... 129

Annex F: Questionnaire Energy Performance Certification Scheme ... 131

Executive Summary

The CEN working groups have done a tremendous job to deliver a huge amount of EPBD CEN standards to guide the implementation of the EPBD in the member states. Because of lack of time and priority it has been inevitable that most of the working groups had more focus on new than on existing buildings. ENPER Exist has jumped into this gap and has provided assistance to the EPBD CEN standards.

Within ENPER Exist various courses have been taken to provide this assistance:

- The expert knowledge of the participants of the project is used to analyse the most important CEN standards. This has been a desk research.
- The usability of the CEN standards on existing buildings has also been tested in practice in a pilot test which focussed on the gathering of the input data.
- The third practical test has been the performance of some detailed calculations with the CEN standards.
- The knowledge of the developers of existing EP methods for existing buildings (on national level and on EU level) is used to find alternative solutions for gaps which were found in the previous tasks.

This document provides the knowledge gained by the analyses of the most important CEN standards. The analysis has taken place in the spring and summer of 2005.

The conclusions per analyses standard are described below. Our comments on the standards have been reported to the relevant CEN working groups partly via the Enper Exist partners which are members of these working groups and partly via official comments sheets in formal the public enquiry of the standards (Because of the timing of the availability of the results and the public enquiry period it has not been possible to submit all comments in the form of formal comment sheets).

prEN ISO DIS 13790 (WI 14) "Energy performance of buildings – Calculation of energy use for space heating and cooling"

This standard gives a calculation method which can be used for existing buildings provided that for various input parameters a list with default values shall be given. These lists should contain defaults for various typologies, building functions and/or different construction dates. Because of the large differences between countries, these lists have to be produced on national level.

Furthermore some aspects need to be simplified for existing buildings. This concerns thermal bridges, solar shading by obstructions, the effect of adjacent unconditioned spaces and the effect of sunspaces. The influence of aging shall be taken into account somehow for glazing.

prEN 15242 (WI 18/19) "Ventilation for buildings – calculation methods for the determination of air flow rates in buildings including infiltration"

The standard for calculating the ventilation flow contains an implicit method and simplified explicit method:

- Our conclusion is that the implicit method described in the standard, although being a rather detailed method, could in principle be used also for existing buildings in case of a quick inspection where no detailed information is available. We have formulated suggestions to modify the standard to accommodate the situations where some detailed data are needed that may not be available from a quick inspection of an existing building.

  Because of the huge amount of simplifications in the input, it becomes questionable whether this rather detailed method is better than a 'statistical' method as allowed for in prEN 15241.
- The simplified explicit method has no advantages and only disadvantages for application.

As an alternative, a 'statistical' method as allowed for in prEN 15241 seems to be a more practical simplification.

prEN 15241 (WI 20/21) "Ventilation for buildings - Calculation methods for energy losses due to ventilation and infiltration in commercial buildings"

The standard differentiates hourly, monthly, yearly or statistical methods.

Our conclusion is that the hourly, monthly or yearly method could in principle be used for existing buildings in case of a quick inspection where no detailed information is available. We have formulated suggestions to modify the standard to accommodate the situations where some detailed data are needed that may not be available from a quick inspection of an existing building.

The hourly method may lead to the suggestion of being an accurate method, while the main input data are not accurate at all. The alternative of a monthly or yearly method could be an option, although for such calculation it is not clear how to deal with e.g. defrosting.

The option in prEN 15241 of a statistical approach to be applied at national level seems to be a good and practical approach for existing buildings. It gives sufficient freedom to develop a national method with national default and/or typical values where needed.

It would however not make sense to apply a statistical method on the system characteristics, and an implicit calculation of the air flow rates according to prEN 15242 (se above). Therefore, we recommend to explicitly add in prEN 15242 the similar option of a statistical approach to be applied at national level.

prEN 15316-3-2 (WI 11) "Domestic hot water systems. Part 3-2. Distribution"

The standard contains methods for distribution pipe losses, circulation pipe losses and auxiliary energy losses.

Conclusions regarding distribution pipe losses:

Four methods to determine distribution pipe losses (based on dwelling area, on delivery pipe lengths - simple method and tabulated data method and tapping profiles) are basically comparable and might be united in one form. As a result required input parameters for existing buildings may have different levels of detail, where little detail will cause default and sometimes higher distribution losses and more details allow more accurate and sometimes lower distribution losses.

Recommended is to harmonize the methods and to determine national/European table values for the heat loss factor / distribution pipe efficiency of distribution pipes for different lengths and diameters.

Conclusions regarding circulation pipe losses

The two methods to determine circulation system losses are basically comparable and might be united in one form. As a result required input parameters for existing buildings may have different levels of detail, where little detail will cause default and sometimes higher circulation system losses and more details allow more accurate and sometimes lower circulation system losses.

Recommended is to harmonize the methods and to determine national/European table values for the heat loss factor of (un)insulated circulation pipes for different diameters.

Conclusions regarding auxiliary energy loss

Ribbon heating is not very common. Power consumption is depending on many factors hard to establish in practise quickly.

For circulation pumps the simplified method is suitable for existing installations and the required inputs are mostly easy to obtain. The detailed method is less suitable for existing buildings.

Recommended is not to invest time in ribbon heating methods yet. Use the simplified method for circulation pumps. In case no data on pump power is available a (national) default value is required, for instance relating pump power to hot water demand.

prEN 15316-3-3 (WI 11) “Domestic hot water systems. Part 3-3. Generation”

The structure in the standard is not clear enough.

In general for the large systems with separate storage, circulation pipes and generators and for the complete systems in dwellings, too little input data will be available to calculate heat losses.

Recommended is to make a clear distinction between large systems with separate storage, circulation pipes and generators on the one hand and complete systems, including combi-boiler systems, in general for dwellings on the other hand is required. For the large systems with separate storage, circulation pipes and generators default heat loss data is required in (national) annexes, depending on easy to establish typology. For the complete systems in dwellings default heat loss data is required in (national) annexes, depending on easy to establish typology.

prEN 15316-1 (WI 7) “Heating systems in buildings. Method for calculation of system energy requirements and system efficiencies. Part 1. General”

The structure and content of the standard is clear. This standard doesn't contain any calculation method on specific installation components, so this standard doesn't require any input itself.

prEN 15193-1 (WI 13) "Energy performance of buildings – Energy requirements for lighting – Part 1: Lighting energy estimation"

This standard is one of the few standards which is made with a clear focus on metered values in existing buildings. This has resulted in the development of the quick method, which indeed is easy to use for existing buildings, but with less accuracy. The usability will be increased with the development of a calculation approach or a database with declared rated installed powers for various lighting and daylighting systems.

To be able to use the comprehensive method in an efficient way, it should be possible to choose per component (parasitic power, daylight impact, operation hours, etc) default values or a simple estimation method.

There is a strong lack of harmonisation with the thermal standards supporting the EPBD. The standard need an intensive revision before it could be implemented in an overall calculation procedure.

prEN 15316-4-1 (WI 9) "Space heating generation systems – Combustion systems"

Our main believe is that for existing buildings simple tables are preferred.

The typology method could be the basis to build a table with single efficiencies. This table could be easily used and will be very well adapted to existing buildings.

It is desirable to have a common procedure to derive the tables. It could also be desirable even to derive common tables.

An important question is: What should be the length of the table? Should it be a database like the UK database (www.sedbuk.com) or should it be a short table with data clustered by categories (like the tables in annex P of WI 5, the prEN about 'Inspection of boilers'). The possibilities of a European database is a subject for the ENPER-Exist Roadmap (WP 4).

The standardisation committees or future research work should look for the relative impacts of boiler sizing, boiler operation and boiler aging and solutions on how to consider them in simple methods applicable to existing buildings.

prEN 15217 (WI 1 + 3) "Energy performance of buildings – Methods for expressing energy performance and for energy certification of buildings"

To get an impression on the plans of the different Member States regarding the content of the energy certificate, the proposed indicator, the performance scales and the classification of recommendations for cost-effective improvement, a small study has been performed regarding the standard on the certification scheme (prEN 15217). This standard contains an annex which is intended to be used by national bodies setting up a certification scheme to document this scheme. This annex was send as a questionnaire to the partners of the project and some other contacts outside to project. The results of this study are given in this report. Note that a huge step has been taken in the period between this study and the publication of this report, so the results will be partly outdated.

1. Introduction

Within ENPER Exist a lot of work has been done to test a selection of the most important CEN standards to see if they are suitable for the existing building practice. This report describes the analysis of the most important CEN standards on EPBD. Objective of this analysis is to find gaps between the CEN standards and the existing building practice from the expert point of view. On various points problems with the methods have come forward and suggestions are given to solve the problems based on the experience of the experts involved in the project.

Within the scope of this project a selection of the most important CEN EPBD standards has been made. CEN standards on heating and cooling dement, ventilation, lighting, heating systems and hot water systems are considered. To be more precise, problems within the following CEN standards are discussed:

- prEN ISO DIS 13790 (WI 14) “Energy performance of buildings – Calculation of energy use for space heating and cooling”
- prEN 15242 (WI 18/19) “Ventilation for buildings : calculation methods for the determination of air flow rates in buildings including infiltration”
- prEN 15241 (WI 20/21) “Ventilation for buildings : calculation methods for energy losses due to ventilation and infiltration in commercial buildings”
- prEN 15316 3-2 (WI 11) “Domestic Hot water system part 3-2 : Distribution”
- prEN 15316 3-3 (WI 11) “Domestic Hot water system part 3-3 : Generation”
- prEN 15316-1 (WI 7) “Heating systems in buildings. Method for calculation of system energy requirements and system efficiencies. Part 1. General”
- prEN 15193-1 (WI 13) “Energy performance of buildings – Energy requirements for lighting – Part 1: Lighting energy estimation”
- prEN 15316-4-1 (WI 9) “Space heating generation systems. Combustion systems”

The results of these analyses are given in chapter 2 to 9.

Missing in this list of important standards are the cooling system standards, which are especially important for Southern Europe member states. These standards could not be taken into account because at the time of analysing the standards the level of development of these standards was too minimal to say something relevant about the usability for existing buildings.

The focus has been mainly on standards which do not have a particular existing building focus on itself. One exception has been made: To get an impression on the plans of the different Member States regarding the content of the energy certificate, the proposed indicator, the performance scales and the classification of recommendations for cost-effective improvement, a small study has been performed regarding the standard on the certification scheme (prEN 15217). This standard contains an annex which is intended to be used by national bodies setting up a certification scheme to document this scheme. This annex was send as a questionnaire to the partners of the project and some other contacts outside to project. The results of this study are given in chapter 10.

The development of the schemes in the Member States is a fast continuing process. Therefore the answers given can easily be outdated. The results of the questionnaire should be seen in that context. To avoid misunderstandings about state of the implementation in specific Member States, the answers are made anonymous.

The analysis has taken place in the spring and summer of 2005. It was important to start the analysis this early, because it enabled us to give formal comment to the standards within the public enquiry period. Through this, there was a formal guarantee that our comments were taken into account. It is important to bear in mind that the standards developed a lot since this period, hopefully partly because of our comments. Parts of the comments given in this document are therefore outdated.

To avoid repetition no separate concluding chapter is added to the document. A summary of the conclusions and recommendations can be found in the executive summary of this document.

2. prEN ISO DIS 13790 (WI 14) “Energy performance of buildings – Calculation of energy use for space heating and cooling”

2.1 Introduction

2.1.1 Content of the standard

The standard has the following scope:

It gives calculation methods for assessment of the annual energy use for space heating and cooling of a residential or a non-residential building, or a part of it.

2.1.2 Main output variables of the standard

The method includes the calculation of:

1. the heat transfer by transmission and ventilation of the building when heated or cooled to constant internal temperature;

2. the contribution of internal and solar heat sources to the building heat balance;

3. the annual energy needs for heating and cooling, to maintain the specified set-point temperatures in the building;

4. the annual energy required by the heating and cooling system of the building for space heating and cooling, using heating and cooling system characteristics which are to be found in specific European (prEN wi 7-10, prEN wi 12) or International standards, or, where applicable, in national documents.

5. the additional annual energy required by the ventilation system for e.g. providing the air flow (determined according to prEN wi 18/19) and pre-heating and/or pre-cooling the air (determined according to prEN wi 20/21).

2.2 Analyses of the standard

2.2.1 Introduction

The standard covers three different types of methods:

- A fully prescribed monthly quasi-steady state calculation method (plus as a special option: a seasonal method)

- A fully prescribed simple hourly calculation method;

- Calculation procedures for detailed simulation methods.

2.2.2 Detailed simulation methods

A dynamic method models the thermal resistances, thermal capacitances and heat flows from heat sources in the building or building zone. There are numerous methods to do so, ranging in complexity from very simple to very detailed. There are other standards (e.g. prEN wi 17) describing detailed simulation methods or performance criteria for such methods. This standard provides the environment of standardised boundary conditions that enables compatibility and consistency between the different methods.

Because the actual input data differs between the different detailed methods and because this input data is the most important feature which makes a method more or less usable for existing buildings, we won't focus on detailed simulation methods in this study.

2.2.3 Monthly quasi-steady state calculation method and simple hourly calculation method

The actual calculation rules of the monthly quasi-steady state calculation method and simple hourly calculation method differ, but the input and output parameters are more or less the same. Therefore, in this ENPER Exist document, they are discussed together.

2.2.4 Influencing factors and input parameters

The next paragraphs together describe the main structure of the calculation of the monthly and annual energy needs for heating and cooling. The main influencing factors are described.

2.2.4.1 Partitioning into different calculation zones

A building may need to be partitioned into different zones, with separate calculation of the energy need for heating and cooling per zone:

The input has to be gathered per zone. To allow short visits the amount of zones should be minimised for existing buildings and it should be very clear from the beginning which zones have to be taken into account.

2.2.4.2 Energy need for space heating and cooling

To calculate the energy need for space heating and cooling various influencing factors are taken into account. The most important factors are listed below, together with potential problems for existing buildings.

a) Heating season length (for seasonal calculation only)

b) heat transfer by transmission

- heat transfer coefficient by transmission of all construction elements to adjacent space(s) or outdoor

  The calculation of this coefficient is described <u>in other standards</u> (WI 23/24) and contains among others:

  - the determination of R_c and/or U-values of the construction elements
  - the effect of heat bridges
  - the effect of adjacent unconditioned spaces and adjacent sunspaces

  Adaptation to existing buildings of these elements is the concern of these other standards. Some aspects can be handled in this standard, like a simplified method to take into account the effect of sunspaces.

  Relevant aspects are:

  Concerning R_c and U-values:

  - To allow short visits, lists with R_c and U-values based on construction type and date of construction should be available on national level.

- Aging of insulation material is a relative quick process and is already taken into account in the determination of the calculation values of the lambda of insulation material.

- Aging of glazing is a very slow process and is not taken into account in the determination of the U-value of glazing. Because the effect can be large, this is a point of concern for existing buildings.

Concerning heat bridges:

- Taking into account thermal bridges can be a time consuming task. The effect of a thermal bridge depends on the type of thermal bridge and on the insulation value of the construction surrounding the thermal bridge. For poor insulated buildings, the effect of heat bridges is very small. In moderately insulated buildings the effect of poor designed connections can be as huge as small thermal bridges in good insulated buildings. So ignoring thermal bridges in existing buildings is no solution. Taking into account all thermal bridges is not efficient either. There should be a method which gives a good balance between the insulation value of the building and the type of heat bridge which may be ignored and which have to be taken into account, preferably using as much default values as possible and as few input parameters as possible.

Concerning the effect of adjacent unconditioned spaces and adjacent sunspaces

- In the calculation of the heat transmission coefficient to adjacent unconditioned space a reduction factor, *b*, is used to account for the reduced temperature difference compared to heat transmission to the external environment. Suggested is to introduce a simplified method for determination of *b*, preferably using as much default values as possible and as few input parameters as possible. Because of large national differences, default values have to be determined on national level.

- The effect of sunspaces is divided un a transmission part and a solar radiation part. Suggested is to introduce a simplified method to determine the effect of sunspaces in which these two parts are combined, preferably using as much default values as possible and as few input parameters as possible. Because of large national differences, default values have to be determined on national level.

- Internal setpoint temperature of the building zone

  For different building types a list of default values should be available on national level. Note that measured values should be handled with care, because setpoint temperature and indoor air temperature are not the same.

- The temperature of the adjacent space or the outdoor temperature

- Effect of nocturnal insulation

  - U-values of windows and window and shutter

Lists should be available on national level, taking into account aging, if relevant.

- The hourly pattern of the shutter

  A typical default pattern should be available on national level. Patterns can be different for week days and weekend days and for different building functions.

heat transfer by ventilation

- heat transfer coefficient by ventilation and infiltration

  The calculation of this coefficient is described in other standards (WI 18/21). Adaptation to existing buildings of this element is the concern of these other standards.
- the supply temperature of the air flow

  For the effect of adjacent unconditioned spaces and adjacent sunspaces: see the part about heat transfer coefficient by transmission.
  When mechanical ventilation is concerned, this temperature is determined in other standards (WI 18/21).
- Heat recovery, with or without bypass during summer and measures in winter to prevent from freezing.

- night time ventilation for free cooling

internal heat sources

- The internal heat sources may include:
  - metabolic heat from occupants and dissipated heat from appliances;
  - dissipated heat from lighting devices;

    The value shall exclude the heat that is directly removed by exhaust ventilation via the luminaries; this heat shall be accounted for as heat source in the ventilation system.

    The value shall include the heat flow rate from lighting elements that are not covered in the lighting energy use calculation method, such as decorative lighting, removable lighting, special-task lighting, building-grounds lighting, process-related lighting.
  - heat or cold dissipated from hot and mains water and sewage systems;
  - heat or cold dissipated from heating, cooling and ventilation systems;
  - heat or cold from processes and goods.

Part of this data is determined in other standards (WI 7-12, 13, 18-21 etc) For all the other data a list of default values should be available on national level for different building types and building use. The same applies to the schedules used.

- Internal heat in an adjacent unconditioned space is taken into account with a reduction factor.

Like with transmission and ventilation, the effect of the unconditioned space can be taken into account in a more simple way by using defaults on national level;

solar heat sources

- solar energy transmittance of the window (g-value)
  - give default values for the g-values of typical window types with and without shading
- amount of solar irradiance
- reduction for outdoor obstacles
  - a more simplified approach than described in the standard is preferred to determine the influence of shading
- solar gains of sunspaces
  - a more simple approach than described in the standard to take into account sunspaces in existing buildings in general is preferred.
- solar heat gains of opaque elements
  - give default values for the absorption coefficient of opaque elements
  - use default values for the external surface heat resistance of the considered opaque construction

dynamic parameters

- The simple hourly method lumps the thermal capacity of the building or building zone into a single resistance-capacitance pair.
- In the monthly and seasonal methods, the dynamic effects are taken into account by introducing the gain utilisation factor for heating and the loss utilisation factor for cooling. The effect of inertia in case of intermittent heating or switch off is taken into account by introducing a adjustment on the set point temperature or a correction on the calculated heat need
- Both methods use a internal heat capacity

Default values for typical constructions should be given

Indoor conditions

- Intermittent heating and cooling (weekend, vacation)

  give default intermittency patterns at national level for different building types and uses

2.3 Conclusions and recommendations

This standard gives a calculation method which can be used for existing buildings provided that for various input parameters a list with default values shall be given. These lists should contain defaults for various typologies, building functions and/or different construction dates. Because of the large differences between countries, these lists have to be produced on national level.

Note that a lot of input parameters are determined in other standards.

Furthermore some aspects need to be simplified for existing buildings. This concerns:

- thermal bridges
- solar shading by obstructions
- the effect of adjacent unconditioned spaces
- the effect of sunspaces

The influence of aging shall be taken into account somehow for:

- glazing

The comments sheets, which was sent to the CEN working group responsible for the prEN ISO DIS 13790 (WI 14) “Energy performance of buildings – Calculation of energy use for space heating and cooling” is added in annex A. This comment sheet contains the concrete recommendations to the working group regarding suggested changes the standard.

3. prEN 15242 (WI 18/19) “Ventilation for buildings – calculation methods for the determination of air flow rates in buildings including infiltration”

3.1 Introduction

3.1.1 Content of the standard

The analysed standard concerns:

prEN 15242 Ventilation for buildings – calculation methods for the determination of air flow rates in buildings including infltration (EPBD WI 18/19)

Version: April 2005.

3.1.2 Main output variables of the standard

The standard **prEN 15242** has the following main output variables:

- The volume air flow rate by ventilation and infiltration for (among others) energy and summer comfort calculations
  - Through leakages or purpose provided openings in building envelope
  - Due to ventilation system, taking into account the product and system characteristics

We will focus only on the **application for energy calculations**.

3.2 Analysis of the standard prEN 15242

3.2.1 Introduction

prEN 15242 Ventilation for buildings - Calculation methods for the determination of air flow rates in buildings including infiltration

CONTENT: Describes method to calculate the ventilation air flow rates for buildings to be used for applications such as energy calculations, heat and cooling load calculation, summer comfort and indoor air quality evaluation. Applies to mechanically ventilated buildings; passive ducts; hybrid systems switching between mechanical and natural modes; window opening by manual operation for airing or summer comfort issues.

Provides two methods: instantaneous (implicit) method and simplified method.

In the next paragraph we will analyse the two methods, focusing on application for energy calculations.

3.2.2 General comments

Evidently, the English language has not been checked which sometimes makes the standard difficult to understand (example: 6.2.12). At several spots the standard even contains editorial comments in French (example: 6.5.4, 7.1.2.3.1, 7.1.3.2, 7.1.4, annex C, etc…) which indicate that the standard is not yet complete.

Also: the symbols used in the equations are not consistent.

3.2.3 Instantaneous (implicit) method:

The calculation of the air flows is done for a given situation of outdoor climate, indoor climate and system running.

The calculation consists of the following successive steps (see clause 6.1):

1. Calculation of mechanical ventilation
2. Passive and hybrid ductventilation
3. Calculation of infiltration/exfiltration
4. Combustion air flow
5. Calculation of additional flow for window openings
6. Overall airflow

Clause 6 gives the calculation procedures.

Clause 7 describes the application. Clause 7.1 describes the application for energy calculations. Clause 7.1 contains for instance default values and other simplifying assumptions.

3.2.3.1 Analysis

We will try to follow the calculation procedure in clause 6 step by step, and at the same time check clause 7.1 for the procedures in case of application for energy calculations:

1. Calculation of mechanical ventilation

Clause 6.2.

a) Required air flow for mechanical supply or exhaust

According to building design and national regulations

b) C_{use}: coefficient corresponding to switching on (Cuse=1) or off (Cuse=0) the fan

Depending on occupancy, can be nationally defined

c) ε_v: local ventilation efficiency

Default value = 1

d) C_{cont}: coefficient depending on local air flow control

For variable air flow (demand controlled ventilation or VAV): depends on control efficiency; no further clue here.

But see clause 7.1: default value for energy calculations: =1

e) C_{syst}: coefficient depending on inaccuracies of the components and system (adjustment…etc)

Kind of 'oversizing' factor; no further clues here.

But see clause 7.1: default value for energy calculations: =1.2

f) C_{leak}: due to duct and AHU leakages

Requires detailed input on the duct sizes and duct and AHU characteristics. These data may not be available in case of a quick inspection.

But see clause 7.1: default value for energy calculations, depending on class; the highest default may be used if class unknown.

g) C_{rec}: recirculation coefficient, mainly for VAV system

Refers to annex C; annex C is not completed, but seems to require detailed input on the duct sizes and duct and AHU characteristics. These data may not be available in case of a quick inspection

2. Passive and hybrid duct ventilation

Clause 6.3. Duct natural ventilation system, consisting of air inlets, cows, ducts, air outlets.

Requires detailed input on the cowl and duct characteristics. These data may not be available in case of a quick inspection

3. Calculation of infiltration/exfiltration

Clause 6.5

Requires Cp values for all external envelope components, depending on orientation and height of component and building and zones characteristics.

Clause 7.1 (7.1.2.3) contains more details on the Cp values for application in energy calculations:

Requires:

a) Pressure distribution (Cp values)

Given in Annex A, with for energy calculations: shielding class is “open terrain”.

However, the façade has to be split in low, medium and high part; the roof has to be categorised according to the slope. For existing buildings in case of quick inspection default values would be needed.

b) Overall Cleak per zone

See clause 7.1.2.4 (“splitting of airtightness”)?

Values to be drawn from annex D via annex B?? (There is no reference to annex B from other parts of this standard. Neither a reference to annex D from other parts of this standard).

Assuming that annex D via annex B are the places to be: annex B refers to national values for airtightness of the building (zone); annex D gives the conversion formula from airtightness to Cleak.

Clause 7.1.2.4 further requires as input the ratio of roof/façade area. Problem for quick inspection of existing building?

c) Local air velocity

as function of meteo wind speed and site characteristics

For energy calculations: shielding class is “open terrain” ➔ local air velocity is equal to meteo wind (annex A).

4. Combustion air flow

Clause 6.4.

Uses tabulated values plus values from national standards.

5. Calculation of additional flow for window openings

a) Airing:

Requires (6.6.1.1:) input on the window types and height. These data may not be available in a quick inspection of an existing building. The simplified calculation (6.6.1.2), which allows national coefficient values (plus: in clause 7.1 a default value for energy calculations), is only applicable to specific cases.

b) Summer comfort

Not considered in this analysis

c) Typical use of windows

To be defined at national level

6. Overall airflow

This is given in clause 6.5.4?? If so, why is this not the last (or preferably: the first) subclause under clause 6?

Total flow values for energy calculations

Clause 7.1.4 describes how the calculated air flows have to be summed to obtain the total air flow for a given period.

One can choose hourly calculations or monthly calculations.

The hourly calculations require hourly data on external temperature and wind speed.

The monthly calculations require at least 5 wind speeds (and, assumingly, their frequency) and for each wind speed one calculation for occupied period and one for non-occupied period. The average indoor-outdoor temperature difference can be used.

3.2.3.2 Conclusions

Our conclusion is that the implicit method, although being a rather detailed method, could in principle be used also for existing buildings in case of a quick inspection where no detailed information is available.

But we do have the following comments:

- For many of the input data the standard allows national (typical or default) values, in case of application for energy calculations. In some cases, however, some detailed data are needed that may not be available from a quick inspection of an existing building. We have formulated suggestions to modify the standard to accommodate these needs.
- The method is in itself a detailed method, requiring hourly or monthly air flow-pressure balance calculations. This is no problem, assuming that calculations will be computerised anyway. But given the large number of simplifications in the input (with eventually only just a very few number of input data that are variable), it becomes questionable whether this method is better than a 'statistical' method as allowed for in prEN 15241. In a 'statistical method' detailed calculations are used in the development phase of the calculation procedures, applied on a number of reference cases, to derive a practical simplified formula, e.g. giving the air flow rate as function of type of ventilation system and air tightness of the building (zone) for a given climate. The coefficients in the simplified formula will be based on a detailed model instead of using a simplified model.

3.3 Simplified (explicit) method:

Clause 7.1.3.2 contains a simplified (explicit) method for application in case of energy calculations.

3.3.1.1 Analysis

Although the simplified method in clause 7.1.3.2 is apparently not yet completed (several editorial comments in French, symbols are inconsistent or not introduced), it seems to be a simplification, not in input data, but in calculation algorithm.

The method can only be applied “when it can be assumed that there is no interaction between the ventilation system and the leakages impact (e.g. mechanical system)”.

3.3.1.2 Conclusions

The simplification seems to be rather in the algorithm than in the input data. Besides, the conditions for application will be only valid in special cases (balanced ventilation system).

Therefore, this method has no advantages and only disadvantages for application, assuming that the calculation will not be performed manually anyway.

- As an alternative, a ‘statistical’ method as allowed for in prEN 15241 seems to be a more practical simplification. In a ‘statistical method’ detailed calculations are used in the development phase of the calculation procedures,, applied on a number of reference cases, to derive a practical simplified formula, e.g. giving the air flow rate as function of type of ventilation system and air tightness of the building (zone) for a given climate. The coefficients in the simplified formula will be based on a detailed model instead of using a simplified model.

3.4 Conclusions

The comments sheets, which was sent to the CEN working group responsible for the prEN prEN 15242 “Ventilation for buildings - Calculation methods for the determination of air flow rates in buildings including infiltration” is added in annex B. This comment sheet contains the concrete recommendations to the working group regarding suggested changes the standard.

4. prEN 15241 (WI 20/21) “Ventilation for buildings – calculation methods forenergy losses due to ventilation and infiltration in commercial buildings”

4.1 Introduction

4.1.1 Content of the standards

The analysed standard concerns:

prEN 15241 Ventilation for buildings – calculation methods forenergy losses due to ventilation and infiltration in commercial buildings (EPBD WI 20/21)

Version: April 2005.

4.1.2 Main output variables of the standards

The standard **prEN 15241** has the following main output variables:

- Energy required for ventilation in the building
    - Electrical needs for fan and ventilation system auxiliaries
    - Required energy for defrosting reheating and precooling coils
- Air inlet temperature and humidity
- The volume air flow rate by ventilation and infiltration
- Required energy for heating and cooling of air heating and cooling systems

Missing?:

- *Contribution of heat dissipated by the ventilation system to the internal heat sources of the building (zone)*

We will focus only on the **application for energy calculations**.

4.2 Analysis of the standard prEN 15241

4.2.1 Introduction

prEN 15241 Ventilation for buildings - Calculation methods for energy losses due to ventilation and infiltration in commercial buildings

CONTENT: Describes method to calculate the energy impact of ventilation systems (including airing) in buildings to be used for applications such as energy calculations, heat and cooling load calculation. Its purpose is to define how to calculate the characteristics (temperature , humidity) of the air entering the building, and the corresponding energies required for its treatment as the auxiliaries electrical energy required.

Applications: hourly, monthly, yearly and statistical methods.

In the next paragraph we will focus on the three methods.

4.2.2 General comments

(Repeat from general introduction:)

The standard **prEN 15241** has the following main output variables:

- Energy required for ventilation in the building
  - Electrical needs for fan and ventilation system auxiliaries
  - Required energy for defrosting reheating and precooling coils
- Air inlet temperature and humidity
- The volume air flow rate by ventilation and infiltration
- Required energy for heating and cooling of air heating and cooling systems

Missing?:

- *Contribution of heat dissipated by the ventilation system to the internal heat sources of the building (zone)*

The standard refers to WI 12 for air heating and/or cooling systems.

We will therefore **ignore air heating and cooling** in the following analysis.

The standard differentiates hourly, monthly, yearly or statistical methods.

However, the hourly, monthly and yearly methods are very similar and therefore will be analysed together.

4.2.3 Hourly or monthly or yearly method

These three methods start from the same steady state calculation.

This steady state calculation is then performed either hourly, with hourly input data, or yearly (monthly), “taking into account the yearly (monthly) distribution of outdoor temperatures and making an assumption on the corresponding indoor temperatures”.

For systems with medium or high humidity impact, the same approach is used by taking into account the yearly (monthly) distribution of outdoor temperature and outdoor humidities and making an assumption on the corresponding indoor temperatures and humidities.

The final results are the yearly (monthly) value on energy for preheating, precooling and auxiliaries.

4.2.3.1 Analysis

The steady state part:

Duct heat losses require input data such as duct length and specific heat loss of the duct which may not be available for existing buildings.

The calculation requires input data such as fan power and heat exchanger efficiency, to be obtained from other (in casu product) standards.

We did not check those product standards whether they allow for tabulated default values. Probably not, therefore we suggest to add it as option in this standard.

Temperature setpoints are not specified, except for defrosting. Consequently, this standard does not impose restrictions that would cause problems in the application for existing buildings.

The hourly calculation option:

No additional problems for application on existing buildings, assuming that computerised calculation is not a problem.

The yearly (monthly) calculation options:

It is not clear how to deal with e.g. defrosting of heat xchangers.

4.2.3.2 Conclusions

Our conclusion is that the hourly, monthly or yearly method could in principle be used for existing buildings in case of a quick inspection where no detailed information is available.

But we do have the following comments:

- For the main elements specific input data are needed that may not be available from a quick inspection of an existing building. We have formulated suggestions to modify the standard to accommodate these needs.

- The hourly method requires a computerised calculation which is no problem in itself, assuming that calculations will be computerised anyway. But it may lead to the suggestion of being an accurate method, while the main input data are not accurate at all. The alternative of a monthly or yearly method could be an option, although for such calculation it is not clear how to deal with e.g. defrosting.
- If a simplified approach is the preferred option, then the 'statistical method' (see next paragraph) is probably a better approach. In a 'statistical method' detailed calculations are used in the development phase of the calculation procedures, applied on a number of reference cases, to derive a practical simplified formula. The coefficients in the simplified formula will be based on a detailed model instead of using a simplified model.

4.2.4 Statistical method

This method is described in clause 7.3.

It is possible to define on a national basis simplified approaches based on a statistically analysis of results.

4.2.4.1 Analysis

As described in clause 7.3 of the standard, the following rules shall be fulfilled:

- The field of application shall be specified (for example, detached houses, specified ventilation system…)
- All specific assumptions (such as indoor temperature) or data (for example climate) shall be clearly described,
- The set of cases used for the statistical analysis shall be clearly described,
- The remaining inputs data for the simplified approach shall be the same as the ones described in the steady stat calculation, or part of them,
- For the input data of the steady state calculation not taken into account, the conventional value used shall be specified (for example, no defrosting in a mild climate),
- The results of the simplified approach shall be compared to the reference ones for the set of cases taken into account in the statistical analysis

This method gives sufficient freedom to develop a national method with national default and/or typical values where needed.

4.2.4.2 Conclusions

The option in prEN 15241 of a statistical approach to be applied at national level seems to be a good and practical approach for existing buildings. It gives sufficient freedom to develop a national method with national default and/or typical values where needed.

It would however not make sense apply a statistical method on the system characteristics, and an implicit calculation of the air flow rates according to prEN 15242 (se above). Therefore, we recommend to explicitly add in prEN 15242 the similar option of a statistical approach to be applied at national level.

4.3 Conclusions

The comments sheets, which was sent to the CEN working group responsible for the prEN 15241 “Ventilation for buildings - Calculation methods for energy losses due to ventilation and infiltration in commercial buildings” is added in annex C. This comment sheet contains the concrete recommendations to the working group regarding suggested changes the standard.

5. prEN 15316-3-2 (WI 11) “Domestic hot water systems. Part 3-2. Distribution”

5.1 Introduction

5.1.1 Objective

The objective of this document is to give an analysis of the usefulness for energy performance assessment for existing building of the standard on heat loss and auxiliary energy consumption of distribution systems for domestic hot water (DHW).

The analysed standard concerns:

prEN 15316-3-2

Heating systems in buildings

Method for calculation of system energy requirements and system efficiencies

Part 3-2: Domestic hot water systems, distribution

July 2005

This standard is the second step in a three step calculation model, consisting of:

1. Tapping requirements
2. Distribution system
3. Generation

5.1.2 Method

For all components and options in the calculation a list of required input data is given. In addition it is indicated whether these inputs require:

- New input data from the user of this standard.
- Data from previous, mostly more general input (like the floor area of a building).
- Data obtained from the standard itself.
- Data obtained from a national annex with national constants/parameters.

In case a computer program is used only new input data requires action; all other data is already in the program so no further action is required here.

For new input data it is indicated in what way it may be obtained in case this isn’t obvious.

5.2 Analysis of the standard

5.2.1 Introduction

The objective of this standard is to give calculation rules for heat loss and auxiliary energy consumption of distribution systems for domestic hot water. The net hot water demand (tapping requirements), calculated separately in prEN 15316-3-1, is the input for this calculation.

Distribution heat losses may occur due to:

- Distribution pipes, transporting DHW from the heat generator or a circulation system to the tapping points.
  This type of pipes is present in all systems in both residential and non-residential buildings.
  The standard gives several calculation methods.
- Circulation pipes, circulating hot water through a building at a constant temperature, acting as a kind of extended storage vessel. Sometimes night set back is applied in order to save energy.
  This type of pipes is quite rare in residential buildings with individual systems and quite general in residential buildings with communal DHW systems.
  The standard gives one calculation method.

Auxiliary energy consumption may occur due to:

- Pumps in the circulation system.
  The standard gives one calculation method.
- Ribbon heating
  This type of heating is not very common in buildings and mostly used to prevent water from freezing in outdoor pipes in winter.
  The standard gives one calculation method.

The *heat losses of the distribution pipes* are related to three physical effects:

- The heat loss at the tapping point during the heating up phase of the pipe, while the water temperature at the tapping point hasn't reached its useful level.
- The heat loss of the pipes during the tapping.
- The heat loss while the pipes cool down when the tapping is finished.

In general the second effect is the smallest effect. The first and third effect requires at least the number of tappings per day for each distribution pipe / tapping point. For more subtle calculations of useful rest heat in the pipes at the start of the next tapping, a detailed tapping pattern is required.

The *heat losses of the circulation pipes* are related to two physical effects:

- Constant heat losses of the pipes at constant operating temperature.
- Cooling down and heating up of the pipes with night set back, resulting in a lower heat loss compared to constant temperature operation.

5.2.2 Result Output variables

The resulting output variables are:

$Q_{W,d}$ Total heat loss due to the distribution system

$Q_{W,d}$ Auxiliary electrical energy required for the ribbon heater in Wh

$W_{Wd,pump}$ Auxiliary electrical energy required for the pump in kWh/year

Total heat loss is split in two major portions:

$Q_{W,d\ ind}$ Heat loss from independent section i of the distribution system

$Q_{W,d\ col}$ Heat loss from collective circuit

Conclusions:

– The major output variables, discussed in the introduction, are covered by the standard.

Proposals for improvement:

– It is obvious that the parameter $Q_{W,d}$ is now used for two quite different purposes, where a distinction is required.
– A clear statement on the dimensions is required: MJ/year or kWh/year.
– Index i needs to be added to $Q_{W,d\ ind}$ if it applies to section i, leaving $Q_{W,d\ ind}$ for the sum of all sections.

5.2.3 Hot water demand input variables

The required input variables are:

Q_W domestic hot water energy demand in MJ

Conclusions:

- As indicated in the introduction, distribution heat losses are merely depending on the number of tappings and less on the total hot water demand. So for more advanced calculations the number of tappings per day for each (relevant) distribution pipe / tapping point should be an input parameter.
- Both hot water demand and the number of tappings are inputs obtained from the "Tapping requirements" standard, where they are determined. So here they don't require additional input of the user.

Proposals for improvement:

- Addition of the number of tappings per day for each distribution pipe / tapping point.
- A clear statement on the dimensions is required: MJ/year.

5.2.4 Parameter input for distribution pipe losses

5.2.4.1 Parameter input for distribution pipe losses based on dwelling area (5.2[1])

Method:

- The method assumes linear or non-linear relations between distribution heat loss and floor area, so one or more national constants are required for the formula (Annex A).
- This method doesn't allow any distinction between different distribution systems.

The required input variables are:

A_N Total floor area of dwelling in m^2

Conclusions:

- The standard limits the use of this method to single-family dwellings with the heat generator inside the heated area and with distribution pipes as short as possible.
- However, since this method doesn't allow any distinction between different distribution systems, it's only suitable to indicate the performance for the worst case situation of a dwelling or other buildings. It's more obvious to add this kind of limitations to the national annex.
- Please note that "heated area" may prove to be an ambiguous description.
- The only parameter required is a general input parameter already known. Using a computer program no additional input data is required.
- A national annex with formulas and constants is required for this standard.

Proposals for improvement:

- The limitations to the use of this method might be dropped in the main text and they can be applied in national annexes, if required. In this way, nations are allowed to use this method in the way most suitable for their situation.
- "Heated area" needs a clear description.

[1] Numbers between brackets refer to paragraph numbers in the standard.

5.2.4.2 *Parameter input for distribution pipe losses based on delivery pipe lengths – simple method (5.3.1)*

Method:

- The method calculates distribution heat loss assuming a complete cooling down of the pipes and water after every tapping. Heat losses at the outlets while desired temperature is not reached are not included in the calculation.
- This method allows a good distinction between distribution systems with different pipe length and diameter.

The required input variables are:

$V_{W,i}$	Volume of water in pipe i in m^3
$M_{M,i}$	Mass of pipe i in kg
$T_{W,nom,i}$	Nominal hot water temperature in pipe i in °C
$T_{int,i}$	Average internal temperature around pipe i in °C
n_{tap}	Number of tappings per day in pipe i
ρ_W	Specific mass of water in kg/m^3
C_{PW}	Specific heat of water in J/kg.K
C_{PM}	Specific heat of pipe material in J/kg.K

Conclusions:

- Since the method doesn't take tap losses into account the distribution losses may be lower than in reality.
- This method requires less input parameters then one might expect at first sight. Using a list of product data (pipe diameters and properties), data input is reduced to *pipe lengths, diameters and material*.
  Pipe length can be obtained easily. Pipe diameter and material can be determined quite easy but if pipes are concealed it may be difficult.
- For internal temperature national values are required.
- The number of tappings may be derived from other input data (see 5.2.3).
- The hot water temperature may be fixed at 60°C or a national value is required.

Proposals for improvement:

- For practical use a (national) list of product data is required.

5.2.4.3 Parameter input for distribution pipe losses based on delivery pipe lengths – tabulated data method (5.3.2)

Method:

- The method uses a table with distribution efficiencies $\eta_{pipe;i}$ as a function of pipe length and inner diameter. In the example of annex C two tapping points are assumed (kitchen and bathroom). Table data are calculated (national) using tapping pattern data (number of tapping per tapping point) and information on heating up and cooling down of pipes. Also factor f_i is determined (national) using tapping pattern data.
- In this approach heat losses at the outlets while desired temperature is not reached may be included in the calculation.

The required input variables are:

Li	Length of pipe to tapping point i in m
$d_{int,i}$	Internal diameter of pipe to tapping point i in mm
f_i	Fraction of hot water demand at tapping point i

Conclusions:

- This method allows a good distinction between different distribution systems.
- This method allows taking tap losses into account.
- This method requires data input of *pipe lengths* and *pipe diameter*.
  Pipe length can be obtained easily. Pipe diameter can be determined quite easy but if pipes are concealed it may be difficult.

Proposals for improvement:

- A (national) table with pipe efficiencies as a function of pipe length and inner diameter needs to be determined.

5.2.4.4 *Parameter input for distribution pipe losses based on tapping profiles (5.4)*

Method:

- The method uses energy loss factors α_{Wd} as a function of pipe length and hot water demand.
- In annex D no distinction is made between different tapping points. Annex D states that in this approach heat losses at the outlets while desired temperature is not reached are not included in the calculation. Nevertheless the method allows inclusion of this effect by including it in the calculation of the formulas for α_{Wd}.

The required input variables are:

L_{ave}	Average length of distribution pipe within heated space (in m?)
L_{nhs}	Average length of distribution pipe in non heated space (in m?) (if appropriate)

Conclusions:

- This method allows a good distinction between distribution systems with different pipe lengths. The effect of pipe diameters is not included but might be included as well.
- This method states not to take tap losses into account but it is no problem to include them as well.
- This method requires data input of *pipe lengths*. These data can be obtained easily.

Proposals for improvement:

- A national annex on the calculation of α_{Wd} is required.

5.2.4.5 Parameter input for distribution pipe losses based on detailed calculation method (5.5)

Method:

- The method calculates heat losses using the basic heat loss equation for a pipe.
- Since the formula requires average temperature of the pipe section it is more suitable to calculate heat loss of circulation pipes at constant temperature than the heat loss of distribution pipes, where average pipe temperature is the result of the heating up and cooling down depending on the number of tappings and pipe properties.
- The cooling down and heating up of the circulation system with night set back is not taken into account; the method assumes that in off-time the losses are zero.
- The problem is to estimate *average pipe temperature* for distribution pipes. The method doesn't give any formula or calculation scheme.

The required input variables are:

U_i	Specific heat transfer coefficient of pipe i in W/mK
L_i	Length of pipe i in m.
$\theta_{W,d,i}$	Average temperature of pipe section i in °C.
θ_{amb}	Average ambient temperature in °C
t_W	Duration f the provision of domestic hot water in days/month
z	Running time of circulation pump (h/days)

The index i relates to three different types of pipe:

- from heat generator to main supply pipes (either with or without circulation)
- main supply pipes (either with or without circulation)
- individual branching pipes to the user outlets (only without circulation)

Annex E gives characteristic values for:

- pipe lengths, depending on floor area;
- average ambient temperature;
- specific heat transfer for different locations and insulation.

Conclusions:

- For distribution pipes this method is not the most obvious one. One of the inputs (*average pipe temperature*) is typically the result of a straightforward calculation of heating up and cooling down due to the tapping program, allowing the direct calculation of the pipe heat loss.
- This method allows a good distinction between distribution systems with different pipe lengths and pipe diameters. This method states not to take tap losses into account.
- This method requires data input of *pipe lengths, specific heat transfer, average ambient temperature and average pipe temperature*. Using a list of product data (pipe diameters and properties), data input is reduced to *pipe lengths, pipe material, diameter* and *insulation*.

  Pipe length can be obtained easily. Pipe diameter and insulation can be determined quite easy but if pipes are concealed it may be difficult.

Since no method is given to obtain *average pipe temperature* this method is hard to use here.

Proposals for improvement:

- Addition of a method to calculate the *average pipe temperature* of distribution pipes.
- However, it's more obvious to drop this method for distribution pipes and only apply it for circulation pipes.

5.2.5 Parameter input for distribution losses of circulation system (5.6)

5.2.5.1 Introduction

In general circulation systems are more complex to handle than distribution pipe systems, due to multiple branching tubes, concealed tubes in shafts and coves and a lack of up-to-date installation drawings. Therefore is will be difficult to obtain correct data on length, diameter, and insulation in most existing buildings. Especially the presence and condition of insulation of concealed pipes is hard to establish.

5.2.5.2 Heat emission based on pipe length (5.6.1)

Method:

- The method calculates circulation system losses as a function of pipe length and specific heat transfer coefficient.
- The effect of pipe diameters and insulation may be included in the specific heat transfer coefficient.
- The cooling down and heating up of the circulation system with night set back is not taken into account; the method assumes full time operation.

The required input variables are:

L	Length of circulation pipe in m
U	Specific heat transfer coefficient of pipe in W/m

Conclusions:

- This method allows a good distinction between circulation systems with different pipe lengths.
- This method requires data input of *pipe length* and *specific heat transfer coefficient*. These data can be obtained more or less easily; in case specific data is hard to obtain default values may be used.
- The specific heat transfer coefficient can be calculated or obtained from a (national) table / annex. The standard gives a default value of 40 W/m pipe.

Proposals for improvement:

- A (national) table / annex on specific heat transfer coefficient is recommended.
- The effect of night set back may be added by the assumption that that in off-time the losses are calculated according tot paragraph 5.2.5.4.

5.2.5.3 *Heat emission based on calculation method (5.6.2)*

Method:

– The method calculates heat losses using the basic heat loss equation for a pipe.
– The cooling down and heating up of the circulation system with night set back is not taken into account; the method assumes that in off-time the losses are zero.

Here the same method may be applied as discussed in 5.2.4.5. The required input variables are:

U	Specific heat transfer coefficient of pipe in W/mK
L	Length of pipe in m.
$\theta_{W,d}$	Average temperature of pipe in °C.
θ_{amb}	Average ambient temperature in °C
t_W	Duration f the provision of domestic hot water in days/month
z	Running time of circulation pump (h/days)

Annex E of the standard gives characteristic values for:

– pipe lengths, depending on floor area;
– average ambient temperature;
– specific heat transfer for different locations and insulation.

Conclusions:

– This method is a more detailed way to calculate the heat losses of circulation pipes, compared to the previous method.
– This method allows a good distinction between distribution systems with different pipe lengths, pipe diameters, insulation and temperatures.
– This method requires data input of *pipe lengths, specific heat transfer, average ambient temperature and average pipe temperature*.
– A list of product data (pipe diameters and properties) reduces the data input on the distribution system to *pipe lengths, pipe material, pipe diameter* and *insulation*. These data can be obtained more or less easily; in case specific data is hard to obtain default values may be used.
– *Average ambient temperature* requires a table with national data.
– *Average pipe temperature* is the average of design supply and return temperatures or may be taken from national data.

Remarks:

– Using a computer program with a database and the calculation scheme is required.

Proposals for improvement:

– A (national) list of product data is recommended

5.2.5.4 *Additional heat emission during periods of no circulation (5.6.3)*

Method:

- The method calculates the full heat loss of the water in the pipe when it cools down to ambient temperature. Two effects are not taken into account:
  - The heat capacity of the pipe material, so the resulting heat demand may be too low.
  - The time it takes too cool down completely, so the resulting heat demand may be too high.
- This method needs to be used in addition to the two methods discussed before to calculate heat losses of circulation systems.

The required input variables are:

c_W	Heat capacity of water in J/m^3.K
V_W	Volume of water in circulation pipes in m^3.
$\theta_{W,d}$	Average temperature of pipes in °C.
θ_{amb}	Average ambient temperature in °C
N_{Norm}	Number of circulation pump operating cycles within the period

Conclusions:

- This method allows to asses the effect of night set back on the heat loss of the circulation system.
- *Additional* required input data depends on the method to calculate heat losses of circulation systems.
  - o Method: Heat emission based on pipe length
    All variables mentioned are required.
  - o Method: Heat emission based on calculation method
    Water volume of the system and the number of operating cycles are required.

  These parameters can be determined more or less easy.

Proposals for improvement:

- Addition of the effect of the insulation on the cooling down and resulting heat loss. This may be done using the specific heat transfer coefficient already used in the calculation of the constant heat loss of the circulation system.

5.2.6 Auxiliary energy

5.2.6.1 Parameter input for auxiliary energy for ribbon heating (6.1)

Method:

- Ribbon or trace heating is mostly applied to prevent freezing of pipes in unheated rooms or outdoor, so it is not very common.
- The method calculates heat losses of the pipe and corresponding electrical energy demand using the basic heat loss equation for a pipe.

The required input variables are:

$U_{W,}d$	Heat loss coefficient of pipe in W/mK
$L_{i,rib}$	Length of pipe heated by trace heating in m.
$\theta_{W,d}$	Average temperature of pipe section in °C.
θ_{amb}	Average ambient temperature in °C
t_W	Duration f the provision of hot water in h

In annex E characteristic values are given for:

- average ambient temperature;
- specific heat transfer for different locations and insulation.

Conclusions:

- This method allows a good distinction between distribution systems with different pipe lengths, pipe diameters, insulation and temperatures.
- This method requires data input of *pipe lengths, specific heat transfer, average ambient temperature and average pipe temperature*.
- A list of product data (pipe diameters and properties) reduces the data input on the distribution system to *pipe lengths, pipe material, pipe diameter* and *insulation*. These data can be obtained more or less easily; in case specific data is hard to obtain default values may be used.
- *Average ambient temperature* requires a table with national data for different types of unheated rooms or outdoor climate.
- *Average pipe temperature* is depending on the way the system is designed and operated and may be taken from national data.

Remarks:

- Using a computer program with a database and the calculation scheme is required.

Proposals for improvement:

- A (national) list of product data and is recommended.
- A national list with *average ambient temperature* and *average pipe temperature* is recommended.

5.2.6.2 Parameter input for auxiliary energy for pumps (6.2)

Simplified method (6.2.1)

Method:

- For circulation systems the method calculates pump power consumption as a function of on time and pump power rating.

The required input variables are:

P_{pump}	Power rating of the pump in W
f_{pump}	Pump on-time in hours/year.

Conclusions:

- A straightforward method suitable for this purpose.
- Pump power can be read from the specs plate for most pumps.
- Pump on-time default value is 8760 hrs/year. If night set back is applied on-time is related to comparable input data required for circulation system losses calculation.

Proposals for improvement:

- In case no data on pump power is available a (national) default value is required, for instance relating pump power to hot water demand.

Detailed method (6.2.2)

Method:

- For circulation systems the method calculates pump power consumption per month as a function of hydraulic energy requirement and pump performance coefficient (efficiency).

The required input variables are:

$W_{Wd,hydr}$ Hydraulic energy requirement in kWh/month

$e_{W,d}$ Performance coefficient for circulation pump.

Conclusions:

- A less obvious method for this purpose.
- Hydraulic energy requirement can be found by pump pressure difference measurement (if options are available) assuming a constant pressure.
- Pump performance coefficient is hard to establish in practise.

Proposals for improvement:

- In case no data pump efficiency is available a (national) default value is required.

5.3 Conclusions and recommendations

5.3.1 Distribution pipe losses:

Conclusions:

- Four methods to determine distribution pipe losses (based on dwelling area, on delivery pipe lengths - simple method and tabulated data method and tapping profiles) are basically comparable and might be united in one form.
  As a result required input parameters for existing buildings may have different levels of detail, where little detail will cause default and sometimes higher distribution losses and more details allow more accurate and sometimes lower distribution losses. The subsequent levels on input parameters details are:
  - No input parameters.
    The losses are directly related to the floor area, a general input parameter already known.
  - Pipe length input parameter.
    The losses may be calculated using delivery pipe lengths - simple method and tabulated data method - and the tapping profiles method. Since no data on pipe diameter and material are required default values are used here.
    Pipe length estimation with accuracy of 1 -2 meters is sufficient and can be done easy in existing buildings.
  - Pipe length and diameter input parameter.
    The addition of pipe diameter is only relevant if the pipes are smaller than default values. The same methods may be used to estimate distribution pipe loses.
    Pipe diameters can be measured easy if they are not concealed.
  - Pipe length, diameter and material input parameter.
    The addition of pipe material is only relevant if the method (tables, formulas) allows making a distinction for material.

  Most material can be determined quit easy but if pipes are concealed it may be difficult.
- The detailed calculation method is not very suitable to determine distribution pipe losses so the use of this method is not worked out here.

Recommendations:
- Harmonize methods.
- Determine national/European table values for the heat loss factor / distribution pipe efficiency of distribution pipes for different lengths and diameters.

5.3.2 Circulation pipe losses

Conclusions:
- The two methods to determine circulation system losses are basically comparable and might be united in one form.
  As a result required input parameters for existing buildings may have different levels of detail, where little detail will cause default and sometimes higher circulation system losses and more details allow more accurate and sometimes lower circulation system losses. The subsequent levels on input parameters details are:
  - Pipe length input parameter.
    The losses may be calculated using circulation pipe lengths. Since no data on pipe diameter and material are required default values are used here and for pipe losses.
    Pipe length estimation with accuracy of 10% is sufficient and can be done easy in existing buildings.
  - Pipe length, heat transfer coefficient and temperatures input parameter.
    With these input a more accurate calculation is possible. It requires more input data. The heat transfer coefficient will be hard to obtain in some situations, especially if pipes are concealed.

Recommendations:
- Harmonize methods.
- Determine national/European table values for the heat loss factor of (un)insulated circulation pipes for different diameters.

5.3.3 Auxiliary energy loss

Conclusions:
- Ribbon heating is not very common.
  Power consumption is depending on many factors hard to establish in practise quickly.
- For circulation pumps the simplified method is suitable for existing installations and the required inputs are mostly easy to obtain. The detailed method is less suitable for existing buildings.

Recommendations:
- Don’t invest time in ribbon heating methods yet.

- Use the simplified method for circulation pumps.
  In case no data on pump power is available a (national) default value is required, for instance relating pump power to hot water demand.

These comments were directly communicated with the CEN working group via the working group members. No additional official comment sheet was submitted.

6. prEN 15316-3-3 (WI 11) “Domestic hot water systems. Part 3-3. Generation”

6.1 Introduction

6.1.1 Objective

The objective of this document is to give an analysis of the usefulness for energy performance assessment for existing building of the standard on heat loss and auxiliary energy consumption of generation systems for domestic hot water (DHW).

The analysed standard concerns:

prEN 15316-3-3

Heating systems in buildings

Method for calculation of system energy requirements and system efficiencies

Part 3-3: Domestic hot water systems, generation

July 2005

This standard is the third step in a three step calculation model, consisting of:

4. Tapping requirements
5. Distribution system
6. Generation

6.1.2 Method

For all components and options in the calculation a list of required input data is given. In addition it is indicated whether these inputs require:

- New input data from the user of this standard.
- Data from previous, mostly more general input (like the floor area of a building).
- Data obtained from the standard itself.
- Data obtained from a national annex with national constants/parameters.

In case a computer program is used only new input data requires action; all other data is already in the program so no further action is required here.

For new input data it is indicated in what way it may be obtained in case this isn’t obvious.

6.2 Analysis of the standard

6.2.1 Introduction

The objective of this standard is to give calculation rules for heat loss and auxiliary energy consumption of *generation and storage systems* for domestic hot water. The corrected hot water demand, the sum of net hot water demand (prEN 15316-3-1) and distribution heat losses (prEN 15316-3-2), is the input for this calculation.

Generation heat losses may occur due to:

- Storage losses.
- Primary circulation pipe losses, circulating hot water between the generator and storage vessel.
- Generator losses.

Please note that for most combi-boilers these losses are hard to distinguish and performance test are carried out for the combi-boiler as a whole, also if a storage vessel is applied.

Auxiliary energy consumption may occur due to:

- Pump in the primary circulation system.
- Auxiliary energy consumption of the generator.

The *storage losses* are related to the heat loss of the storage vessel.

The *primary circulation pipe losses* are related to two effects:

- The heat loss of the pipes during the circulation of hot water to (re)heat the water in the storage vessel.
- The heat loss while the pipes cool down when the (re)heating is finished.

The generation losses are related to:

- Flue gas losses (for oil or gas fired generators).
- Convection and radiation losses of the generator. Since many generator constructions are applied these losses may have different origins.

6.2.2 Result output variables

The resulting output variables are:

$Q_{W,s}$	Heat loss due to hot water storage units in kWh/month
$Q_{W,p}$	Heat loss due to hot water distribution in kWh/month
$Q_{W,g}$	Heat loss due to hot water generation in ?
$W_{Wp,pump}$	Auxiliary electrical energy required for the primary circuit pump in kWh/year
?	Auxiliary electrical energy required for the generator in ?

Conclusions:

– The major output variables, discussed in the introduction, are covered by the standard.
– However a clear introduction of all these output variables is not given in the standard.
– Dimensions are not always clear in the standard.

Proposals for improvement:

– A clear introduction / overview of all output variables is required.
– A clear statement on the dimensions is required: MJ/year or kWh/year.

6.2.3 Hot water demand input variables

The required input variables are:

Q_W	domestic hot water energy demand in kWh/year
Q_{em}	heat emission loss, due to a delay before the outlet temperature reaches the desired temperature kWh/year
Q_d	distribution losses in kWh/year

The sum of these input variables is Q_{corr} (paragraph 6.1), the total hot water demand to be fulfilled by the storage/generator system.

Conclusions:

- All relevant input variables are mentioned but not at the start of the standard.
- The input variables are calculated in pt 1 and 2 of the standard.
- Dimensions applied here are different from the dimensions used in pt 1 and 2 of the standard (J/year or MJ/year).

Proposals for improvement:

- A clearer introduction of these input variables, including Q_{corr}, right at the start of the standard, is required.
- A clear statement on the dimensions is required: MJ/year.

6.2.4 Parameter input for storage heat losses (4 [2])

Method:

- The method calculates heat losses of indirect heated storage vessels. Direct heated vessels are treated as generators.
- The method assumes that stand-by heat loss is known and corrects it for temperature differences.
- In case stand-by losses are not available an estimation can be made. This requires (national) data in an annex.

The required input variables are:

$\theta_{W,s}$	Average temperature of stored water in °C
θ_{amb}	Average ambient temperature in °C
$\theta_{s,s\text{-}b}$	Average temperature difference applied in stand-by heat loss tests in °C
t_W	Duration of the provision of domestic hot water in days/month
$Q_{s\text{-}b}$	Stand-by heat loss in kWh/day

In case no stand-by loss is known, (national) data are required for the constants x, y and z in the following formula:

$$Q_{s\text{-}b} = x + y * V_s^z$$

With

V_s	Vessel volume in litres

Conclusions:

- The standard limits the use of this method to indirect heated vessels. Please note that combi-boilers for dwellings are often tested as a complete system so generation efficiency involves the storage for these systems.
- For existing storage systems stand-by losses are in general not known or easy to obtain. Therefore the formula for the stand-by loss needs to be used and a (national) annex with the constant values is required. Here also $\theta_{s,s\text{-}b}$ needs to be defined.
- The *average temperature of stored water* can be read from the thermostat setting and/or from a thermometer, if applied.
- The *average ambient temperature* per month or over the whole year is hard to establish so a (national) value is required.

Proposals for improvement:

- A (national) table / annex with parameter values for the stand-by loss formula, $\theta_{s,s\text{-}b}$ and the *average ambient temperature* per month or over the whole year is required.

[2] Numbers between brackets refer to paragraph numbers in the standard.

6.2.5 Primary circulation pipes (5)

6.2.5.1 Introduction

The methods apply for systems with indirect heated storage vessels and separate generators.

The related auxiliary energy use is also calculated here.

6.2.5.2 Simple estimation method (5.1)

Method:

– No formulas are given. This method allows national annexes with fixed representative values for heat losses.

Conclusion:

– This method requires national annexes with fixed representative values for heat losses.

6.2.5.3 Detailed calculation method (5.2)

Method:

– The method calculates heat losses using the basic heat loss equation for a pipe.
– The cooling down and heating up of the circulation system between two (re)heating periods is not taken into account; the method assumes that in off-time the losses are zero.

The required input variables are:

U	Length specific heat transfer coefficient in W/mK
L_i	Length of pipe section i in m.
$\theta_{W,p,i}$	Average temperature of pipe section i in °C.
θ_{amb}	Average ambient temperature in °C
t_W	Duration f the provision of domestic hot water in days/month
z	Running time of circulation pump in h/days

The index i relates to the pipe section.

Annex A gives characteristic values for:

– pipe lengths, depending on floor area;
– average ambient temperature;
– specific heat transfer for different locations and insulation.

Conclusions:

– This method allows a good distinction between circulation pipes with different pipe lengths, pipe diameters and insulation.
– However, since this method doesn't take into account the cooling down and heating up of the circulation system, calculated losses will be too low.

– This method requires data input of *pipe lengths, specific heat transfer, average ambient temperature and average pipe temperature*. Using a list of product data (pipe diameters and properties), data input is reduced to *pipe lengths, pipe material, diameter* and *insulation*.
  Pipe length can be obtained easily. Pipe diameter and insulation can be determined quite easy but if pipes are concealed it may be difficult.
– The *running time of the circulation pump* is depending on the heat demand of the vessel and the power of the heat generator.

Proposals for improvement:

– Addition of formulas to calculate the cooling down and heating up of the circulation system. This requires also an assumption on the number of generator cycles per day.
– Addition of a formula to determine the *running time of the circulation pump.*

6.2.5.4 Auxiliary energy (5.3)

Simplified method (5.3.1)

Method:

- For circulation pipes the method calculates pump power consumption as a function of on time and pump power rating.

The required input variables are:

$P_{p,pump}$ Power rating of the primary pump in kW

$f_{p,pump}$ Primary pump constant (in hours/year).

Conclusions:

- A straightforward method suitable for this purpose.
- Pump power can be read from the specs plate for most pumps.
- Pump on-time default value is 8760 hrs/year. Here the same formula to determine the *running time of the circulation pump* is needed like in paragraph 6.2.5.3. Please note that $f_{p,pump}$ here and z in paragraph 6.2.5.3 have identical meanings.

Proposals for improvement:

- In case no data on pump power is available a (national) default value is required, for instance relating pump power to heat generator power.

Detailed calculation method (5.3.2)

Method:

– For circulation pipes the method calculates pump power consumption per month as a function of pump power and the estimated on-time of the pump, using hot water demand and nominal generator power.

The required input variables are:

$P_{p,pump}$	Average power consumption of the pump in W
Q_n	Nominal heat output of the heat generator in kW
$\alpha_{TW,g}$	Proportional contribution of the heat generator
Q_W	Domestic hot water energy demand in kWh/year
Q_{Wh}	Not explained in the text – probably ment to indicate distribution and storage losses in kWh/year

Conclusions:

– The formula to determine the on-time of the pump ($f_{p,pump}$ inparagraph 6.2.5.4 and z in paragraph 6.2.5.3) is given here.
– Detailed and simplified methods can be integrated easily.
– Pump power can be read from the specs plate for most pumps.
– Nominal heat output of the heat generator can be read from the specs plate for most heat generators.
– Q_W and Q_{Wh} are already determined before.
– Proportional contribution of the heat generator is 1 if one generator is applied. No method is given in case more generators are involved.

Proposals for improvement:

– Detailed and simplified methods should be integrated.
– Q_{Wh} needs to be explained or corrected.
– A method should be given to obtain the *proportional contribution of the heat generator.*

6.2.6 Heat generation losses

6.2.6.1 Systems in single family dwellings (6.1)

Despite this heading in at least three other paragraphs methods for systems in single family dwellings are given (here treated in paragraphs 6.2.6.4, 6.2.6.5 and 6.2.6.6) and at least one paragraph (here 6.2.6.3) might be applied to. So this part of the standard requires more structure.

Method:

- The method given here anticipates on the new test standard for hot water heaters and assumes that for a range of hot water demands efficiencies are determined. Now by interpolation, using the corrected (or total) hot water demand, the generation efficiency can be calculated.

The required input variables are:

ηi	Generator efficiency at tapping cycle i
Q_i	Hot water demand at tapping cycle i
Q_{corr}	Corrected (total) hot water demand in kWh/year

Conclusions:

- Q_{corr} is already determined before.
- Efficiency and demand at test tapping cycles are only known for new boilers so this method is hard to use for old hot water generators.

Proposals for improvement:

- Allow (existing) national methods to be used, where possible based on (existing) national hot water generator tests, to be used for existing generators.

6.2.6.2 Systems in other buildings (6.2)

Method:

- For combined systems (combinations of solar panels, base heating, supplementary heating) and multiple boiler installations no clear formulas or methods are given.

Conclusions:

- No clear method available yet.

Proposals for improvement:

- Develop or apply (national) methods.

6.2.6.3 *Liquid oil and gas fired boilers (6.3)*

Method:

- The method given here uses full load and stand-by losses and uses the operation period for hot water production and heating to calculate boiler losses for hot water production.

The required input variables are:

$Q_{W,gl,100\%}$	Heat loss from boiler during firing in one 24 hour period in kWh/day
$Q_{g.sb}$	Stand-by heat loss of the boiler in kWh/day
$t_{W,g}$	Boiler operation period for domestic hot water production in days/month
t_H	Boiler operation period for space heating in days/month

Conclusions:

- Full load and stand-by losses are not generally available for existing boilers.
- Nor formulas or methods are given to estimate boiler operation periods.

Proposals for improvement:

- Allow (existing) national methods to be used, where possible based on (existing) national hot water generator tests, to be used for existing generators.
- Additional (national) data are needed on boiler losses in case no product data are available.
- Formulas and methods need to be given to estimate boiler operation periods.

6.2.6.4 *Alternative generators (6.4)*

Method:

For alternative generators the standard for space heating systems needs to be used.

Conclusion:

- The available methods for heat pumps for space heating systems are not suitable for combi-heat pumps and heat-pump boilers.

Proposals for improvement:

- National annexes on alternative generators are required to allow countries to handle this until a European method is worked out, based on normalized tests.

6.2.6.5 *Direct gas fired domestic storage water heaters (6.5)*

Method:

- Test data according to EN 89 should be used.
- If no data are available default values of 84 % (all appliances) or 98 % (condensing appliances) should be used.
- Stand-by losses should be obtained from EN 89 or be calculated according to annex C of the standard.

– For older heaters data may be given in a national annex.

Conclusion:

– Efficiency and stand-by losses according to EN 89 are not generally available for existing heaters.
– The formulas and methods to estimate stand-by losses are not worked completely.
– The given default values are not obvious and may be to optimistic for older heaters.

Proposals for improvement:

– National annexes on efficiencies and losses are required.
– Default values should be placed in a (national) annex .
– The method needs to be worked out better.
– The distinction between this method and the method in 6.2.6.1 needs to be clarified.

6.2.6.6 Direct electrical fired domestic storage water heaters (6.6)

Method:

– Test data according to prEN 50440 should be used.
– A complex looking formula is given in annex D of the standard to calculate heat losses.
– For older heaters data may be given in a national annex.

Conclusion:

– Efficiency and stand-by losses according to EN 50440 are not generally available for existing heaters.

Proposals for improvement:

– National annexes on (default) efficiencies and losses are required.
– The distinction between this method and the method in 6.2.6.1 needs to be clarified.

6.3 Conclusions and recommendations

Conclusions:

- The structure in the standard is not clear enough. The distinction between large systems with separate storage, circulation pipes and generators on the one hand and complete systems, including combi-boiler systems, in general for dwellings on the other hand is not clear.
- In the standard dimensions and to a lesser extend variable names are used in a confusing way.
- In general for the large systems with separate storage, circulation pipes and generators too little input data will be available to calculate heat losses.
- In general for the complete systems in dwellings too little input data will be available to calculate heat losses.

Recommendations:

- A clear distinction between large systems with separate storage, circulation pipes and generators on the one hand and complete systems, including combi-boiler systems, in general for dwellings on the other hand is required.
  The complete systems are in general tested as a whole so these figures can be used directly in this standard. Only efficiency / heat loss interpolation or correction for hot water demand lower than test demand is required.
- Improve the uniform way to treat dimensions and variable names in the standard.
- For the large systems with separate storage, circulation pipes and generators default heat loss data is required in (national) annexes, depending on easy to establish typology.
- For the complete systems in dwellings default heat loss data is required in (national) annexes, depending on easy to establish typology.

The comments sheets, which was sent to the CEN working group responsible for the prEN 15316-3-3 “Domestic hot water systems. Part 3-3. Generation” is added in annex D. This comment sheet contains the concrete recommendations to the working group regarding suggested changes the standard.

7. prEN 15316-1 (WI 7) “Heating systems in buildings. Method for calculation of system energy requirements and system efficiencies. Part 1. General”

7.1 Introduction

Objective

The objective of this document is to give an analysis of the usefulness for energy performance assessment for existing building of the standard on “Heating systems in buildings, Method for calculation of system energy requirements and system efficiencies - Part 1. General.”

The analysed standard concerns:

prEN 15316-1

Heating systems in buildings,

Method for calculation of system energy requirements and system efficiencies

Part 1. General

July 2005

This standard is a kind of umbrella calculation model for heating systems. Other standards deal with different components of heating systems, like:

7. Heat emission
8. Heat distribution
9. Heat generation
    - Boilers
    - Heat pumps
    - CHP
    - ---

7.2 Method

For all components and options in the calculation a list of required input data is given. In addition it is indicated whether these inputs require:

- New input data from the user of this standard.
- Data from previous, mostly more general input (like the floor area of a building).
- Data obtained from the standard itself.
- Data obtained from a national annex with national constants/parameters.

In case a computer program is used only new input data requires action; all other data is already in the program so no further action is required here.

For new input data it is indicated in what way it may be obtained in case this isn’t obvious.

7.3 Analysis of the standard

The objective of this standard is to specify the structure for the calculation of energy requirements of a space heating and domestic hot water system of a building.

This standard doesn't contain any calculation method on specific installation components, so this standard doesn't require any input itself.

7.4 Conclusions and recommendations

Conclusions:

- The structure and content of the standard is clear.
- This standard doesn't contain any calculation method on specific installation components, so this standard doesn't require any input itself.

Recommendations:

- No recommendations concerning input aspects.

No comment sheet has been submitted to the working group.

8. prEN 15193-1 (WI 13) Energy performance of buildings – Energy requirements for lighting – Part 1: Lighting energy estimation.

8.1 Introduction

8.1.1 Content of the standard

The standard has the following scope:

This European standard was devised to establish conventions and procedures for the estimation of energy requirements of lighting in buildings, and to give methodology for the numeric indicator of energy performance of buildings. It also provides guidance on the establishment of national limits for lighting energy derived from reference schemes.

The standard also gives advice on techniques for separate metering of the energy used for lighting that will give regular feedback on the effectiveness of the lighting controls.

The methodology of energy estimation not only provides values for the numeric indicator but will also provide input for the heating and cooling load impacts on the combined total energy performance of building indicator.

The method is suitable for non-residential buildings.

8.1.2 Main output variables of the standard

The method includes the calculation of:

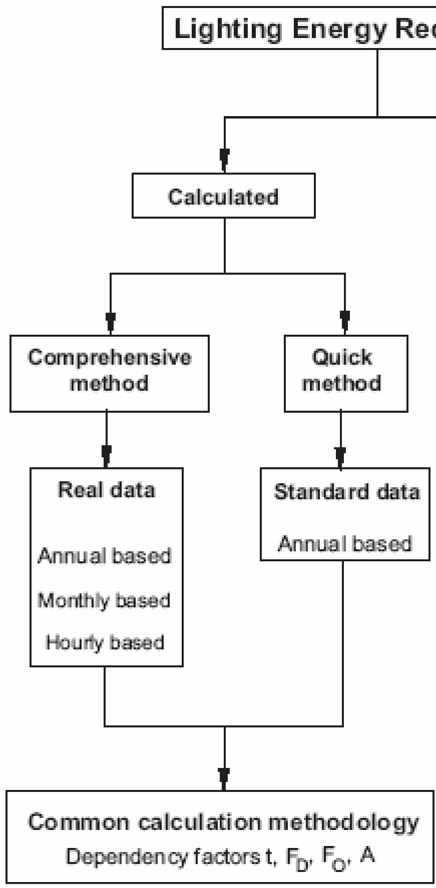
- The energy used for lighting
- Input for the heating and cooling load
- A lighting energy numeric indicator

All the methods described in the standard (see the next chapter) result in these output.

8.2 Analyses of the standard

8.2.1 Introduction

This standard contains two calculation methods and an advise on techniques for separate metering:



The calculation methods are based on the same principles and formula structure. Both take the following general influencing factors into account:

- installed power
- parasitic power[3]
- operating hours
- daylight impact
- occupancy impact

[3] The parasitic power supports the control system and charges power in the standby mode. (it should be discussed if parasitic is the right term; parasitic = for expenses of a third party)

The quick method uses much default values, where the comprehensive method contains more details.

8.2.2 Metering

The extended part about metering gives advise on how measurements can be performed. Because separate lighting circuits or a lighting management system is needed, the usability of the method is very limited. The title of the standard (estimation) does not correspond to this approach.

8.2.3 Quick method

The quick method uses a simple formula. Besides the installed power, all influencing factors (parasitic power, operating hours, daylight time use, non-daylight time use, daylight impact and occupancy impact) are tabulated or fixed values. The tables contain various building types and control types. The list of building types does not consequent correspondence with the tabled values, the “other types of energy consumption buildings” could not be calculated yet.

The installed power is an open input value. The standard gives a method how this value should be measured. Because measurement often is not an option when assessing an existing building, a simple calculation approach or a database with declared rated powers should be available. Also any information on parasitic power is missing. The standard in this way is not useful for estimations in existing buildings.

The daylight approximation in this method does not based on any physical background. The calculated results give unrealistic high numbers and therefore overestimate the energy performance for lighting

This method is very simple and easy to use for existing buildings if the input values are available, but very rough and inaccurate.

8.2.4 Comprehensive method

The comprehensive method allows for a more accurate determination of the lighting energy estimation.

The following influencing factors have to be determined:

- installed power
- parasitic power
- operating hours
- daylight impact
- occupancy impact

8.2.4.1 Installed power

See quick method.

8.2.4.2 Parasitic power

The parasitic power is an open input value. The standard gives a method how this value should be measured. Because measurement often is not an option when assessing an existing building, a database with declared rated powers should be available. It should be possible to use the default value of the quick method. Formally the standard does not allow this (yet).

8.2.4.3 Operating hours

The operation start and end time of the building are open input values. If these are not known, it should be possible to use the tabulated values of the quick method. Formally the standard does not allow this (yet).

The operation hours are divided in daytime hours and night time hours based on the latitude of the location. Besides the real latitude it should be possible to use a fixed latitude per county or region.

8.2.4.4 Daylight impact

The impact of daylight is determined in three steps:

- segmentation of the building into zones/areas with and without *daylight supply*;
- determination of the room parameters, façade geometry and outside obstruction estimation of *daylight penetration* into the interior space;
- prediction of the energy saving potential depending on the local - site dependent - *daylight supply* based on the estimation of *daylight penetration*

The rules for segmentation are easy usable in existing buildings. The definitions of zones are not analogue to the heating and cooling standards

The input parameters for determination of the room and façade geometry and outside obstructions are all accessible, but time consuming to gather.

The definition of daylight supply areas are unprecise, there is as well no rules for sectors receiving daylight from different facades or roof lights. A simple approach including estimated daylight factor is missing.

Roof lights could not be integrated in the calculation yet, because of missing formulars

The prediction of the energy saving potential is subsequently based on tables containing various locations and the maintained illuminance and control systems. There is no guidance about how to handle this illuminance.

8.2.4.5 Occupancy impact

The impact of occupancy is based on tables containing various systems and building types. This is easy to use for existing buildings.

8.2.4.6 *Monthly method*

The monthly redistribution might result in saving potential (in the summer month) bigger than 100%. The values have to be checked, or a better calculation accuracy has to be performed in the standard.

8.3 Conclusions and recommendations

This standard is one of the few standards which is made with a clear focus on metered values in existing buildings. This has resulted in the development of the quick method, which indeed is easy to use for existing buildings, but with less accuracy. The usability will be increased with the development of a calculation approach or a database with declared rated installed powers for various lighting and daylighting systems.

To be able to use the comprehensive method in an efficient way, it should be possible to choose per component (parasitic power, daylight impact, operation hours, etc) default values or a simple estimation method.

There is a strong lack of harmonisation with the thermal standards supporting the EPBD. The standard need an intensive revision before it could be implemented in an overall calculation procedure

These comments were submitted to the working group directly via a working group member. There has been no official comment sheet submitted.

9. prEN 15316-4-1 (WI 9) “Space heating generation systems – Combustion systems”

9.1 Introduction

9.1.1 Content of the standard

The analysed standard concerns:

PrEN WI 9, "Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies. Part 2.2.1 Space heating generation systems – Combustion systems".

Version: TC228WG4 N323Rev1 (Dec. 2004).

Remark 1: at the time of the analysis, the official prEN was not available yet.

Remark 2: this standard (part 2.2.1) is concerned with the generation efficiency of room heating only. Tap water heating is no part of this standard!

9.1.2 Main output variables of the standard

The standard lists the following output variables:

- the fuel heat requirement;
- the generation total heat loss (flue gas and generator envelope);
- the auxiliary consumption;
- the recoverable and recovered auxiliary energy;
- the recoverable generation heat losses

From this list we derive the following main output variables:

- Generator seasonal efficiency
- Auxiliary energy consumption

The standard gives three options, each covering the two selected output variables. Therefore, we can analyse the two main output variables together.

9.2 Analyses of the standard

9.2.1 Introduction

Quoting the standard:

"In this standard three performance calculation methods of the heat generation are described corresponding to different uses (simplified or detailed estimation, on site measurements ...).

They differ

- *in the data used,*
- *the running conditions taken into account,*
- *the considered of calculation period.*

The calculation method can be chosen in function of the available data and the objectives of the user."

In the next paragraph we will focus on the three methods.

9.2.2 Typology method:

Quoting the standard:

"The considered period is the heating season. The performance calculation is based on the data related to the boiler directive. The running conditions (climate, distribution system connected to the generator, ..) are resumed by typology of the considered region and not case specific. Therefore, if there is no appropriate annex with the adapted values, this method cannot be used."

At this moment there is only an appropriate annex available for the UK housing sector. The analyses is performed on the general procedure.

9.2.2.1 Analyses

The performance calculation is based on the data related to the boiler directive and on a simplified description of the boiler type..

Annex E1 contains a list of influencing factors and input parameters used in this method.

Input parameters:

The following list gives the disadvantages of some input parameters used in this method regarding existing buildings:

- Measured efficiency according to the boiler directive: These data can only be obtained by measurements which have to be performed in a lab and can not be

performed on site. For new buildings these data shall be provided by boilers manufacturers. A practical solution has to be defined to get these data or equivalent data for existing buildings.
- Burner type: Even though this parameter contains categories for input, some details appear to be not always easy to recognise in practise by non-experts;
- Store volume: For non-experts and without product information this parameter seems not easy to assess. However the question is if information about the store is relevant for the efficiency of the boiler for room heating. The store is used for tap water heating, which is dealt with in another standard (WI 11 part 3.3 'Domestic hot water. Generation'); a clarification has to be done regarding what is dealt with in this standard and in the other one.
- Output power (nominal power of boiler): Is this information available on the type tag of existing boilers? If not, this is information which is unknown.

Our vision is that the easiest way to use this method will be to develop at the national or international level a database with boiler data. The auditor will then collect information on the boiler type and will use the data base to get the boiler data. Such an approach is already applied in UK (www.sedbuk.com).

Influencing factors:

As this method is simplified some parameters are not taken into account.

- Boiler sizing: The sizing of the boiler is not considered in the method. So the impact of an oversized boiler which can lead to poor efficiency can not be considered.
- Ageing or maintenance : a measurement of the boiler combustion efficiency can be done on site especially for boiler inspection. A method could be introduce to correct the "initial efficiency" measured in test lab according to the results of this measurement.

Note: Ageing and age are different aspects. Age of the boiler of course is a problem, because older boilers are of a less efficient type. This is taken into account in the methods, because typology is an aspect in all methods.

- Operation : the boiler efficiency is dependent of the boiler operating temperature. Increase of building insulation could lead to a strong decrease of this temperature. It could be useful to introduce a simple correction factor on the boiler efficiency to take into account the actual boiler operating temperature.

Calculation procedure

The method is based on a very simple calculation procedure which can be applied easily on site. It can also enables to derive tables with efficiency which can be applied directly or with simple correction factors.

9.2.2.2 Conclusions

Our believe is that at least for small buildings auditors will want to use a table with seasonal efficiency values.

Our advise is to use this typology method as a guideline how to develop a simplified table with single seasonal efficiencies. The table should be produced by the developers of the standard (CEN or national), not by the auditor of the calculation.

It is important that this table can be applied to all existing boilers. Therefore a paragraph should be added within this typology method how to manage boilers (boiler types) which are not tested according to the typology method.

The method will then be used in cooperation with boiler manufacturers to develop data bases enabling to get easily the information regarding a single boiler.

It could be important to introduce an additional factors to take into account boiler over sizing which can have an important impact on boiler efficiency.

Single correction factors could also be introduced in the method to take into account boiler ageing and maintenance as well as actual boiler operation.

The calculations to be performed on site are very simple and easily applicable.

9.2.3 Case specific boiler efficiency method

Quoting the standard:

"This method is also based on the data related to the boiler directive, but complementary data are needed in order to take into account the specific running conditions of each individual installation. The considered period can be the heating season but also a shorter period (month, week, or the operating modes according prEN 13790). The method is not limited and can be used with the default values that are given in an informative annex E2.

Principle:

a) the losses are expressed for three different load ratios or power outputs

b) the calculation of the losses for a specific load, is made by linear interpolation between these three power outputs."

9.2.3.1 Analyses:

Like the typology method, this method as well is based on data related to the boiler directive, which is suitable for new boiler only. However, the method gives an alternative, based on default values (categories).

Annex E1 contains a list of influencing factors and input parameters used in this method.

Input parameters:

The following list gives the input parameters used in this method regarding existing buildings as well as potential difficulties to assess them:

- Measured efficiency and losses. (at three loads) according to the boiler directive: The problem is the same as for the typology method, moreover the method request the losses at 0% load and the measurement of this value is not mandatory according to the directive. A practical solution has to be defined to get these data or equivalent data for existing buildings. The method gives an alternative, based on default values (categories), nevertheless these default values are based on limits defined in the boiler directive and are not necessary adapted to old boilers which do not comply with the boiler directive
- Correction factor taking into account the variation of temperature as a function of the average temperature. Default values are given.
- Water temperature of the boiler, function of the specific running conditions. A method is given to assess this value based on the design data for new buildings but no method is given on how to asses this data for existing buildings. Such a method could be developped
- Output power (nominal power of boiler): This value is used to assess the impact of boiler sizing according to load.
- Recovery of envelope heat loss based on a typology of the burners. This value could easily be assessed in existing buildings.

Influencing factors:

This method enables to take into account the boiler sizing and the boiler operation which are not considered by the typology method.

One parameter is not considered:

- Ageing or maintenance : a measurement of the boiler combustion efficiency can be done on site especially for boiler inspection. A method could be introduce to correct the “initial efficiency” measured in test lab according to the results of this measurement.

Calculation procedure

The calculation method takes into account the interaction between the building and the hvac system. Considering these interactions leads to a more accurate but also to a more complex method. The calculation procedure shall be applied monthly. There is no possibility to derive simple tables.

9.2.3.2 Conclusions

List of pro’s en con’s of the typology method regarding existing buildings:

To apply this method to existing building it is necessary to develop a data base enabling to get an easy access to boiler characteristics. This data base could include default data for all types of new or old boilers.

This method enables to take into account more influencing factors than the typology methods. It considers especially the boiler sizing and the boiler operation. The approach to take into account these parameters for new buildings is defined in the standard but an approach adapted to existing buildings shall be developed.

The method include an interaction between the hvac system and the building which leads to more accuracy but also to more complexity.

A calculation software is necessary to perform the calculations, it is not possible to derive simple tables.

9.2.4 Boiler cycling method

Quoting the standard:

"This method distinguishes in a more explicit way the losses of a generator which occurs during boiler cycling (ie. combustion losses). Some of theses parameters can be measured on site. This method is well adapted for existing buildings."

"The calculation method is based on the following principle.

The operation time is divided in two parts:

- *burner on operation;*
- *burner off operation (stand-by)*

Losses are taken into account separately for these two periods of time.

During burner operation, the following losses are taken into account:

- *sensible heat of flue gas with burner ON.*
- *heat losses through generator envelope*

During burner OFF time, the following losses are taken into account:

- *sensible heat of air flowing to the chimney*
- *heat losses through the generator envelope*

Auxiliary energy is considered separately if it enters the system before or after the heat generator."

9.2.4.1 Analyses:

The standard states that this method is specially suited for existing buildings. Indeed the measurements used are suitable for existing situations.

Annex E1 contains a list of influencing factors and input parameters used in this method.

Input parameters:

The following list gives the disadvantages of some input parameters used in this method regarding existing buildings:

- Output power (nominal power of boiler): Is this information available on the type tag of existing boilers? If not, this is information which is unknown;
- Various measurements: these are only suitable in situations where there is time and expertise available to perform these measurements. When only a quick visit is possible, the method appears not to be suitable. The methods contains the possibility to use default values, but a measurement under actual conditions is needed in every alternative.

Influencing factors:

The advantage of using measurements under actual conditions is that the aspects **maintenance/ageing** are taken into account.

A missing factor is **operation**. Like mentioned earlier, to our opinion, this factor does not influence the performance of the boiler generation efficiency enough to take it into account.

9.2.4.2 Conclusions

List of pro's en con's of the typology method regarding existing buildings:

Pro's:

- No for existing buildings specially relevant influencing factors appear to be missing in the method.
- The method is suitable for existing buildings when there is time and expertise available to perform the measurements.

Con's:

- If no time and expertise is available to perform the measurements there is a problem to assess this information;
- This method also does not result in a simple table with seasonal efficiencies.

9.3 Conclusions and recommendations

The standard CEN prEN WI 9, part combustion systems, gives three options, each covering the two main output variable:

1. typology method
2. case specific boiler efficiency method
3. boiler cycling method

Our main believe is that for existing buildings simple tables are preferred.

The typology method could be the basis to build a table with single efficiencies. This table could be easily used and will be very well adapted to existing buildings.

It is desirable to have a common procedure to derive the tables. It could also be desirable even to derive common tables.

An important question is: What should be the length of the table? Should it be a database like the UK database (www.sedbuk.com) or should it be a short table with data clustered by categories (like the tables in annex P of WI 5, the prEN about 'Inspection of boilers').

The possibilities of a European database is a subject for the ENPER-Exist Roadmap (WP 4).

Correction factors

Three additional factors have an impact on boiler efficiency

- Boiler sizing
- Boiler operation
- Boiler ageing.

The standardisation committees or future research work should look for the relative impacts of these three parameters and solutions on how to consider them in simple methods applicable to existing buildings.

No comment sheet was submitted, because the analysis was done way before the publication of the prEN standard. The comments were submitted via a member of the working group.

10. prEN 15217 (WI 1 + 3) “Energy performance of buildings – Methods for expressing energy performance and for energy certification of buildings”

10.1 Introduction

The Energy Performance Directive of Buildings requires Member States to develop a energy performance certificate for buildings. prEN 15217 contains an annex which is intended to be used by national bodies setting up a certification scheme to document this scheme.

Within the scope of the first work package of ENPER Exist (WP1: Tools Application) this annex was send as a questionnaire to the partners of the project and some other contacts outside to project. The goal is to get an impression on the plans of the different Member States regarding the content of the energy certificate, the proposed indicator, the performance scales and the classification of recommendations for cost-effective improvement.

The development of the schemes in the Member States is a fast continuing process. Therefore the answers given can easily be outdated. The results of the questionnaire should be seen in that context. To avoid misunderstandings about state of the implementation in specific Member States, the answers are made anonymous.

A general overview of the respondents is given in paragraph 10.2. Paragraph 10.3 gives the results of the questionnaire for each question. Paragraph 10.4, gives a short summary of the most important results.

The annexes of the standard are given in Annex F

10.2 Respondents

The questionnaires were filled in by the participants of ENPER Exist. In addition some questionnaires were filled in by contact persons outside the project.

Most Member States did not have a certification scheme running at the moment when they answered the questionnaire. Please note that Member States who do have a scheme running, voluntary or mandatory, probably will change the scheme in the coming period because of the introduction of the EPBD.

The questionnaires were answered based on the previously running schemes or on preliminary ideas of the new schemes. The development of the schemes in the Member States is a fast continuing process. Therefore the answers given can easily be outdated.

Because in a lot of Member States different methods are developed for residential buildings and non-residential buildings, the questionnaire was often filled in for either one of those categories.

The answers to the questionnaire contain results from:

- Denmark - based on a mandatory running scheme
- Flanders - based on preliminary proposals of the schemes for new residential buildings, offices and educational buildings
- France - based on a voluntary running scheme for residential buildings
- Germany - based on preliminary proposals of the schemes
- Greece - based on preliminary proposals of the schemes
- Ireland - based on preliminary proposals of the schemes for single family houses
- The Netherlands - based on a voluntary running scheme
- Sweden - based on preliminary proposals of the schemes
- Portugal - based on preliminary proposals of the schemes
- UK - based on preliminary proposals of the schemes

10.3 Results in detail

This chapter contains the results of the questionnaire for each question. The questions are given in a text block, which is followed by a summary of the answers.

10.3.1 Application domain of the scheme

The scheme apply to the following building types

☐ *Single family houses*	☐ *Apartment block*	☐ *Other residential buildings*
☐ *Offices*	☐ *Education buildings*	☐ *hospitals*
☐ *Hotels and restaurants*	☐ *Sport facilities*	☐ *Wholesale and retail trade service buildings*
☐ *Industrial buildings*	☐ *Storage*	☐ *Other types:* ....

Some methods only apply on residential buildings. In that situations mostly single family houses as well as apartment blocks and other residential buildings are included. Some methods only apply to offices or to offices and educational buildings.

From the methods which take into account almost all categories, only two methods takes into account industrial buildings and no method takes into account storage buildings.

Other types of buildings which are mentioned are: religious and agricultural buildings (both on a voluntarily bases) and not clinical heath care buildings.

For apartments or units designed for separate use in blocks the certification is based on the assessment of :

☐ *the apartment or unit* ☐ *a common certification of the whole building*
☐ *another representative apartment or unit in the same building*

Never “another representative apartment or unit in the same building” was chosen. Two methods are based on “the apartment or unit”, three on “a common certification of the whole building”, with four methods both options were possible.

It can be applied in the following situations

☐ *Rent* ☐ *Sales* ☐ *New buildings after construction* ☐ *Display in public buildings*

Five methods can be applied in all situations.

Two methods can only be applied to new buildings, one only to rent and sales situations, one to sales and new buildings and one to rent, sales and new buildings but not to display in public buildings.

10.3.2 Basis of the rating

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

Energy uses

Space heating	☐	*Hot water*	☐
Mechanical ventilation	☐	*Lighting*	☐
Space cooling	☐		

Energy production, in particular by renewable sources and co-generation. ☐

Other uses of electivity: ☐ ....

All method take into account space heating and hot water. In addition, all but one take into account mechanical ventilation. Two methods, valid for only residential buildings, do not include space cooling. Three methods, valid for only residential buildings, do not take into account lighting. In addition, one method, valid for only residential buildings, says to take lighting into account, but only based on specific electricity consumption for lighting.

All methods but one take into account energy production, in particular by renewable sources and co-generation, but sometimes this only applies to solar systems.

Other uses of electricity which are mentioned are:

- conventional values that include lighting and cooking (residential buildings)
- auxiliary energy for pumps and fans, but not domestic appliances (residential buildings)
- Fans, pump, humidification, other equipment
- all uses
- all uses, because the method is an operational rating

The indicator used represents

☐ *Delivered energy* ☐ *Primary energy* ☐ *CO2 emission* ☐ *Cost*

The weighting for each energy carrier are:

....

The following combinations of indicators is used in the various methods:

- Delivered energy and CO_2 emission 1x
- Delivered energy, Primary energy and CO_2 emission 1x

- Primary energy and CO_2 emission 2x (one of these methods can also calculate delivered energy and cost)
- Delivered energy and Primary energy 1x
- Primary energy 4x
- Delivered energy, CO_2 emission and cost 2x

Not all weighting factors are given, the next ones are mentioned:
- Heating and electricity are calculated separately (method without primary energy)
- Heating and electricity (and water) are registered separately (operational rating)
- electricity: 0.29 kg of oil equivalent/kWh, other fuels 0.086 kg of oil equivalent/kWh

Primary energy:
- 2,58 for electricity, 1 for the other
- 2.78 for electricity, natural gas and LPG 1.1, domestic fuel oil 1.2, coal 1.1, wood pellets 0.2, CHP fossil fuels 0.6, solar direct hot water 0 (with auxiliary consumption to be added
- 2.5 for electricity, electricity produced by cogeneration 1.8, fossil fuels 1, biomass 1

CO_2-emission:

-

	Heating	other
No system	0.18	0.04
Electricity	0.18	0.04
GAZ	0.205	0.205
Fuel	0.27	0.27
Wood	0	0
Coal	0.342	0.342
District heating	0.3	0.3

- natural gas 198 gr/kWh final energy, domestic fuel oil 257 gr/kWh final energy, coal 325 gr/kWh final energy, LPG 225 gr/kWh final energy, peat 229 gr/kWh final energy, wood pellets 62 gr/kWh final energy, electricity mix 688 gr/kWh final energy

Note that the question appears to be misunderstood in some cases: here answers were given in relation to normalisation or neutralisation of the indicator.

The rating is an:

☐ *Asset rating (rating based on calculations of the energy used by a building for heating, cooling, ventilation, hot water and lighting, with standard input data related to internal and external climates and occupancy)*

☐ *Operational rating (rating based on measured energy use).*

Most methods are based on asset rating. Some methods use operational rating in specific situations, stated in the table below.

Asset rating	**Operational rating**
One family houses	Apartments and multi family houses
New buildings, major renovated buildings, existing residential buildings, existing non-residential buildings changing of use or occupant	Existing non-residential buildings remaining with the same use and the same occupant
Small buildings (<1500m^2)	Large buildings (>1500m^2)

The dimensions used are

☐ *Internal dimensions (length measured form wall to wall and floor to ceiling inside each room of a building)*

☐ *External dimensions (length measured on the interior of a building, ignoring internal partitions)*

☐ *overall internal dimensions (length measured on the exterior of a building)*

All three options are used in several methods.

Note: The description of overall internal dimensions and external dimensions is mixed up in the question, so it is not clear how these two options were interpreted by the people who filled in the questionnaire.

10.3.3 Classification

The energy performance classes are described in the following way:

☐ *According to Annex A of this document* ☐ *Following an other procedure*

if the annex A is not used describe the classification procedure and the limits of the classes

Only one method will describe the classes according to Annex A, although even here there might be small adjustments, namely considering sub-categories (e.g., A1-A3, B1-B3, etc.).

The following remarks were made regarding the methods which will (probably) follow other procedures:

- "The energy consultant assesses the energy condition of the building and labels it A, B or C on the Energy Rating: A is the highest mark. Heating, electricity and water are assessed separately. When heating is being assessed, the marks A, B and C are further divided into five sub-categories from 1 to 5, 1 being the best mark. Thus the scale for heating goes from A1 to C5."

- "The label consists of four ratings on a scale from A to M. The actual heat consumption is climate corrected yearly to a normal year through the use of degree days by the ELO consultant, while electricity and water consumption is not climate corrected. Finally, the energy performance and total environmental impact are calculated and rated (A to M) on behalf of amount and emission figures for the actual supplied electricity and heating."
- "An open scale (Tachometer) with reference values is used"
- "A continuous scale is used, based on the ratio of the primary energy consumption of the building divided by a conventional allowed energy consumption."
- "The following classes are proposed:

KWh primary energy / m²	Class
X ≤ 50	A
50 < X ≤ 100	B
100 < X ≤ 200	C
200 < X ≤ 300	D
300 < X ≤ 450	E
450 < X ≤ 600	F
X > 600	G

kg CO2 / m²	Class
X ≤ 10	1
10 < X ≤ 20	2
20 < X ≤ 30	3
30 < X ≤ 40	4
40 < X ≤ 50	5
50 < X ≤ 60	6
X > 60	7

"

10.3.4 Classification adaptation

Describe the procedure used to adapt the classification to *Variations of the external climate* *...* *Specific use of the building: eg to differentiate between buildings which are used 5, 6 or 7 days a week, or buildings having different occupation densities* *...*

The following answers were given concerning the climate:

- "The limits of the classes are the same for the whole country, they do not depend on the climate."
- "The energy consumption for heating and for cooling are corrected by the ratio of the nominal needs (asset rating) of the building in the real location and in a reference location."
- "Only the national climate is used (some indicators in the energy calculation are based on the national climate as well)."
- "No adapatation in function of the external climate. The calculation of the asset rating are made with a typical climate."
- "No variation is used for asset rating and a degree days correction is used for operational rating."
- "The actual heat consumption is climate corrected yearly to a normal year through the use of degree days by the consultant, while electricity and water consumption is not climate corrected."
- "Average monthly weather data is used."

The following answers were given concerning the specific use:

- "Conventional occupation is used."
- "Asset ratings are calculated according to nominal profiles of use by type of building, in terms of both hours/day and days/week of use, and even holidays for schools."
- "Standard uses are used depending on the building type."
- "A standard use of the building is assumed. The real occupation pattern of the building is not taken into account to estabish the certificate (new building)."
- "34 different user profiles are available to be applied for asset rating, different benchmarks are developed for operational rating."
- "The scheme is based on measured values."

10.3.5 Reference values

Explain how the limits of the class are linked to the following points

Energy performance regulation reference. This corresponds to the limit value that should be expected of new buildings in conformity with national or regional Energy Performance Regulation in 2006

Building stock reference. This corresponds to the value that should be expected to be reached by approximately 50 % of the national or regional building stock in 2006

Zero energy reference:This correspond to a building that produces as much energy as it uses.

..

The following answers were given concerning the energy performance regulation reference:

- "Class B."
- "Low B"
- "New buildings meeting the national Energy Performance standards will get class A or A+."
- "No classes are used. The maximum level (100) will be imposed to new buildings by the new energy performance regulation."
- "An A3 house will fulfil the building regulation."

The following answers were given concerning the building stock reference:

- "Reference for 1990 regulations"
- "Not decided yet what is the definition of the average building stock. I.e. not decided yet if there will be reference to the energy performance of 50% of the building stock or that certain groups of buildings will be excluded here or get a weighting factor."
- "No studies done yet to assess the average level."
- "The average letter G correspond to the average of the consumption's on the registered labelling schemes. The average consumption is updated regularly."
- "A B3 house is a typical one single-family house."

The following answers were given concerning the zero energy regulation reference:

- "Not taken into account yet: Class A = < 50 kWh pe / m^2. Later a A+ class could be added"
- "Not applicable."
- "Zero energy buildings probably will get an A+ classification (or even A++)."
- "Zero energy buildings correspond with a level of 0. A building producing more energy than what is consumed will have a negative level."

10.3.6 Certificate format

The format of the certificate is
Based on annex B of this document : ☐ Yes ☐ No partly
Describe the details of the certificate.
..

Almost all methods use a different format than is presented in Annex B of the questionnaire. But 6 methods use a label which looks a lot like the A-G label with the green to red coloured arrows.

Some methods use a continuous scales (sometimes in addition to the A-G scale).

10.3.7 Recommendations

Describe the recommendations given by the certificate:
..

The following recommendations are given in the various methods:

- "The experts will indicate the recommendations on building insulation + heating system + hot water system + ventilation improvements. A general list of "good energy behaviour" points should be added to inform the end-user."
- A standard list of possible measures is included in the Energy performance Certificate. The measures appropriate for the specific building are checked The standard list for non-residential buildings contains the following measures:
    - Floor insulation (or improvement of this)
    - Roof insulation (of improvement of this)
    - Wall insulation (or improvement of this)
    - High Performance glazing
    - Sun blocking glazing
    - Solar shading
    - Improvement of air tightness
    - High efficiency boiler
    - Heatpump
    - CHP
    - Heat recovery from ventilation air
    - Throttle control fans
    - Revolution control fans
    - Revolution control pumps
    - Energy saving lamps and/or high frequency lighting with mirror fittings
    - Sweeping switch and/or daylight controlled lighting
    - Heatpump boiler
    - Insulation of pipes and fittings

- Solar energy system
- Ground coupled heat/cold storage
- Moisture recovery

The standard list for residential buildings contains the following measures:

- Floor insulation (or improvement of this)
- Roof insulation (of improvement of this)
- Wall insulation (or improvement of this)
- High Performance glazing
- Door insulation
- High efficiency boiler
- High efficiency boiler for combined space heating and domestic hot water
- Heatpump
- Heatpumpboiler
- Insulation of pipes for the circulation of hot water
- Solar energy system
- Direct current fans
- Improvement of air tightness
- Insulation of pipes for space heating
- Water saving showerhead"

- "A detailed proposal is based on economic values for asset rating. A general proposal is based on building types/building use for operational rating."
- "Cost efficient advises addressing measures that will be cost efficient in the future"
- "The energy plan shall include an estimate of investments and annual savings involved in the individual proposals and the estimated economy during lifetime of the measures proposed. Finally the plan shall state the user-economic cost-effectiveness of the individual proposals. Energy rating and an energy plan shall be drawn up once a year. Energy rating shall consist of a standardised energy rating based on inspection of the building and the owner's registration of actual energy and water use and CO_2 emission. The energy plan shall include proposals for profitable saving for all types of energy and water use in the building."
- "For all buildings an energy plan shall be drawn up that includes proposals for profitable savings for all types of consumption of energy and water of the building. Furthermore, the energy plan shall include an estimate of investments and annual savings involved in the individual proposals and the estimated economy during lifetime of the measures proposed. Finally the plan shall state the user-economic cost-effectiveness of the individual proposals."

10.3.8 Experience with the certification scheme

☐ *The scheme is under development* ☐ *The scheme was applied to a pilot study:* *Describe the pilot study and give the number of buildings where the scheme was applied* ☐ *The scheme is under application* *define the number of buildings where it has been applied*

Three of the methods are under application. Two of them are mandatory. In the last 6.5 years 100.000 non-residential and 300.000 residential buildings were assessed with these methods. The other is a voluntary method. During the last 5 years 500.000 residential buildings were assessed with this method.

The other methods are under development. Four of them are used in pilot project with various numbers of buildings (1, 50, 100 and 5000).

10.4 Main results

A summary of the most important results is given below:

- Most methods which assess residential buildings assess all types of residential buildings and not just single family houses or apartment blocks
- Methods which assess non-residential buildings often assess all buildings types except
    - storage buildings and
    - (often) industrial buildings
- Methods which assess residential buildings never asses apartments or units based on another representative apartment or unit. Residential buildings are assessed per unit or a common certificate is made of the whole building.
- In general all methods take into account all uses of energy. Methods for residential buildings sometimes do not take into account space cooling and or lighting.
- All methods use at least primary energy or CO_2-emission (or both) as indicator. In addition delivered energy is also often used. Cost is used as indicator but only in a few situations.
- Most methods are based on asset rating, some methods use operational rating in specific situations.
- There appear to be roughly two types of labelling schemes:
    - schemes using categories
    - schemes using a continuous scale
- The schemes which use categories almost all will use variant of the A-G arrow scale. Some examples of these variants:
    - some will use more or less classes (e.g. A-M)
    - some will use a sub-rating (e.g. A1-3, B1-3, C1-3 etc)
    - some will use a scale for CO_2 in addition
- The type of recommendations given by the certificate varies from a standard list on which appropriate measures are checked to detailed proposals.
- Three methods are under application: one voluntary, two mandatory (one for small and one for large buildings). With the mandatory methods in total 100.000 non-residential and 300.000 residential buildings were assessed, the voluntary method in total assessed 500.000 residential buildings until now.
- All other methods are under development. Four of them are used in pilot project with various numbers of buildings (1, 50, 100 and 5000).

Annex A: Comment sheets to CEN: prEN ISO DIS 13790 (WI 14) “Energy performance of buildings – Calculation of energy use for space heating and cooling”

This annex contains the comments sheets, which was sent to the CEN working group responsible for the prEN ISO DIS 13790 (WI 14) “Energy performance of buildings – Calculation of energy use for space heating and cooling”.

	General comment		ge	Within the EU Save project ENPER Exist this draft standard was analysed to see if it is suitable for existing buildings. Some special attention is needed to some input data to make the data acquisition in existing buildings possible within the boundary conditions which are relevant in existing buildings (few inspection time, no specific expertise of inspector). All comments based on the ENPER Exist analysis begin with “From ENPER Exist:”.	When default tables with national values are suggested, it would be very helpful and good for harmonisation if (e.g. in an informative annex) a procedure to derive such a default table or at least an example of such a default table is given in the standard.	
	3 Terms and definitions	3.8 conditioned space	te	From ENPER Exist: The current definition of an conditioned space “room or enclosure heated and/or cooled to a given set-point-temperature” means that only spaces with a set-point temperature are conditioned spaces and therefore lie within the calculation zone (see 6.2). However, in existing buildings one can encounter for example a local heating device without a given set-point temperature, or a dwelling with one set-point temperature for the living room. Other spaces within the thermal envelope are indirectly conditioned. In the current definition of a conditioned space these two examples implicate that the whole, or almost the whole building is an unconditioned space and implicitly the thermal envelope is an inner partition. It is not likely that this is the intention.	Change the definition of a conditioned space in “room or enclosure heated and/or cooled”.	
	6.3.3 Criteria for partitioning into zones		ge	From ENPER Exist: The input has to be gathered per zone. To allow short visits the amount of zones should be minimised for existing buildings and it should be very clear from the beginning which zones have to be taken into account. The strict rules for partitioning are a concern for existing buildings.	???	
	7.2 Energy need for heating and cooling	local heating		From ENPER Exist: A problem with heating systems in existing buildings is that old houses often have a local heating system. This results in a poor thermal comfort, but also in low energy consumption because large parts of the house are not heated at all. This low energy consumption may lead to a relative good energy performance. It is a question	Suggested is to introduce e.g. a ‘comfort correction’ to take this into account, the same way as it is done in the Dutch EPA (EP advise for existing buildings).	

				whether this is a desirable situation.		
	8.3 Transmission heat transfer coefficients	U-value of glazing	ge	From ENPER Exist: Aging of glazing is a very slow process and is not taken into account in the determination of the U-value of glazing. It should be noted that this is a matter of concern for existing buildings because the effect can be large.	Solved in WI 14 or WI 23/24???	
	8.3 Transmission heat transfer coefficients	thermal bridges	ge	From ENPER Exist: Taking into account thermal bridges can be a time consuming task. The effect of a thermal bridge depends on the type of thermal bridge and on the insulation value of the construction surrounding the thermal bridge. For poor insulated buildings, the effect of heat bridges is very small. In moderately insulated buildings the effect of poor designed connections can be as huge as small thermal bridges in good insulated buildings. So ignoring thermal bridges in existing buildings is no solution. Taking into account all thermal bridges is not efficient either. There should be a method which gives a good balance between the insulation value of the building and the type of heat bridge which may be ignored and which have to be taken into account, preferably using as much default values as possible and as few input parameters as possible.	It can be discussed if a simplified method for thermal bridged should be part of ISO/DIS 13789 or prEN ISO 13790. We suggest to give a simplified method for thermal bridged in prEN ISO 13790 in a special paragraph under 8.4 “Input data and boundary conditions”. Suggested is to take the impact of the thermal bridge into account as a variation of the U-Value of the wall or a variation of heat transfer coefficient by transmission. The value of this variation depending on the level of insulation of the wall	
	8.3 Transmission heat transfer coefficients	the effect of adjacent unconditioned spaces	ge	From ENPER Exist: To calculate the reduction factor b in the heat transmission coefficient, a lot of information of the unconditioned space needs to be collected. The amount of work collecting these data is not in proportion with the extra accuracy of the calculation results. The value for the b-factor lies in the same order for a lot of unconditioned spaces.	Default b-factors for unconditioned spaces may be defined at national level for different types of unconditioned spaces with recommendations when to use them. The b-factor may also be calculated.	
	8.3 Transmission heat transfer coefficients	the effect of adjacent sunspaces	ge	From ENPER Exist: The effect of sunspaces is divided un a transmission part and a solar radiation part. The calculation of this coefficient is described in other standards (WI 23/24), but the method (data acquisition) is too labour intensive for	Suggested is to introduce a simplified method in prEN ISO 13790 to determine the effect of sunspaces in which these two parts are combined, preferably using as much default values as possible and as few input parameters as possible. Because of large national differences, default	

				existing buildings.	values have to be determined on national level.	
	8.4.2 Effect of nocturnal insulation	U-values of windows and window and shutter	ge	From ENPER Exist: For existing buildings to be able to use the method to calculate the effect of nocturnal insulation, a list with default values of U-values of windows and combinations of windows is needed. And a typical default pattern (shutter open/closed) should be available on national level. Patterns can be different for week days and weekend days and for different building functions.	Suggested is that for different windows and combinations of windows and shutters a lists is made available on national level, taking into account aging if relevant. Idem for a default pattern.	
	9.3 Ventilation heat transfer coefficients	air tightness	ge	From ENPER Exist: The calculation of this coefficient is described in other standards (WI 18/21). Adaptation to existing buildings of this element is the concern of these other standards. It should be noted that the characterisation of the air tightness of existing buildings is a matter of concern. It would be very helpful if a table with default values was available.	Suggested is to add default tables of the air tightness, based on the age of the building / type or material.	
	9.3.1 General		te	From ENPER Exist: The supply temperature of the airflow from mechanical ventilation should not be a value to be measured during building inspection, because this data is hard to collect. It should be a default value dependent on system characteristics.		
	10 Internal heat sources	10.3 Input data and boundary conditions	ge	From ENPER Exist: Part of this data is determined in other standards (WI 7-12, 13, 18-21 etc) For all the other data a list of default values should be available on national level for different building types and building use. The same applies to the schedules used.	Provide tables with default values for the various elements of internal heat sources. The same applies to the schedules used. Make a link to the (default!) pattern of occupancy of the zone. It might be useful to provide a larger number of pattern of use of the zone compared to what is usually provided for new buildings.	
	10.2	$Q_{i,u,l}$	te	From ENPER Exist: To calculate the heat flow rate from internal heat sources	Add a sentence that internal heat sources in adjacent unconditioned spaces may be	

				in unconditioned spaces, a lot of information of the unconditioned space needs to be collected. Especially with large b-factors the influence of these internal heat sources on the conditioned space is small.	neglected under certain conditions.	
	10.3.2.4 Heat dissipated from or absorbed by heating, cooling and ventilation systems		te	From ENPER Exist: The heat flow rate from heating, cooling and ventilation systems shall be obtained from prEN 7-10, 12, 18-19. It is not preferable that an extensive inspection is needed to collect data for the calculation of this heat flow rate. For example boiler sizes, thermal insulation level of boilers etc.	Add the sentence that the heat flow rate from heating, cooling and ventilation systems may be defined on national level as a function of the system characteristics.	
	10.3.2.4	Alternative option :	ed	From ENPER Exist: In the first sentence it says “hot water system”, but this part is about the space heating system.	Replace “hot water system” with “space heating system”.	
	11.2 Total solar heat sources	formula 22	te	From ENPER Exist: To calculate the solar heat sources in unconditioned spaces, a lot of information of the unconditioned space needs to be collected. In fact the solar heat sources in unconditioned spaces can often be neglected. In most case unconditioned spaces are not parts of the usable floor area and therefore no daylight requirements exist for these spaces.	Add a sentence that solar heat sources in adjacent unconditioned spaces may be neglected if not a sunspace.	
	11.4 Solar heat sources	11.4 Input data and boundary conditions	ge	From ENPER Exist: For g-values the draft refers to other standards. It would be very helpful if a table with default values was available.	Suggested is to give default values for the g-values of typical window types with and without shading.	
	11.4.3 external shading reduction factors	solar shading	ge	From ENPER Exist: The calculation method for the external shading reduction factor proposed in annex G is time consuming. One has to determine horizon, overhang and fin angles for every single glazing in	Add the sentence that the shading reduction factor of glazing may be defined at national level as a function of the type of shading device (horizon, overhang, fin).	

				order to calculate it's shading reduction factor.		
	11.4.4 Frame fraction		te	From ENPER Exist: The fixed values for the frame factor (0,3 in heating mode and 0,2 in cooling mode) should not be compulsory. Because of the different window typology in the various EU countries, a fixed frame factor should be defined at national level. Only one frame factor for both heating and cooling mode could be sufficient.	Replace the sentence "The value shall….cooling mode calculations" with "The value shall be determined at national level".	
	11.4.5 Opaque building elements		ge	From ENPER Exist: It would be very helpful if a table with default values was available for: - the absorption coefficient of opaque elements - the external surface heat resistance of the considered opaque construction	Suggested is to give default values for: - the absorption coefficient of opaque elements - the external surface heat resistance of the considered opaque construction	
	12 Dynamic parameters	internal heat capacity	ge	From ENPER Exist: It would be very helpful if a table with default values was available for the internal heat capacity for typical constructions.	Suggested is to give default values for the internal heat capacity for typical constructions on national level.	
	13 Indoor conditions	Setpoint temperature	ge	From ENPER Exist: For existing buildings a easy method is needed to obtain the setpoint temperature.	Suggested is that for different building types a list of default values is made available on national level. Note that measured values should be handled with care, because setpoint temperature and indoor air temperature are not the same.	
	13 Indoor conditions	13.1 intermittency	ge	From ENPER Exist: It would be very helpful if default intermittency patterns where available at national level for different building types and uses.	Suggested is to give default intermittency patterns for different building types and uses at national level.	
	13 Report		ge	From ENPER Exist:		

				It is not clear what the goal of this report is and what the position of this report is in relation to the energy certificate.		

Annex B: Comment sheets to CEN: prEN 15242 “Ventilation for buildings – calculation methods for the determination of air flow rates in buildings including infiltration”

This annex contains the comments sheets, which was sent to the CEN working group responsible for the prEN 15242 “Ventilation for buildings – calculation methods for the determination of air flow rates in buildings including infiltration”.

	General comment		ge	Within the EU Save project ENPER Exist this draft standard was analysed to see if it is suitable for existing buildings. Some special attention is needed to some input data to make the data acquisition in existing buildings possible within the boundary conditions which are relevant in existing buildings (few inspection time, no specific expertise of inspector). All comments based on the ENPER Exist analysis begin with “From ENPER Exist:”.	When default tables with national values are suggested, it would be very helpful and good for harmonisation if (e.g. in an informative annex) a procedure to derive such a default table or at least an example of such a default table is given in the standard.	
	General		ge	From ENPER Exist: Evidently, the English language has not been checked which sometimes makes the standard difficult to understand (example: 6.2.12). At several spots the standard even contains editorial comments in French (example: 6.5.4, 7.1.2.3.1, 7.1.3.2, 7.1.4, annex C, etc…) which indicate that the standard is not yet complete. Also: the symbols used in the equations are not consistent.		
	1 Scope		ge	From ENPER Exist: The scope does not mention naturally ventilated buildings	Add to list of applications: naturally ventilated buildings	
	6.1 (Basis of implicit method)		te	From ENPER Exist: Please add reference to clause 7	Add at end of this subclause: Clause 7 contains specific rules and default values for different applications.	
	6.2 (mech.vent.)	6.2.5 Ccont	te	From ENPER Exist: Procedures like “This has to be done” are not particularly helpful, if no clues are given how this has to be done. It would be helpful if reference is added to clause 7 for specific (e.g. default) values, depending on the application	Add reference to clause 7 for specific (e.g. default) values, depending on the application	
		6.2.6 Csyst	te	From ENPER Exist: It would be helpful if reference is added to clause 7 for specific (e.g. default) values, depending on the application	Add reference to clause 7 for specific (e.g. default) values, depending on the application	

		6.2.7/6.2.9 duct leak	te	From ENPER Exist: It would be helpful if reference is added to clause 7 for specific (e.g. default) values, depending on the application	Add reference to clause 7 for specific (e.g. default) values, depending on the application	
		6.2.8 AHU leak	te	From ENPER Exist: It would be helpful if reference is added to clause 7 for specific (e.g. default) values, depending on the application	Add reference to clause 7 for specific (e.g. default) values, depending on the application	
		6.2.10 Crec	Te	From ENPER Exist: See comments on annex C		
	6.3 (pass./hybr. Vent.)		te	From ENPER Exist: Requires detailed input on the cowl and duct characteristics. These data may not be available in a quick inspection of an existing building.	Add: For existing buildings, and only in case of a quick inspection and/ or if more detailed information cannot be obtained quickly, national default values may be used instead	
		6.5.3	te	From ENPER Exist: What is the source for Cleak? It would be helpful if reference is added to clause 7 for specific (e.g. default) values, depending on the application	Add reference to clause 7 for specific (e.g. default) values, depending on the application	
	6.5 (Exfiltration..)	6.5.4	te	From ENPER Exist: Is this the calculation of the total resulting air flow? If so, why is this not the last (or preferably: the first) subclause under clause 6?	Move this clause up: after clause 6.1: first the principle (6.1), then the main equation(s) (6.2), followed by the successive details (6.3 – 6.6)	
	6.6 air flow windows)	6.6.1 airing	te	From ENPER Exist: 6.6.1.1: Requires input on the window types and height. These data may not be available in a quick inspection of an existing building.	Add: 6.6.1.2: This simplified method can also be used for existing buildings, when there is no detailed information available	

				The simplified calculation (6.6.1.2), which allows national coefficient values, is only applicable to specific cases. From ENPER Exist: It would be helpful if reference is added to clause 7 for specific (e.g. default) values, depending on the application	Add reference to clause 7 for specific (e.g. default) values, depending on the application	
	7.1 (Application, energy calculations)		te	From ENPER Exist: The option **in prEN 15241** of a statistical approach to be applied at national level seems to be a good and practical approach for existing buildings. It gives sufficient freedom to develop a national method with national default and/or typical values where needed. It would however not make sense to apply a statistical method on the system characteristics (prEN 15241), and an implicit calculation of the air flow rates according to prEN 15242. Therefore, we recommend to explicitly add in prEN 15242 the similar option of a statistical approach to be applied at national level as in prEN 15241.	Add similar option of a statistical approach to be applied at national level as in prEN 15241.	
	7.1 (Application, energy calculations)	7.1.2.4 (splitting air tightness)	te	From ENPER Exist: There is no other clause referring to Cleak values in annex B, therefore we assume that this clause is the one where this reference is to be made. The ratio of façade/roof area would preferably be replaced by a default value in case of a quick inspection of an existing building	Change title of clause into “Airtightness values”. Add reference to annex B for Cleak values. Add option to use a default value for the ratio of façade/roof area in case of a quick inspection of an existing building	
	Annex A (Wind pressure			From ENPER Exist: The façade has to be split in low, medium and high	Add: For existing buildings, and only in case of a quick inspection and/ or if more detailed information	

	coefficients)			part; the roof has to be categorised according to the slope. For existing buildings in case of quick inspection default values are needed instead.	cannot be obtained quickly, national default values may be used instead	
	Annex B (Leakage characteristics)		te	From ENPER Exist: There is no reference to this annex. This annex is far from complete; at least it should explain that the conversion from airtightness to Cleak is given in annex D	Add (in 7.1.2.4?) reference to annex B. Complete the text of this (normative!) annex Add in annex B: The conversion from airtightness to Cleak is given in annex D	
	Annex C		Te	From ENPER Exist: Normative or informative annex? Annex C is evidently not yet complete. Apart from this, the annex seems to require detailed input on the system characteristics. These data may not be available in a quick inspection of an existing building	Add: status of annex (normative or informative) Add: For existing buildings, and only in case of a quick inspection and/ or if more detailed information cannot be obtained quickly, national default values may be used instead	
	Annex D (Conversion formulas)		te	From ENPER Exist: There is no reference to this annex. Supposingly, for calculation of Cleak, this annex is to be referred to from (e.g.) annex B. From where are ELA values to be obtained?	Add (in 7.1.2.4? or in annex B?) reference to annex D (calculation of Cleak from air leakage characteristics). Provide source or defaults for ELA values	

Annex C: Comment sheets to CEN: prEN 15241 “Ventilation for buildings – calculation methods forenergy losses due to ventilation and infiltration in commercial buildings”

This annex contains the comments sheets, which was sent to the CEN working group responsible for the prEN 15241 “Ventilation for buildings – calculation methods forenergy losses due to ventilation and infiltration in commercial buildings”

	General comment		ge	Within the EU Save project ENPER Exist this draft standard was analysed to see if it is suitable for existing buildings. Some special attention is needed to some input data to make the data acquisition in existing buildings possible within the boundary conditions which are relevant in existing buildings (few inspection time, no specific expertise of inspector). All comments based on the ENPER Exist analysis begin with “From ENPER Exist:”.	When default tables with national values are suggested, it would be very helpful and good for harmonisation if (e.g. in an informative annex) a procedure to derive such a default table or at least an example of such a default table is given in the standard.	
	Introduction		ed	From ENPER Exist: The relationship with other standards is already clear enough if explained once; no need to repeat.	Delete duplicate text, figure and table.	
	6. Steady state calculation	6.3.1 (duct heat lossesr)	te	From ENPER Exist: Requires specific input on duct length and specific heat loss of ducts. These data may not be available in a quick inspection of an existing building.	Add: For existing buildings, and only in case of a quick inspection and/ or if more detailed information cannot be obtained quickly, national default values may be used instead	
	6. Steady state calculation	6.3.3 (fan power)	te	From ENPER Exist: Requires specific input on fan power. These data may not be available in a quick inspection of an existing building.	Add: For existing buildings, and only in case of a quick inspection and/ or if more detailed information cannot be obtained quickly, national default values may be used instead	
	6. Steady state calculation	6.3.4 (heat exchanger)	te	From ENPER Exist: Requires specific input on heat exchanger efficiency. These data may not be available in a quick inspection of an existing building.	Add: For existing buildings, and only in case of a quick inspection and/ or if more detailed information cannot be obtained quickly, national default values may be used instead	
	7.2 Yearly or monthly method		te	From ENPER Exist: It is not clear how to deal with e.g. defrosting of heat exchangers in such yearly (monthly) calculation		

	Annex B		ge	From ENPER Exist: Missing (referred to in clause 6.3.3)		

Annex D: Comment sheets to CEN: prEN 15316-3-3 “Domestic hot water systems. Part 3-3. Generation”

This annex contains the comments sheets, which was sent to the CEN working group responsible for the prEN 15316-3-3 “Domestic hot water systems. Part 3-3. Generation”.

NEN	6.1		ge	Efficiency and demand at test tapping cycles are only known for new boilers so this method is hard to use for old hot water generation.	Add a method which is suitable for existing boilers as well. At least allow (existing) national methods to be used, where possible based on (existing) national hot water generator tests, to be used for existing generators.	
NEN	6.3		ge	Full load and stand-by losses are not generally available for existing boilers	Add a method which is suitable for existing boilers as well. At least allow (existing) national methods to be used, where possible based on (existing) national hot water generator tests, to be used for existing generators. Additional (national) data are needed on boiler losses in case no product data are available.	
NEN	6.3		te	No formulas or methods are given to estimate boiler operation periods	Add a formula or method to estimate boiler operation periods	
NEN	6.5		ge	Efficiencies and stand-by losses according to EN 89 are not generally available for existing heaters.	Add a method which is suitable for existing boilers as well. At least allow (existing) national methods to be used.	
NEN	6.6		ge	Efficiencies and stand-by losses according to EN 50440 are not generally available for existing heaters.	Add a method which is suitable for existing boilers as well. At least allow (existing) national methods to be used.	

Annex E: Annexes of chapter 9

E1. Typology method

Remarks only general, because national annex needed and not available (only residential sector UK)

Main influencing factors

Note: This overview is to detect hidden assumptions that are untrue for existing buildings and to check for missing physical factors.

The typology method is a framework method, allowing for national annexes.

The national annexes have to be pre-prepared and can differ in their levels of detail.

<u>Output: Generator seasonal efficiency:</u>

Output: Generator seasonal efficiency **Option: Typology method**			
Clause	**Influencing factor**	**How**	**Remarks**
5.2	**In general framework:**		
	Climate	Fixed nationally	Thus no influence of deviating weather conditions
	Boiler type	Categories (yes/no condensing, yes/no incl. store, etc.)	
	Fuel type	Categories (natural gas, LPG, oil, etc.)	
	Measured efficiency	Variable number, from test	
	Output power (nominal power of boiler)	Variable number	
	Ignition method	Categories (yes/no permanent pilot flame)	
	Burner type	Categories (modulating, stepped or on/off)	
	Store characteristics	Variable numbers (volume, insulation thickness)	
	Operating regime	Fixed, per bld sector	Thus no influence of deviating operating

	(operating temperatures, control type)		regime on **generation efficiency**, is taken into account.
	Occupancy pattern (load curve)	Fixed, per bld sector	Thus no influence of deviating occupancy pattern on **generation efficiency**, is taken into account.
	Building sector	Categories	

Missing physical factors:

This typology method is a simplified method; consequently some physical factors have been ignored, eg:

- Influence of operating regime (operating temperatures, control type)
- Influence of occupancy pattern (load curve, …)
- Influence of heat demand for space heating
- Recovery of envelope heat loss
- Recovery of auxiliary energy consumption

These factors are not specially important for existing buildings.

<u>Maintenance state and ageing:</u>

Maintenance state of the boiler and ageing of the boiler are influencing factor which are not taken into account. However, maintenance and ageing are aspects which have much less effect on the generation efficiency of the boiler than the age (boiler type!) of the boiler itself.

Ageing and maintenance can have a significant influence when insulation of a store is concerned. Stores are relevant when the generation efficiency of the tap water heating part is analysed (combined systems), but not in this situation where only the room heating is concerned.

<u>Operation:</u>

Operation aspects are not relevant regarding the boiler generation efficiency.

<u>Output: Auxiliary energy consumption:</u>

No specific influencing factors for auxiliary energy consumption mentioned in the standard itself.

Missing physical factors:

The standard should indicate which factors should be taken into account, such as presence and size of pump (inc. control), ventilator and electronics. These aspects are not specific for existing buildings.

Analysis of required input

Output: Generator seasonal efficiency:

Output: Generator seasonal efficiency **Option: Typology method**					
Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examination?**	**Remarks regarding points which are specifically important for existing buildings**
	Weather data	Fixed nationally	Yes	Yes	Assuming that influence is small
	Boiler type	Categories (yes/no condensing, yes/no incl. store, etc.)	Yes, except for some details, which are not always easy to recognise in practise by non-experts	Yes, but some may not be covered	Take list from WI5
	Fuel type	Categories (natural gas, LPG, oil, etc.)	Yes	Yes	
	Measured efficiency	Variable number of full and part load, from test acc. to Boiler Efficiency Directive	No	No	Test is only suitable for new boilers: it is a standard test on lab conditions. Note that many existing boilers have not been tested acc. to B.E.D. Note: degradation of performance due to aging is not a big issue concerning boilers.

	Store and measured efficiency	Category (yes/no store loss included in measured efficiency)	No	No	See previous.
	Output power (nominal power)	Variable number	Yes?	Yes?	Only suitable when the output power is printed on the type number on the boiler.
	Store volume	Variable number	No	No	e.g. UK: input unclear!
	Store insulation thickness	Classes	Yes	Yes	E.g. UK: < 10 mm > 10 mm Recommendation: Actual state should be taken into account. Note: store is an aspect of the tap water efficiency. Why is it an issue here: we deal with room heating only???
	Ignition method	Categories (yes/no permanent pilot flame)	Yes	Yes	
	Burner type	Categories (modulating, stepped or on/off)	No, categories are not always easy to recognise in practise by non-experts	Yes	Recommendation: See also above: practical solution: national database with most applied products??, plus default values
	Operating regime (operating temperatures, control type)	Fixed, per bld sector	Yes	Yes	Operating regime can have a major effect on the tailored energy saving advice
	Occupancy pattern (load curve, …)	Fixed, per bld sector	Yes	Yes	Occupancy pattern can have a major effect on the tailored energy saving advice

	Building sector	Categories	Yes	Yes	

Output: Auxiliary energy consumption:

See influencing factors: No input parameters for auxiliary energy consumption mentioned in the standard itself.

E2. Case specific boiler efficiency method

Main influencing factors

Maintenance state and ageing:

Maintenance state of the boiler and ageing of the boiler are influencing factor which are not taken into account. However, maintenance and ageing are aspects which have much less effect on the generation efficiency of the boiler than the age (boiler type!) of the boiler itself.

Ageing and maintenance can have a significant influence when insulation of a store is concerned. Stores are relevant when the generation efficiency of the tap water heating part is analysed (combined systems), but not in this situation where only the room heating is concerned.

Operation:

Operation aspects are not relevant regarding the boiler generation efficiency.

Analysis of required input

Output: Generator seasonal efficiency:

The required input is presented in two tables: the first gives the input with use of real values the second with use of default values.

Output: Generator seasonal efficiency **Option: Case specific boiler efficiency method (with use of real values)**					
Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examination?**	**Remarks**
5.3	Generator efficiency at full load	based on product data measured according to boiler directive (variable number)	No	No	Test is only suitable for new boilers: it is a standard test on lab conditions. Note that many existing boilers have not been tested acc. to B.E.D.
	Generator efficiency at intermediate load	based on product data measured according to boiler directive (variable number)	No	No	Test is only suitable for new boilers: it is a standard test on lab conditions. Note that many existing boilers have not been tested acc. to B.E.D.
	Generation type	Categories (standard, low temperature, condensing)	Yes	Yes	
	Average temperature of emitter	○ If control depends on inside temperature: emitter type categories ○ If control depends on outside temperature: type of temperature distribution (categories: low, medium ,	Yes	Yes	

		high) and control type of generator (categories: constant or variable temperature)			
	Generation output at full load	Is this information available on the type tag of existing boilers? (variable number)	Yes, if available on type tag	Yes, if available on type tag	If this information is not available on available on the type tag, this information is unknown.
	Generation output at intermediate load	Is this information available on the type tag of existing boilers? (variable number)	Yes, if available on type tag	Yes, if available on type tag	
	Stand by losses	Based on information on certificate (variable number)	Yes, if certificate is available	Yes, if certificate is available	If no certificate is available, information is not known.
	Recovery of envelope heat loss	Default, based on burner type (categories: atmospheric of fan assisted burner)	No?	Yes	Are these types known to non-experts?

Output: Generator seasonal efficiency **Option: Case specific boiler efficiency method <u>(with use of default values)</u>**					
Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examinatio n?**	**Remarks**
5.3	Generator efficiency at full load	based on : ○ Generation output at full load (variable number)	○ Yes, if availabl e on type tag	○ Yes, if availabl e on type tag	If this information is not available on the type tag, this information is unknown.

		and ○ generation type (categories)	○ Yes	Yes	
	Generator efficiency at intermediate load	based on : ○ Generation output at full load (variable number) and generation type (categories)	○ Yes, if available on type tag Yes	○ Yes, if available on type tag Yes	If this information is not available on the type tag, this information is unknown.
	Generation type	Categories (standard, low temperature, condensing)	Yes	Yes	
	Average temperature of emitter	○ If control depends on inside temperature: emitter type categories ○ If control depends on outside temperature: type of temperature distribution (categories: low, medium , high) and control type of generator (categories: constant or variable temperature)	Yes	Yes	
	Generation output at full load	Is this information available on the type tag of existing boilers? (variable number)	Yes, if available on type tag	Yes, if available on type tag	If this information is not available on available on the type tag, this information is unknown.
	Generation output at intermediate load	Default based on generation output at full load	Yes	Yes	
	Stand by losses	based on : ○ Generation output at full load (variable number)	○ Yes, if availabl	○ Yes, if availabl	If this information is not available on the type

		and o generation type (categories)	e on type tag Yes	e on type tag Yes	tag, this information is unknown.
	Recovery of envelope heat loss	Default, based on burner type (categories: atmospheric of fan assisted burner)	No?	Yes	Are these types known to non-experts?

Output: Auxiliary energy consumption:

The required input for the determination of the auxiliary energy consumption is also presented in two tables: the first gives the input with use of real values the second with use of default values.

Output: Auxiliary energy consumption **Option: Case specific boiler efficiency method (with use of real values)**					
Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examinati on?**	**Remarks**
5.3	Power of auxiliary equipment	Based on product information if performance is certified (variable numbers)	Yes	Yes	If no certificate is available, this information is unknown

Output: Auxiliary energy consumption **Option: Case specific boiler efficiency method (with use of default values)**

Clause	Required input	How	Suited for short visit?	Suited for detailed examination?	Remarks
5.3	Power of auxiliary equipment	based on : ○ Generation output at full load (variable number) and generation type (categories)	○ Yes, if available on type tag Yes	○ Yes, if available on type tag Yes	If this information is not available on the type tag, this information is unknown.

E3. Boiler cycling method

Main influencing factors

The standard gives a general introduction on the physical factors taken into account.

Quote from clause 4.1.1:

"*Main influencing factors:*

- *the heat demand of the heat distribution system;*
- *the heat demand of the domestic hot water distribution system (combination boiler);*

and the losses or gains due to the following physical factors:

- *heat losses to the chimney (or flue gas exhaust) during running and stand by;*
- *heat losses through the generator(s) envelope during running and stand by;*
- *auxiliary energy.*

The relevance of these effects on the energy requirements depends on:

- *the type of heat generator(s);*
- *the location of the generator;*
- *the part load ratio;*
- *the running conditions (temperature, control, …)*
- *control strategy (ON-OFF, multi-stage, modulating, cascading, etc.)."*

Maintenance state and ageing:

The advantage of using measurements under actual conditions is that the aspects maintenance/ageing are taken into account.

Operation:

Operation aspects are not relevant regarding the boiler generation efficiency.

Analysis of required input

<u>Output: Generator seasonal efficiency:</u>

The required input is presented in two tables: the first gives the input with use of real values the second with use of default values.

Output: Generator seasonal efficiency **Option: Boiler cycling method <u>(with use of real values)</u>**					
Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examination?**	**Remarks**
5.4	Combustion power of the generator	Is this information available on the type tag of existing boilers? (variable number)	Yes, if available on type tag	Yes, if available on type tag	If this information is not available on available on the type tag, this information is unknown.
	Specific load ratio: based on	measured on existing systems (time counters) (variable number)	No	Only when there is time and expertise for measurements	
	Losses through the chimney:	(for existing systems) measurement according national standards or recommendations (variable number)	No	Only when there is time and expertise for measurements	
	Average of flow and return temperature in test conditions	(for existing systems) measurement during combustion efficiency test (variable number)	No	Only when there is time and expertise for measurements	

	Average of flow and return temperature in actual conditions	measurement during actual conditions (variable number)	No	Only when there is time and expertise for measurements	
	Exponent of the load factor:	default based on boiler type (categories: wall mounted boiler, steel boiler, oil boiler, cast iron boiler)	Yes	Yes	
	Losses through generator envelope in test conditions	default based on generator insulation type (categories)	Yes	Yes	
	Reduction factor taken into account the location of the generator	default based on generator type and location (categories)	Yes	Yes	
	Temperature of the room where the generator is installed	(variable number)	Yes	Yes	
	Losses through chimney when burner is off in test conditions	(for existing systems) measurement of flow rate and temperature at the boiler flue gas outlet (variable number)	No	Only when there is time and expertise for measurements	
Additional data required for multistage or modulating generators					
	Minimum combustion power of the generator	default based on fuel type (categories)	Yes	Yes	
	Losses factors at minimum combustion power	default based on boiler type (categories)	Yes	Yes	

Output: Generator seasonal efficiency **Option: Boiler cycling method <u>(with use of default values)</u>**					
Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examination?**	**Remarks**
5.4	Combustion power of the generator	Is this information available on the type tag of existing boilers? (variable number)	Yes, if available on type tag	Yes, if available on type tag	If this information is not available on available on the type tag, this information is unknown.
	Specific load ratio: based on	input from other standard (variable number)	Yes	Yes	
	Losses through the chimney:	default based on boiler type (categories: atmospheric boiler, force draught gas boiler, oil boiler, condensing boiler)	Yes	Yes	
	Average of flow and return temperature in test conditions	default based on boiler type (categories: atmospheric boiler, force draught gas boiler, oil boiler, condensing boiler)	Yes	Yes	
	Average of flow and return temperature in actual conditions	measurement during actual conditions (variable number)	No	Only when there is time and expertise for measurements	No defaults available
	Exponent of the load factor:	default based on boiler type (categories: wall mounted boiler, steel boiler, oil boiler,	Yes	Yes	

		cast iron boiler)			
	Losses through generator envelope in test conditions	default based on generator insulation type (categories)	Yes	Yes	
	Reduction factor taken into account the location of the generator	default based on generator type and location (categories)	Yes	Yes	
	Temperature of the room where the generator is installed	(variable number)	Yes	Yes	
	Losses through chimney when burner is off in test conditions	default based on boiler type and chimney height (categories)	Yes	Yes	
Additional data required for multistage or modulating generators:					
	Minimum combustion power of the generator	default based on fuel type (categories)	Yes	Yes	
	Losses factors at minimum combustion power	default based on boiler type (categories)	Yes	Yes	

<u>Output: Auxiliary energy consumption:</u>

The required input for the determination of the auxiliary energy consumption is also presented in two tables: the first gives the input with use of real values the second with use of default values.

Output: Auxiliary energy consumption

Option: Boiler cycling method <u>(with use of real values)</u>

Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examination?**	**Remarks**
5.4	Electric power	Actual measured value	No	Only when there is time and expertise for measurements	
Additional data required for multistage or modulating generators:					
	Electric power of burner auxiliaries at minimum combustion power	○ default based on: auxiliary type and fuel type (categories)	Yes	Yes	

Output: Auxiliary energy consumption

Option: Boiler cycling method <u>(with use of default values)</u>

Clause	**Required input**	**How**	**Suited for short visit?**	**Suited for detailed examination?**	**Remarks**
5.4	Electric power	- declared by manufacturer or - default based on: auxiliary type and fuel type (categories)	Yes	Yes	

Additional data required for multistage or modulating generators:					
	Electric power of burner auxiliaries at minimum combustion power	○ default based on: auxiliary type and fuel type (categories)	Yes	Yes	

E4. Explanation of terms used in this document

Short visit versus detailed examination

In the analysis we will come across procedures that require a certain level of information (input data) that is not applicable for a quick energy performance assessment, but that could be well suited for a more detailed energy performance assessment.

Consequently, it would be convenient to define two or three levels of EP assessment with respect to the effort to acquire input data, and refer the analysis of the CEN standards to each of these two or three levels.

The CEN standard W.I 4, "Energy Performance of Buildings – Assessment of energy use and definition of ratings" does not contain a suggestion for terms and definitions for such distinction.

For the time being, we will make a preliminary distinction between:

- **a short visit:** typically from one or two hours for a dwelling to one day for a complex building.
- **an extensive examination**: one day for a dwelling to a few days for a complex building.

Concerning different types of inputs:

Input = variable number:

Any value, from certain sources

Input = default value(s):

From ENPER final report B6:

Default value or method:

A method or numerical value that is specified in the EP method as method/value that may be used but may also be disregarded in favour of another method that is specified as a higher order method. Usually the formulation is as follows:

Method A shall be used; but as a departure of method A one may use the following method/value (followed by the default method/value).

The default method/value does **not necessarily lead to more conservative results** than the higher order method, but is an **alternative**. Example: a default efficiency.

Input = classes:

Values that fall into certain band widths, thus forming classes

Input = categories or typology:

No values but categories of products, systems or technologies identified by specific type.

Input = fixed value:

From ENPER final report B6:

Fixed value:

A numerical value that is specified in the EP method* as value that shall be used and shall not be replaced by another value. For instance: the (national mean) coefficient to convert electricity consumption to primary energy consumption; a coefficient to scale the calculated energy consumption to EP*, or the coefficient in EP to neutralize the shape of the building.

Fixed values are often used for new buildings for parameters linked to operation and maintenance as these parameters are not known when the calculation is performed. For existing building it could be important to replace fixed valued by actual values which are sometimes easy to obtain.

Other terms and definitions:

From ENPER final report B6:

Building function:

is the type of use of the building: residential, office, school, etc. The Directive on energy performance of buildings gives a proper division into various building types.

Note: other terms found for this are: building use, building sector

Influencing (physical) factors:

The physical factors that influence the result. These comprise the input data plus all parameters that explicitly or implicitly assume certain physical conditions.

Notes:

- it is important to detect hidden assumptions (=fixed parameters), which may be true for new buildings but not for existing buildings;

  example: solar heat through (new, thus thermally insulated) roof can be neglected
- one physical factor may require more than one input variable;

  example: shading by external obstacles (e.g. buildings): geometry, diffuse fraction of solar radiation, solar angle;
- the level of detail in which a physical factor is described is arbitrary and has to rely on expert knowledge
- *example: shading by external obstacles (e.g. buildings): a more detailed physical factor is: solar reflection by external obstacles*

Annex F: Questionnaire Energy Performance Certification Scheme

Questionnaire Energy Performance Certification Scheme

The Energy Performance Directive of Buildings requires Member States to develop a energy performance certificate for buildings. This document contains a questionnaire which gives the opportunity to document the certification scheme which is developed in your country or in your project. The result will be used to produce a vision on the plans of the different Member States regarding the content of the energy certificate, the proposed indicator, the performance scales and the classification of recommendations for cost-effective improvement.

The questionnaire is based on Annex A of the draft EPBD CEN standard: “Methods for expressing energy performance and for energy certification of buildings” - prEN wi 1+3:2004.

Annex B and C of the same draft standard are also copied, because the questionnaire refers to them.

We ask you to complete the questionnaire and document the certification scheme which is developed in your country or in your project.

If your certification scheme differs for different building types or in certain circumstances, please duplicate this questionnaire and fill in the questionnaire for all the different schemes.

Please send the completed questionnaire back to: Marleen Spiekman: m.spiekman@bouw.tno.nl

Thank you for your time.

Who has supplied this information:

Name: ....

Company: ....

Email: ....

Date: ....

What is your link with EP certification:

....

Where can we find more information on the certification scheme

....

Replace ☐ by X to mark your choices.

1 Application domain of the scheme

The scheme apply to the following building types

☐ Single family houses	☐ Apartment block	☐ Other residential buildings
☐ Offices	☐ Education buildings	☐ hospitals
☐ Hotels and restaurants	☐ Sport facilities	☐ Wholesale and retail trade service buildings
☐ Industrial buildings	☐ Storage	☐ Other types: ....

For apartments or units designed for separate use in blocks the certification is based on the assessment of :

☐ the apartment or unit ☐ a common certification of the whole building

☐ another representative apartment or unit in the same building

It can be applied in the following situations

☐ Rent ☐ Sales ☐ New buildings after construction ☐ Display in public buildings

2 Basis of the rating

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

Energy uses

Space heating	☐	Hot water	☐
Mechanical ventilation	☐	Lighting	☐
Space cooling	☐		

Energy production, in particular by renewable sources and co-generation. ☐

Other uses of electivity: ☐ ....

The indicator used represents

☐ Delivered energy ☐ Primary energy ☐ CO2 emission ☐ Cost

The weighting for each energy carrier are:

....

The rating is an:

☐ Asset rating (rating based on calculations of the energy used by a building for heating, cooling, ventilation, hot water and lighting, with standard input data related to internal and external climates and occupancy)

☐ Operational rating (rating based on measured energy use).

The dimensions used are

☐ Internal dimensions (length measured form wall to wall and floor to ceiling inside each room of a building)

☐ External dimensions (length measured on the interior of a building, ignoring internal partitions)

☐ overall internal dimensions (length measured on the exterior of a building)

3 Classification

The energy performance classes are described in the following way:

☐ According to Annex A of this document ☐ Following an other procedure

if the annex A is not used describe the classification procedure and the limits of the classes

....

4 Classification adaptation

Describe the procedure used to adapt the classification to

Variations of the external climate

....

Specific use of the building: eg to differentiate between buildings which are used 5, 6 or 7 days a week, or buildings having different occupation densities

....

5 Reference values

Explain how the limits of the class are linked to the following points

Energy performance regulation reference. This corresponds to the limit value that should be expected of new buildings in conformity with national or regional Energy Performance Regulation in 2006

Building stock reference. This corresponds to the value that should be expected to be reached by approximately 50 % of the national or regional building stock in 2006

Zero energy reference:This correspond to a building that produces as much energy as it uses.

....

6 Certificate format

The format of the certificate is

Based on annex B of this document : ☐ Yes ☐ No partly

Describe the details of the certificate.

………………………………………………………………………………………

7 Recommendations

Describe the recommendations given by the certificate:

………………………………………………………………………………………

8 Experience with the certification scheme

☐ The scheme is under development

☐ The scheme was applied to a pilot study:

Describe the pilot study and give the number of buildings where the scheme was applied

☐ The scheme is under application

define the number of buildings where it has been applied

Annex A

Procedure for buildings classification

A.1 Introduction

This annex provides a simple procedure to define the limits of the classes of energy performance.

The procedure enables the definition of classes that are consistent for all building types.

It can be applied to asset, to operational ratings and to any of the indicators defined in (of prEN wi 1+3:2004).

To apply the procedure to a given type of buildings it is necessary to define the values of the reference/benchmark R_r and R_s for this building type.

The procedure enables to calculate a classification indicator C which is used to define the limit of classes.

A.2 Classification procedure

The steps of the procedures to determine the performance class of a given building are the followings

c) Define the type of the building (e.g. office building)

Select the "Energy Performance Regulation" reference Rr and the "Building Stock" reference Rs which correspond to this building type

Define the value of the energy performance of the building EP

Calculate $\frac{EP}{Rr}$

Calculate $\frac{EP}{Rs}$

Determine the classification indicator C with the following rules

1) If $\frac{EP}{R_r} \leq 1$ take $C = \frac{EP}{R_r}$

in this case the Energy Performance of the building, EP, is better than the Energy Performance Regulation Reference, R_r.

If $1 \leq \frac{EP}{Rs}$ take $C = 1 + \frac{EP}{R_s}$

in this case the Energy Performance of the building, EP, is worse than the Building Stock Reference,R_s.

In the other cases take $C = 1 + \frac{EP - R_r}{R_s - R_r}$

In this case the Energy Performance, EP, of the building is between the Energy Performance regulation reference, R_r, and the Building stock reference, R_s.
The performance class is determined with the following rules

Class A if $C < 0{,}5$

Class B if $0{,}5 \leq C < 1$

Class C if $1 \leq C < 1{,}5$

Class D if $1{,}5 \leq C < 2$

Class E if $2 \leq C < 2{,}5$

Class F if $2{,}5 \leq C < 3$

Class G if $3 \leq C$

The value of C is computed only to enable the classification and is not necessarily reported on the certificate.
The value of C can be used when generating the certificate to define precisely the position of the actual building in reference to the overall performance scale.

A.3 Additional steps

For operational rating it can be appropriate to apply two additional procedures.

d) The value of EP should be modified to take into account a possible difference between the actual climatic data and the reference climatic data used to define the values of R_r and R_s. This modification is done in accordance with prEN wi 4.

The values of R_r and R_s should be adjusted if the actual use of the building is different from that assumed to define the values of R_r and R_s for that building type (e.g. building open 7 days a week and R_r and R_s corresponding to building open 5 days a week).

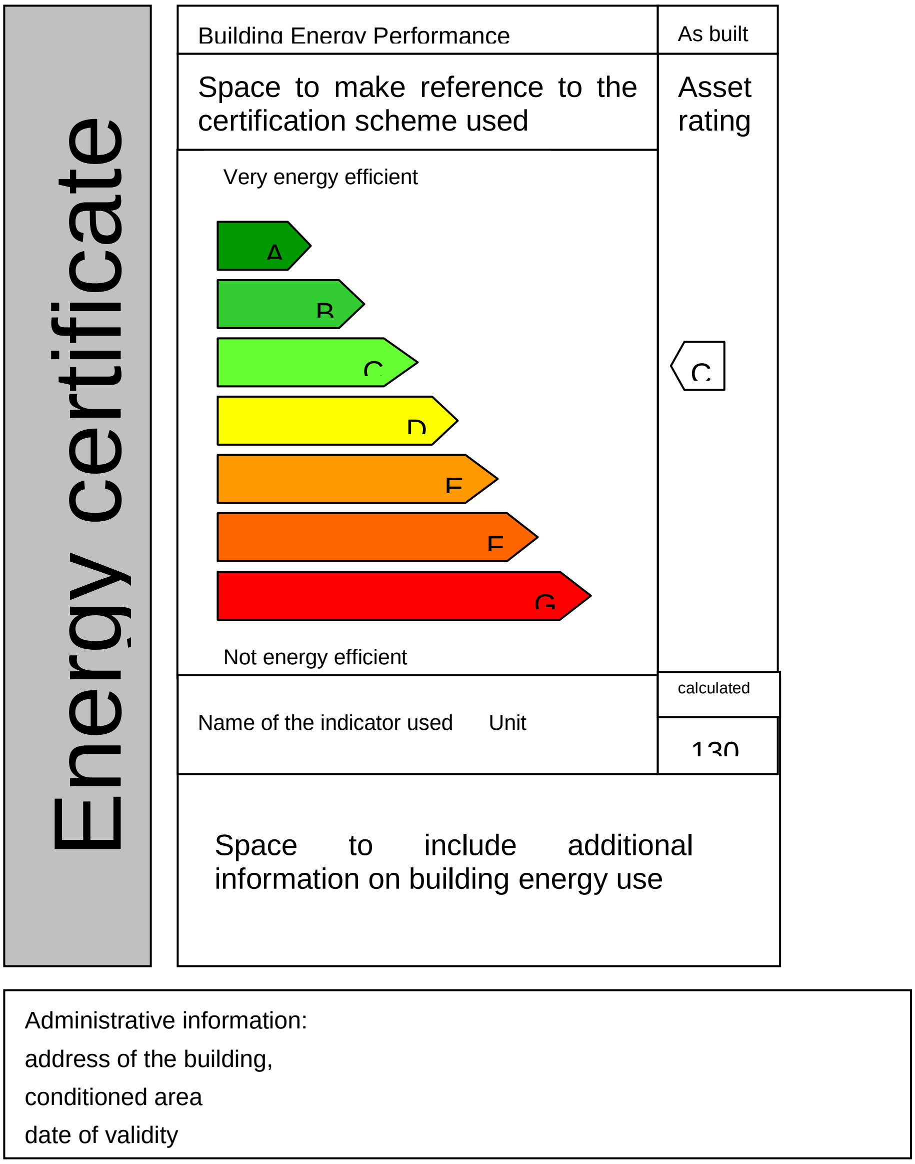
Annex B

Certificate format

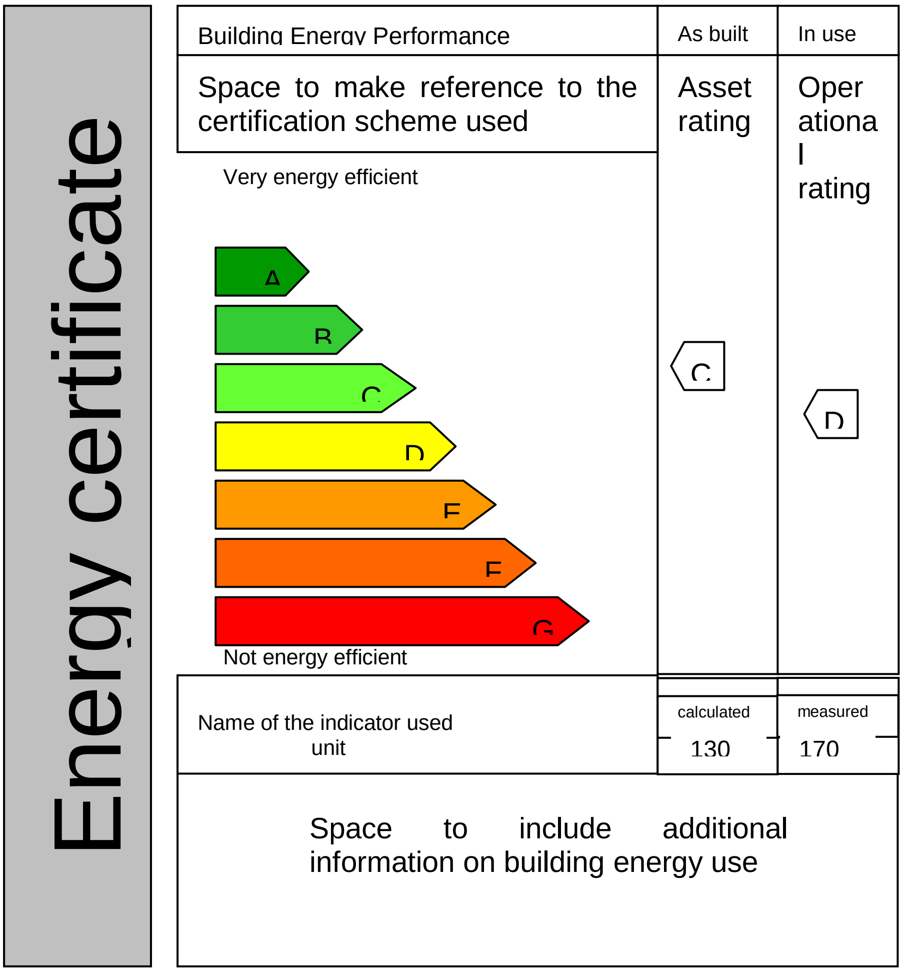
This annex provides two examples of an energy certificate format. These examples are provided for illustration only and do not enter in all the details needed for a certificate. In particular ways to present recommendations for improvements as well as ways to present the supporting evidence of the certificate are not presented.

Many other solutions are possible.

Example 1 with one single rating



Example 2 with two ratings



Administrative information:
address of the building,
conditioned area
date of validity