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Lot 15
Solid fuel small combustion installations

Task 1: Scope and Definition

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Introduction

THE ECODESIGN DIRECTIVE

This study on Solid Fuel Small Combustion Installations (the "Lot 15 study"), is one of the preparatory studies carried out for the European Commission in the context of the **Directive 2005/32/EC on the eco-design of Energy-using Products (EuP)**. This framework Directive does not directly introduce binding requirements for specific products, but defines conditions and criteria for setting, through subsequent implementing measures, requirements regarding environmentally relevant product characteristics.

According to the Directive, the implementing measures can be proposed for product categories which meet the following criteria:

Significant volume of products placed on the EU market (indicatively > 200 000 units per year)

Significant environmental impact

Significant potential for improvement

The implementing measures are to be based on an environmental assessment taking into account products characteristics and functionality. Technologies available on the market should be taken as a reference.

The first step, in considering whether and which eco-design requirements should be set for a particular product group, is a preparatory study recommending ways to improve the environmental performance of the product. The preparatory study will provide the necessary information to prepare for the next phases in the policy process (carried out by the Commission) and in particular the impact assessment, the consultation forum, and the possible draft implementing measures laying down eco-design requirements for EuPs.

As in all Ecodesign preparatory studies, a common and coherent methodology (MEEuP)[1] is used for analysing environmental impact and improvement potential of the products and ecodesign options are analysed from life cycle costing perspective. This methodology consists of eight main tasks which will be conducted in an iterative manner.

Task 1: Definition

Task 2: Economic and market analysis

Task 3: Consumer behaviour and local infrastructure

Task 4: Technical analysis of existing products

Task 5: Base-cases

Task 6: Technical analysis of BAT

[1] VHK, *Methodology for Ecodesign of Energy-using Products (MEEuP), Final Report*, European Commission (DG ENTR), 2005. ec.europa.eu/enterprise/eco_design/finalreport1.pdf

Task 7: Improvement potential

Task 8: Final analysis: scenario, policy, impact, and sensitivity analysis

WIDER CONTEXT OF THE LOT 15

Lot 15 products fuelled by biomass are especially topical, as the Proposal for a Directive on the promotion of the use of energy from renewable sources, published the 23rd of January 2008, aims to establish an overall binding target of a 20% share of renewable energy sources in energy consumption and binding national targets by 2020 in line with the overall EU target. This Directive, together with the oil and gas scarcity, is expected to encourage the use of biomass solid fuels. Hence, the stock of such Solid fuel Small Combustion Installations (SCIs) is likely to increase in the coming years.

However, Clean Air for Europe (CAFE) programme[2] has identified domestic combustion installations burning coal and wood as a major source of local air pollution and concludes that tackling particulate matter (PM) emissions from these sources need to be given high priority. The CAFE initiative has led to a thematic strategy[3] setting health and environmental objectives and emission reduction targets for the main pollutants, including fine particulate matter.

Recently, Carbosol research programme[4] has further highlighted the fact that biomass burning (wood fires in homes, and burning of agricultural and garden waste) causes between 50 and 70% of particulate carbon pollution in winter in Europe. Assessments at Member States level confirm the important contribution of small-scale combustion of solid fuels to the air emissions.

In order to ensure the sustainability of the EU renewable energy policy, it is therefore crucial to address the air emissions from the small scale-solid fuel combustion installations. This wider policy context underlines the importance of considering energy efficiency along with direct air emissions of SCIs in this study.

2 ec.europa.eu/environment/archives/cafe/general/keydocs.htm

3 Thematic Strategy on air pollution, COM(2005) 446, ec.europa.eu/environment/archives/air/cafe/pdf/strat_com_en.pdf

4 www.vein.hu/CARBOSOL/

1. Task 1 – Definition

The objective of Task 1 is to present the complete canvas of relevant products and present the key definitions and preliminary scope of this preparatory study (Lot 15). It provides a brief technical description of all products (including suggested functional unit) and preliminary data on energy consumption and improvement potential of these products. Product definitions available from different sources (e.g. EU trade statistics, existing standards, existing regulations or voluntary initiatives, industry) are used for developing the scope of this study. Additionally, the key parameters needed for the analysis in the next steps of the study are identified. The harmonised test standards and additional sector-specific procedures for product-testing are also identified and discussed. Finally, this task presents relevant legislations, voluntary agreements, and labelling initiatives at EU level, in Member States, and in third countries.

1.1. PRODUCT CATEGORY AND PERFORMANCE ASSESSMENT

The objective of the sub-task 1.1 is to define the categories of product that fall within the scope of the study, from a broad functional and technical perspective. Additional sub-categories of products, based on finer technical differences may be defined in Task 4.

This scoping exercise is a crucial step, since there is no established agreement on the exact meaning of 'solid fuel small combustion installations'. The definition of the scope is therefore based on the analysis of the four key features mentioned in this definition: installation, size (small), functionality (combustion), and fuel type (solid fuel). Regarding the functionality, according to the Terms of Reference, this study should cover appliances used "in particular for heating".

1.1.1. KEY CRITERIA FOR DEFINING THE SCOPE

➔ **Product vs. installation**

The term 'product' is the standard term used in the Ecodesign Directive. In contrast, 'installation' is a term employed in the IPPC Directive[5] in the context of industrial activities where it is defined as *"a stationary technical unit where one or more activities... are carried out, and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution."* Thus, installations are usually bespoke projects, assembled in-situ with component parts from various sources to match design specifications. Furthermore, an 'installation' in the context of IPPC and Large Combustion Plant (LCP) Directives can also be used to describe an assembly of individual combustion appliances, rather than one single appliance.

It would be difficult to tackle such installations through the Ecodesign Directive, which focuses on individual products and being based on the Article 95 of the Treaty, aims at

[5] Directive 96/61/EC concerning Integrated Pollution Prevention and Control

internal market harmonisation and ensuring free movement of goods based on CE marking.

In the context of this study, an installation is thereby considered to refer to a single commercially-distributed combustion appliance, including associated control, fuel handling, ash handling, and related operating equipment.

➔ Size and capacity

For combustion installations, the reference to size relates directly to the capacity. For smaller SCIs, such as domestic installations, the capacity of the appliance is usually expressed as the useful heat output. In contrast, the capacity of larger appliances (i.e. in industrial installations) is generally defined in terms of thermal input, typically the net rated thermal input.

However, currently there is no generally agreed definition for a 'small' solid fuel combustion installation. The meaning of 'small' depends on the context, e.g. an SCI in the industrial context can be much bigger than a small SCI used for domestic purposes. Figure 1-1 illustrates the range of activities where solid fuel SCIs can potentially be found, from domestic to commercial and industrial sectors.

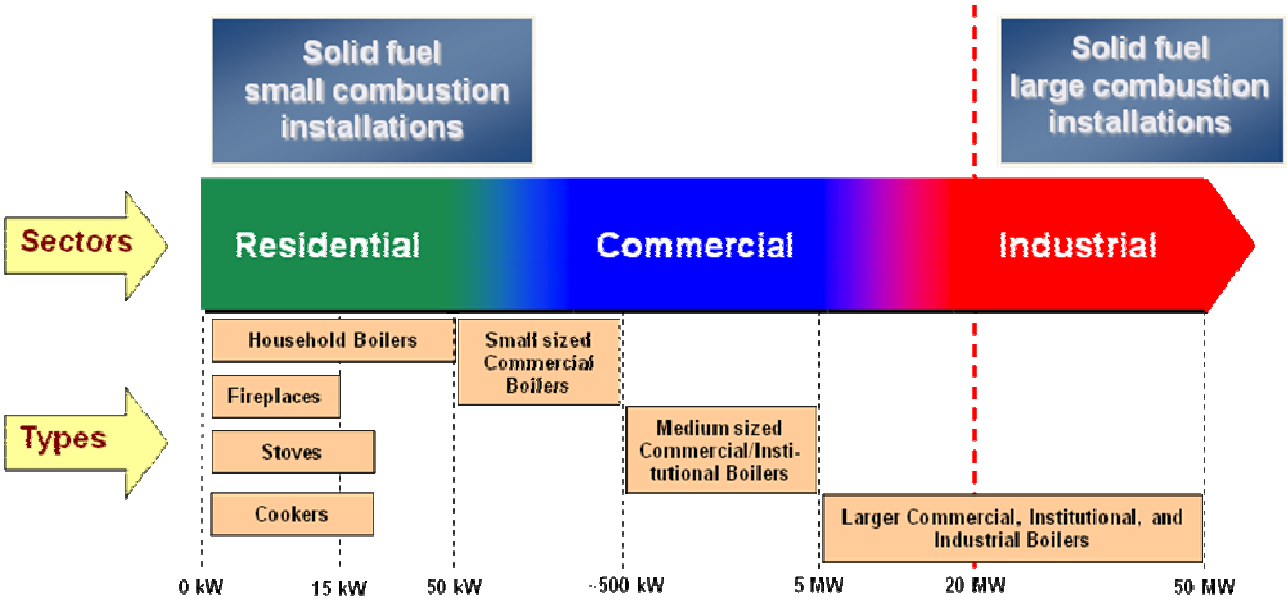

Figure 1-1: Range of uses and sizes of solid fuel combustion installations

The capacity ranges shown above are indicative and the boundaries are not always absolute. In general, lower capacity SCIs (below 50 kW) are mostly found in the residential sector[6]. The upper range (20-50 MW and above) is used in the industry and large institutions. The middle capacity range SCIs (50 kW - 20 MW) can be found in commercial, smaller industrial, and larger residential, institutional, and community heating applications.

While there is no clear definition of 'small' combustion installations, installations above the capacity of 20 MW can be considered large industrial installations, regulated through other EU policy instruments. Indeed, several EU policy instruments set an upper size threshold for defining SCIs. For example, large solid fuel combustion plants

[6] The 50 kW threshold for domestic use is based on upper size criteria in EN Standards for residential solid fuel appliances.

are currently regulated at the European level primarily through the Large Combustion Plants (LCP) Directive 2001/80/EC and Directive 96/61/EC on Integrated Pollution Prevention and Control (IPPC). These Directives concern combustion installations with a thermal capacity exceeding 50 MW[7] rated thermal input. Recently, these two Directives have been recast (together with five others) into a single legislative instrument in the Proposal for a Directive on industrial emissions[8], adopted by the Commission on 21 December 2007. The proposal would lower the threshold for IPPC-regulated combustion installations down to 20 MW. In addition, the EU greenhouse gas Emissions Trading Scheme (ETS) established by Directive 2003/87/EC, applies to all installations carrying out energy activities with a net thermal capacity greater than 20 MW[9].

It is reasonable to define a medium size range of about 0.5-20 MW where installations are largely assembled on-site and are typically more variable in terms of final, installed product design. As mentioned earlier, these larger appliances are usually bespoke projects assembled in-situ with component parts from various sources to match the design specifications. In contrast, appliances up to around 0.5 MW output are available as stand-alone products which can be shipped essentially complete from manufacturers (albeit with various options for fuel transfer to the appliance which may differ between installations).

Hence, SCIs defined on the basis of final product design (as a standalone appliance) would be smaller than 0.5 MW output.

➔ Functionality

■ End-use

The primary function of SCIs is the combustion, or oxidation of solid fuels to liberate heat which can then be directly utilised to provide heat and/or power.

Alternatively, solid fuel boilers can also be used to produce steam for electricity production or, perhaps more likely, electricity as well as heat in a combined heat and power (CHP) application. There are also gasification and pyrolysis systems which may provide immediate combustion of the synthesis gas, within one unit, for heat. Gasification may also be used to generate a fuel that can be used for combustion in a separate engine to generate electricity (and perhaps heat). Gasification of solid fuels (mineral fuels, some wastes and also biomass) is an emerging technology with potential benefits for removing some pollutants or pollutant precursors prior to combustion. Even if they can be used in CHP applications with a capacity below 500 kW, these systems are first and foremost employed in installations in the MW power range.

The Terms of Reference of the study state that the Lot 15 study is to look at solid fuel SCIs – especially for heating. However, heating is a rather general functionality, which can refer to space heating in dwellings as well as in the context of industrial processes.

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7 Under IPPC, and to an extent LCP, Directive, an installation can include a number of combustion appliances smaller than 50 MW whose total capacity exceeds 50 MW. There is no "de minimis" for the size of individual combustion appliances which may form part of an installation.

8 ec.europa.eu/environment/ippc/pdf/recast/dir_2007_844_en.pdf

9 Note that the definition of installation for ETS is the same as for an IPPC installation (see p 9).

Therefore, it is necessary to define the functionality of lot 15 appliances more precisely.

Functional scope

Solid fuel SCIs are mainly used for heat within the broad applications described below. However, in some instances a single appliance may have multiple uses. For instance, cookers can also provide room heating, and direct heating appliances can also incorporate heat exchangers for indirect heating. Moreover, domestic space heating appliances may be used either as the main heat source for a building, denoted hereafter as the primary heat source, or only to supplement other heating sources, denoted hereafter as a secondary heat source (for heating a single room or for supplementing the primary heat source).

Direct heating[10] and decorative appliances: these appliances provide direct space heating by radiation and/or convection, or are used mostly for decorative purposes. They can be used as the primary heat source of the building, but they are often simply used as secondary heat source, and therefore may not operate frequently. They comprise fireplaces and stoves and do not usually provide heat outputs in excess of 50 kW. Many such appliances actually have capacity ratings of 20 kW or less (Table 1-1) and are covered by a number of EN standards[11].

Indirect heating appliances[10]: these appliances provide heat indirectly, via hot water, air, or some other heat transfer media. Indirect heating appliances are typically used as the primary heat source in a building. They include central heating boilers for single residences, institutions, multiple residences, or larger district heating applications (Table 1-1). Smaller appliances are typically based on water as the heat transfer medium, whereas larger appliances may use steam. EN standards are available for solid fuel residential boilers (up to 50 kW output) and for solid fuel boilers up to 300 kW output.

Cooking appliances: beyond their cooking function, solid fuel cookers are often used for their direct/indirect space heating function, as such, they fall within the scope of this study. Solid fuel cookers are designed for domestic or conceivably small-scale commercial or institutional use (for example, bakeries and pizza ovens). There are EN standards covering aspects of residential cookers elaborated by CEN Technical Committee (TC) 295. Although the CEN TC 281 has also published several standards for outdoor cooking appliances (barbecues), they are considered outside the scope of this study, since they do not have a space heating function. Furthermore, barbecues are used only occasionally and it could be difficult to establish a meaningful definition of appliance efficiency (see examples in Annex, section 1.4.1.).

Process heating applications: process heating applications supply the heat needed to produce basic materials and commodities in the industry (Table 1-1). An example of process heating application is the combustion and reduction of coke to refine metals. Such applications are considered to primarily represent heating

[10] The categorisation with Task 1 differentiate between direct and indirect appliances, however it is acknowledged that direct heating appliances can also be fitted to a boiler.

[11] CEN Technical Committee 295 has published product standards on inset fires, open fires, slow release appliances, space heaters, cookers, wood pellet fired appliances (boilers and room heaters), space heaters and independent boilers with space heating, see section 1.2.

activities and could be considered a subset of the indirect heating activity. However, process heating activities use bespoke reaction vessels and the market size is unlikely to be large. Accordingly, they are considered outside the scope of this study.

Waste recovery: for energy production is a common activity in industrial and commercial operations (Table 1-1). Typically these sectors use the combustion of waste materials and recovery of the heat for indirect heating or process use. However, the waste is typically co-fired with a conventional fuel or burnt in bespoke combustion appliances. Moreover, such waste combustion (or incineration) installations are typically in the MW power range. For all these reasons, waste recovery appliances are considered outside the scope of this study.

Table 1-1: Summary of SCIs uses and sectors

Use	Residential	Commercial, institutional or industrial		
		Small	Medium	Large*
Direct heating	<20-35 kW	<50 kW	-	-
Indirect heating	<50 kW	<300 kW	<0.3-5 MW	5-20 MW
Cooking	<50 kW	<300 kW	-	-
Decorative	<20-35kW	<50 kW	-	-
Process	-	<300 kW	<0.3-5 MW	5-20 MW
Waste recovery	-	<300 kW	<0.3-5 MW	5-20 MW
'-' denotes that this application is not significant in this sector *Large applications tend to use net rated thermal input				

➔ Solid fuels

■ Fuel types

Various solid fuels are listed in Table 1-2 and include traditional mineral fuels (lignite, coal of various ranks from anthracite to high volatile bituminous coal), manufactured mineral fuels (coke, mineral fuel briquettes or ovoids), peat, biomass (woods, straw, charcoal, other solid biomass), and wastes. Both mineral and biomass fuels can come in different shapes and sizes. Coal (and lignite) can be used as fine powder, in lump form (of varying size classification) or as manufactured briquettes. However, an SCI would not typically burn powdered or pulverised fuel (this technology is more commonly associated with very large boilers used for electricity generation). Peat is available as dried sods, milled or briquetted - but again, milled peat is unlikely in an SCI. Wood can be burnt as logs, chips, or pellets (compressed sawdust of various sizes).

There is no universal classification for solid fuels. However, international classification schemes for mineral fuels exist, as well as technical specifications for solid biomass fuels and solid recovered fuels (these CEN specifications are produced by technical committees 335 and 343 respectively). Some classifications for solid fuels are also described in various product standards (in particular the harmonised standards for

residential solid fuel appliances produced by CEN technical committee 295 - see section 1.2. for more details). In the context of small scale combustion installations, solid fuels can be divided in two main categories, as per the EMEP/Corinair Emission Inventory Guidebook[12]:

Solid mineral fuels, e.g. hard coal, brown coal, patent fuels, brown coal briquettes, coke, charcoal, and peat.

Solid biomass fuels, e.g. wood as well as wood wastes and agricultural wastes used as fuels (straw, corncobs, etc).

Wastes other than those specifically mentioned above are not commonly used as fuel in standard small combustion installations.

Table 1-2: Types of solid fuels

Fuel family	Fuel
Mineral fuels	Anthracite
	Bituminous coal (low and high volatile)
	Lignite (brown coal)
Manufactured mineral fuels	Petroleum coke (usually high sulphur)
	Briquettes, ovoids
	Coke
	Manufactured solid smokeless fuels
Peat	Peat and peat briquettes
Biomass	Straw
	Wood: lumps, logs, chips, pellets
	Charcoal
	Other biomass fuels
Wastes	Wood waste (e.g. bark, sawdust)
	Agricultural or arboricultural waste (e.g. grain, corn, maize)
	Food waste (e.g. nut hulls, fruit pits)
	Industrial waste

Fuel quality

Fuel type, fuel quality, and the stability of the physicochemical properties of the fuel can all have a great influence both on the magnitude and the composition of pollutant emissions. Figure 1-2 illustrates the diversity of relevant fuel types, along with the

[12] EMEP/Corinair Emission Inventory Guidebook provides guidance for the compilation of emission inventories for countries reporting under the UN Convention on Long-Range Transboundary Air Pollution (CLRTAP). See definitions section of small combustion chapter available at : http://reports.eea.europa.eu/EMEPCORINAIR5/en/B216v2.pdf

emissions that can be of concern in the context of small scale SCIs. This issue will be discussed in more detail in Task 3.

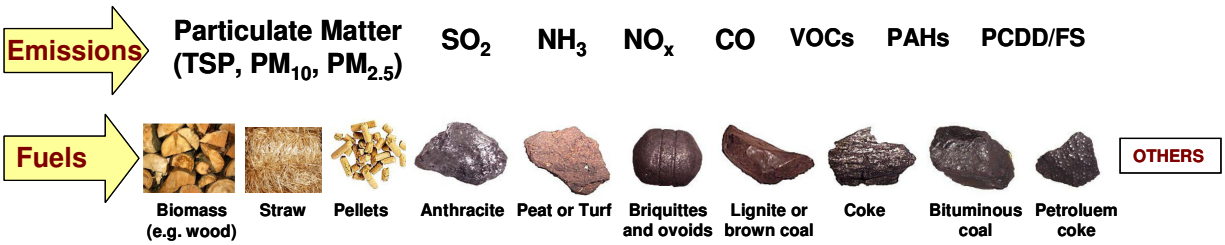

Figure 1-2: Range of fuels and emissions of small combustion installations

The quality standards of solid fuels are not always well defined. For coal, the quality can be described by the physicochemical properties of the coal, based on the works carried out by the International Organisation for Standardisation (ISO) and the American Society for Testing and Materials (ASTM International). For solid biomass fuels, a range of detailed de-facto test standards exist in a number of MS (e.g. for wood pellets and wood chips). At the European level, work has been carried out in the recent years by a dedicated technical committee CEN/TC 335 in order to develop appropriate test standards for biomass fuels (see section 1.4.2. in Annex of this document). The solid biomass fuel technical specifications are currently being upgraded to EN-standards, after which the national standards will be withdrawn[13].

However, the test standards for solid fuel SCIs (see section 1.2.) usually define the characteristics of the fuel to be used for testing, so as to fix this variable for the purpose of testing. It is acknowledged that the quality of fuels used in real-life can bear little resemblance to the test fuels, with subsequent impacts on emissions. These aspects will be discussed in more detail in Task 3 of this study.

Sensitivity of SCIs to fuel characteristics

Many significant pollutants are products of incomplete combustion. The use of a wrong fuel quality (different moisture or size), or a wrong fuel type will generally lead to combustion problems which will therefore have a detrimental impact on emissions and on the appliance efficiency, if the design of the SCI does not take this requirement into full account. Usually, solid fuel SCIs are designed for a specific fuel type, and appliances designed for one fuel type do not operate satisfactorily with another fuel type. However, tolerance to the use of wrong fuel types will vary according to the type of appliance. For instance, traditional open fireplaces and stoves can be reasonably tolerant to variations in fuel type and quality through increased user-intervention. In contrast, modern automatic appliances require more consistent fuels. Accordingly, manually and automatically fuelled appliances tend to use different types of fuels:

Manually-fuelled appliances (e.g. domestic use) typically use wood logs, coal or manufactured solid fuels. An appliance designed for coal or wood is generally not suitable for coke, but there exist multi-fuel enclosed appliances which can burn coke, anthracite, manufactured fuels or wood logs.

Automatically-fuelled appliances are usually designed to burn a specific fuel type. Often, the manufacturer also defines some limits on key fuel parameters, such

[13] For this reason, no information about the national biomass fuel standards is included in this report.

as moisture content, ash, and fuel size. Smaller automatic appliances, e.g. domestic appliances below 25 kW, tend to be designed to use manufactured biomass fuels, such as wood pellets or wood chips, or manufactured mineral fuels. Wood chips can be used both in small and large wood-fuelled appliances, but are more common for non-domestic appliances. Domestic mineral fuel automatic appliances tend to use anthracite or manufactured mineral briquettes, whereas larger appliances can use coal (but often within an upper coal size limit). However, there are exceptions, for example, automatic log-fired domestic boilers and heaters.

The use of a given fuel type and therefore the choice of the appliance has been, and to a great extent still is, heavily determined by local characteristics, such as local fuel availability. Thus, it is possible to identify MS or regions where coal/mineral fuels are the best established solid fuels, and other regions where wood is the predominant solid fuel. In recent years, the range of measures and instruments deployed to encourage the use of sustainable resources has led to substantial development of automatic wood-fuelled appliances. The relative market size of appliances using different types of solid fuels will be assessed in Task 2, while solid fuel use for heating will be quantified in Task 3.

1.1.2. EXISTING PRODUCT CATEGORIES

➔ PRODCOM categorisation

A number of PRODCOM categories could apply to SCIs. They are summarised in the Annex 1.4.3. However, most PRODCOM categories concern appliances that can be fired by any type of fuel (including gas, oil, etc.). Only two categories apply exclusively to solid fuel appliances:

29.72.11.50 “Iron or steel solid fuel domestic cooking appliances and plate warmers (including those with subsidiary boilers for central heating)“, and

29.72.12.70 “Iron or steel solid fuel domestic appliances (including heaters, grates, fires and braziers; excluding cooking appliances and plate warmers)”.

Thus, PRODCOM does not provide suitable definitions or categorisation approach for the purpose of this study.

While a detailed market analysis of solid fuel SCIs will be carried out in Task 2, it can already be observed (Annex 1.4.3.) that the production figures for the above-mentioned two categories of appliances are very high (1 million domestic cooking appliances and 2 million other domestic solid fuel appliances in 2006). In contrast, the low production figures for very large boilers indicate that larger SCIs are unlikely to have the production quantities required by the methodology MEEuP[14] (200 000 units per year).

➔ European product standards

The CEN Technical Committees 57 and 295 cover heating boilers and residential solid fuel appliances respectively. Current EN standards are listed in Table 1-3. A number of

[14] The Ecodesign Directive covers products which represent a significant volume of sales and trade: more than 200 000 units a year within the European Community.

these standards also cover the testing procedure. They are presented in further detail in section 1.2. and 1.4.4.

Table 1-3: EN standards for solid fuel SCIs

Technical Committee	Standard reference	Title
TC 57 Central heating boilers	EN 303-5:1999	Heating boilers - Part 5: Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking
	EN 15270:2007	Pellet burners for small heating boilers - Definitions, requirements, testing, marking (applies to burners applied to non-integral boiler)
TC 295 Residential solid fuel burning appliances	EN 12809:2001 /A1:2004 /AC:2006/7	Residential independent boilers fired by solid fuel - Nominal heat output up to 50 kW - Requirements and test methods
	EN 12815:2001 /A1:2004 /AC:2006/7	Residential cookers fired by solid fuel - Requirements and test methods
	EN 13229:2001 /A1:2003 /A2:2004 /AC:2006/7	Inset appliances including open fires fired by solid fuels - Requirements and test methods
	EN 13240:2001 /A2:2004 /AC:2006/7	Room heaters fired by solid fuel – Requirements and test methods
	EN 14785:2006	Residential space heating appliances fired by wood pellets - Requirements and test methods
	EN 15250:2007	Slow heat release appliances fired by solid fuel - Requirements and test methods
	prEN 15281 (under development)	Sauna stoves fired by solid fuel - Requirements and test methods
	prEN 15544 (under development)	One off tiled/mortared stoves – Dimensioning

This categorisation gives indications about the possible thresholds that could be used within the Lot 15 to define the sub-product categories. The proposed categories for Lot 15 study are presented in the next section. However, these are not definitive and can be subdivided, for example while defining the base-cases (Task 5).

1.1.3. CONCLUSIONS: SCOPE OF THE STUDY

Solid fuel SCIs represent a very fragmented and diverse market in Europe, and a variety of products could fall under the scope of this study. Given the limited time available for this study and in order to perform a thorough evaluation of the products, it is necessary to determine the precise scope of the study in terms of products to be analysed and those to be excluded.

It is important to note that the scope, based on the analysis presented in the above sections, can be further refined when market and use data are investigated in Task 2 and 3, respectively. **Further sub-categorisation may also be introduced based on the technical considerations that will be looked at in Task 4.**

Based on the considerations presented in section 1.1.1. , the scope of the study is limited to **single combustion appliances used for direct and/or indirect indoor space heating** and with **a capacity below 500 kW**. These appliances include mass-manufactured appliances, and manufacturer's pre-designed units designed to be built on-site. They include appliances used as a primary heating source and appliances used occasionally, as a secondary heat source. Figure 1-3 provides an overview of the appliances covered by the Lot 15 study. It can be seen that Lot 15 appliances are mostly domestic appliances, which can be categorised according to their likely end-use and according to the existing product definitions in EN standards. Three main categories of products can be identified:

- Direct heating domestic appliances, including cooking appliances, with an output <50 kW
- Indirect domestic heating appliances, with an output <50 kW
- Indirect heating non-domestic (commercial/industrial) appliances, with an output between 50 - 500 kW

For this study, and for consistency purposes with existing standards, the upper capacity of the relevant EN standards is adopted for domestic direct heating appliances (i.e. 50 kW output). However, we acknowledge, in agreement with a number of comments from stakeholders, that the upper capacity for direct heating domestic heating (and cooking) appliances is typically around 20-35 kW. In subsequent tasks, the average heat output as well as other characteristics will be defined at the EU level for each product category, and additional sub-categories may be considered.

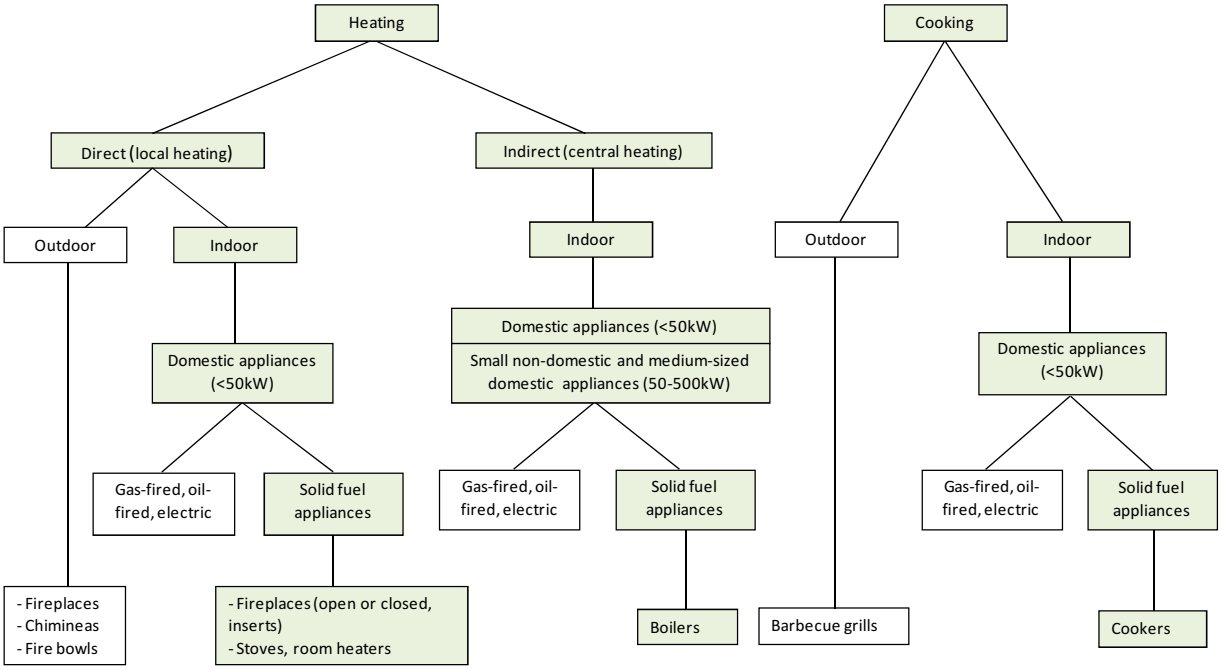

Figure 1-3: Scope overview (green boxes indicate inclusion in the scope)

Product designed for the use of both solid fuels and other fuels (e.g. oil) may be covered (if they appear as a significant product group in the market analysis in Task 2). However, only the performance with solid fuels will be assessed in this study.

The focus of this study is on the combustion appliances themselves, rather than on the types of fuels they use. However, as noted in section 1.1.1. , fuel type and quality are

important parameters in the performance of solid fuel SCIs. Accordingly, issues related to fuel quality will be looked at in Task 3, regarding real life use conditions, and also in Task 2 regarding the relative market shares of different fuels and corresponding appliances. Moreover, the technical assessment of existing appliances in Task 4 will take into account the different fuels types where relevant. Furthermore, the base-cases in Task 5 will be elaborated based on appropriate appliance – fuel type combinations. The influence of fuel quality on the performance of SCIs and on the conclusions of the study can also be assessed in a sensitivity analysis in Task 8.

➔ Appliances within the scope of the Lot 15 study

Solid fuel SCIs cover a wide range of products, with different technologies, ranging from simple open fireplaces with manual loading and control, to sophisticated stoves or boilers with automatic fuel and combustion control systems.

■ Direct heating domestic appliances

These appliances diffuse heat directly into the living space by radiation and/or convection. However, a simple heat exchanger can also be added to divert the combustion gases ('back boiler') and recover the energy indirectly, into a hot water system.

- Open fireplaces

  Traditional open fireplaces (Figure 1-4), which are commonly found in houses across Europe are the simplest type of SCIs. However, they are an inefficient way of heating and they are mostly used for decorative purposes. Indeed, the fire usually dies out after 2-3 hours, which means frequent re-loading of fuel is necessary and open fireplaces are not suitable to keep the house warm overnight. Moreover, open fireplaces are characterised by a simple combustion chamber which is open to the living space. This makes the control of air supply extremely difficult (especially at lighting and reloading), with an excess air supply resulting in incomplete combustion, high fuel consumption for the heat produced, and high emissions of pollutants. Accordingly, open fireplaces typically require a high level of user intervention for ensuring a good combustion, such as to control the air supply, de-ash, load and mix the fuel. The fuel is manually loaded on a fixed grate inside the combustion chamber. While wood logs are the traditional fuel type used in open fireplaces, a wide range of solid fuel types can be used. Open fireplaces can achieve good quality combustion and lower smoke emissions with fuels that meet stringent clean air requirements. It is also possible to design open fireplaces that burn naturally "smoky" fuels with acceptable emission levels.

Figure 1-4: Open fireplace[15]

- Fireplace inserts

Fireplace inserts can be used to increase the efficiency of a traditional open fireplace. They consist of a cast-iron or steel combustion chamber, closed by a glass or ceramic window, which is installed within an existing open fireplace. The confined combustion chamber and improved air flow warrant improved combustion efficiency compared to traditional open fireplaces. However, the characteristics of inserts are similar to those of open fireplaces, in particular regarding their heat output, the types of fuels used and the high degree of user intervention required.

- Closed fireplaces

Closed fireplaces are free-standing units, used to create new fireplaces in a building (Figure 1-5). They are similar to inserts, but differ in that in addition to the combustion chamber, they can have air ducts, flue exhaust pipe, and stone covering. They have a similar or better efficiency and air controls than inserts, but frequent fuel loading and user intervention are required.

Figure 1-5: Closed fireplace[15]

- Cookers

Solid fuel cookers, besides their cooking function, can heat the kitchen and neighbouring room(s) (Figure 1-6). Solid fuel cookers typically have a heat output of 5-15 kW. They can only provide heat for a relatively short time, since the combustion chamber is small. Depending on the design, their efficiency can vary between 50-70%.

[15] Appliance(s) displayed at Progetto Fuoco, international exhibition of plants and materials for wood-fired heating (Verona, January 2008).

Figure 1-6: Cookers[15]

- Stoves

Solid fuel stoves exist in different design configurations (Figure 1-7). Older cast-iron or steel stoves have a basic combustion chamber and a single air inlet, with combustion efficiencies of 40-50%. These stoves typically burn wood logs or mineral fuels (e.g. coal briquettes and anthracite). The combustion efficiency of stoves can be improved, for example by controlling the (passive) air flow through the combustion chamber and by enhancing the secondary combustion of the flue gases. Accordingly, newer stoves can have double-combustion processes with a primary and secondary air supply to ensure combustion efficiencies of fuels above 80%. Like fireplaces, most stoves need to be re-loaded frequently, requiring a high degree of user intervention.

However, some stoves can provide heat over long periods of time with a single fuel load. Slow heat release stoves are surrounded with refractory stones, bricks or clay (or any other material with great inertia) which can store heat. A duct system is designed inside the stone surrounds, so that on their way out, the combustion gases exchange their heat with the stone mass. The heat stored inside the stone mass is then slowly released by radiation inside the living space, providing heat for up to 12 hours or more.

Figure 1-7: Manually loaded stoves[15]

In recent years, pellet stoves (Figure 1-8) have become popular in Europe, and continue to be the focus of active development in the SCI sector. These appliances require less user-intervention, since they have automatic fuel-feeding mechanisms. In addition, the automatic combustion control allows to achieve high efficiencies and low emissions of particulate matter. However, pellet stoves are more expensive than the manual stoves.

Figure 1-8: Automatically loaded pellet stove[15]

- **Indirect heating domestic appliances**

The combustion unit of indirect heating SCIs is equipped with a heat exchanger, to distribute heat to the entire house by a system of hot water pipes. The system typically also involves a control and regulation unit, including pumps and a buffer storage for hot water generation. When placed in the living space, solid fuel boilers may also provide a direct heating function. Solid fuel domestic small boilers have a maximum output typically below 35 kW (Figure 1-9). Numerous types of solid fuel small boilers can be found on the European market, according to the type of fuel supported (e.g., anthracite, manufactured mineral fuels, wood logs, wood pellets), the combustion technology (e.g. underfeed, overfeed, downdraught), and the type of air control. Recent biomass appliances employ techniques such as hot air ignition, underfeed stokers and variable speed fans to control combustion and reduce emissions. Modern coal boilers (Figure 1-10) also have automatic control of air and fuel supply.

Figure 1-9: Outside and inside views of a boiler[16]

Similar to direct heating appliances, development of semi-automatic and fully automatic solid fuel boilers has been an area of intensive development during recent years. However for boilers, these developments are not limited to pellet appliances. Automatic fuel feeding mechanisms can also be found for appliances using other types of solid fuel.

[16] Left picture: Trianco heating products limited, England, http://www.trianco.co.uk/index.cfm
Right picture: appliance displayed at Progetto Fuoco, international exhibition of plants and materials for wood-fired heating (Verona, January 2008).

Figure 1-10: Coal stoker boiler capacity of 25 kW[17]

- **Indirect heating non-domestic appliances**

Semi-automatic biomass and mineral fuel boilers have been used in non-domestic sector for many years (50 kW - 500 kW output). Modern systems available for solid fuels (primarily chips and pellets but also for special types of bituminous coal and anthracite) are essentially fully-automatic and can cope with variable load. The boilers tend to be manufactured in 'families' covering a range of capacity, typically the range will share a common furnace but perhaps differing heat-exchanger capacity provided by a modular design.

Figure 1-11: Boiler of 130-250 kW capacity (Binder, sold in Austria)

➔ **Appliances outside the scope of the Lot 15 study**

Some products are proposed to be excluded from the study because they don't meet one or several of the scope criteria:

- **Different functionality**

- **Outdoor direct heating appliances** (e.g. braziers, chimneys, patio heaters or similar)[18].
- **Outdoor cooking appliances** (e.g. barbecues): although the CEN TC 281 has also published several standards for outdoor cooking appliances, they are considered

[17] Zakad Budowy Kotów (BUD-KOT), Poland, http://www.budkot.pl/index.php

[18] Examples provided in Annex, Section 1.4.1.

outside the scope of this study, since they do not have a space heating function. Furthermore, barbecues are used only occasionally and a meaningful definition of the appliance efficiency could be difficult.

- **Indoor cooking appliances that do not providing direct/indirect heating** (e.g. bakery and pizza ovens).
- **Sauna stoves**: sauna stoves are used to heat the stones of the stove to eventually provide steam for a sauna bath rather than for space heating of the sauna interior itself. Furthermore, sauna stoves differ from other stoves in that high flue gas temperatures are required in order to heat the stones to about 300°C. To take into account the specificities of the sauna stoves, a separate EN standard is being finalised for multi-firing sauna stoves.
- **CHP appliances**: they also have underlying technical differences and very limited market significance.

Not fitting the definition of a product

- **Process heating appliances:** process heating activities use bespoke reaction vessels and the market size is unlikely to be large. Accordingly, they are considered outside the scope of this study.
- **Waste recovery appliances:** unless the waste is similar to a conventional fuel and has similar handling requirements (for example chipped waste wood), waste recovery appliances are unlikely to be a 'standard' product and thus it does not fall within the scope of this study. Outdoor garden 'incinerators' for disposal of residential horticultural waste are also considered outside the scope of this study.
- **Parts of the indirect heating system**, possibly sold in a package with a solid fuel boiler and possibly combining other energy sources than solid fuels (e.g. gas, solar energy) (see section 1.4.5. in Annex for examples), because the focus of the Lot 15 study is on individually sold products .
- **Bespoke, uniquely designed and constructed appliances (e.g. masonry fireplaces)** will not be explicitly covered by the study, but where their functionality is similar to one of the product groups covered, the conclusions of this study could be applicable to them.

Note that **exclusion of a product from the scope of this preparatory study does not mean that it is excluded from the scope of the Ecodesign Directive.** The Directive covers all energy-using products and the products excluded from this study may still be covered by an implementing measure on the basis of a separate assessment.

Product vs. system

Many stakeholders have commented on the chosen 'product approach' of the Lot 15 study, noting that considering the appliance in isolation from the overall heating system has limited value. Furthermore, and quite rightly, the comments highlighted that advanced solutions at system level can achieve high efficiencies and low emissions per heat output.

It is evident that boilers in particular are in real life a part of a system comprising water circuitry, its valves, controls and radiators. Both boilers and direct heating appliances

are part of a larger system at building level, comprising insulation, possible ventilation, etc. The whole system at the level of a building should be adapted to the local climatic conditions.

However, most of the aspects at system level are outside the control of the heating appliance manufacturer and, given that the Ecodesign Directive provides market harmonisation based on CE marking, it should be possible to test the compliance prior to placing it on the market.

Whereas, discussion at system level is relevant for the overall efficiency, it has a limited added value in assessing the direct air emissions. And while efficiency at the appliance level does not reflect the overall efficiency of the system, it nevertheless allows considering and comparison of the improvement options for an appliance, which is the purpose of this study. Furthermore, the 'product approach' is consistent with the MEEuP methodology.

The present study focuses on products and it does not evaluate the various heating solutions or provide the solution to achieve global energy efficiency. It rather aims to ensure that the solid fuel combustion appliances that are implemented as part of a system will be efficient and have low emissions.

Other European legislation and initiatives, notably the Energy performance of buildings Directive, aim at improving the efficiency of the heating systems on the whole.

Consequently, the 'product approach' is maintained for the current study. It should however be noted that the product – system relationship will be looked at later in Task 4 of the study.

➔ **Summary**

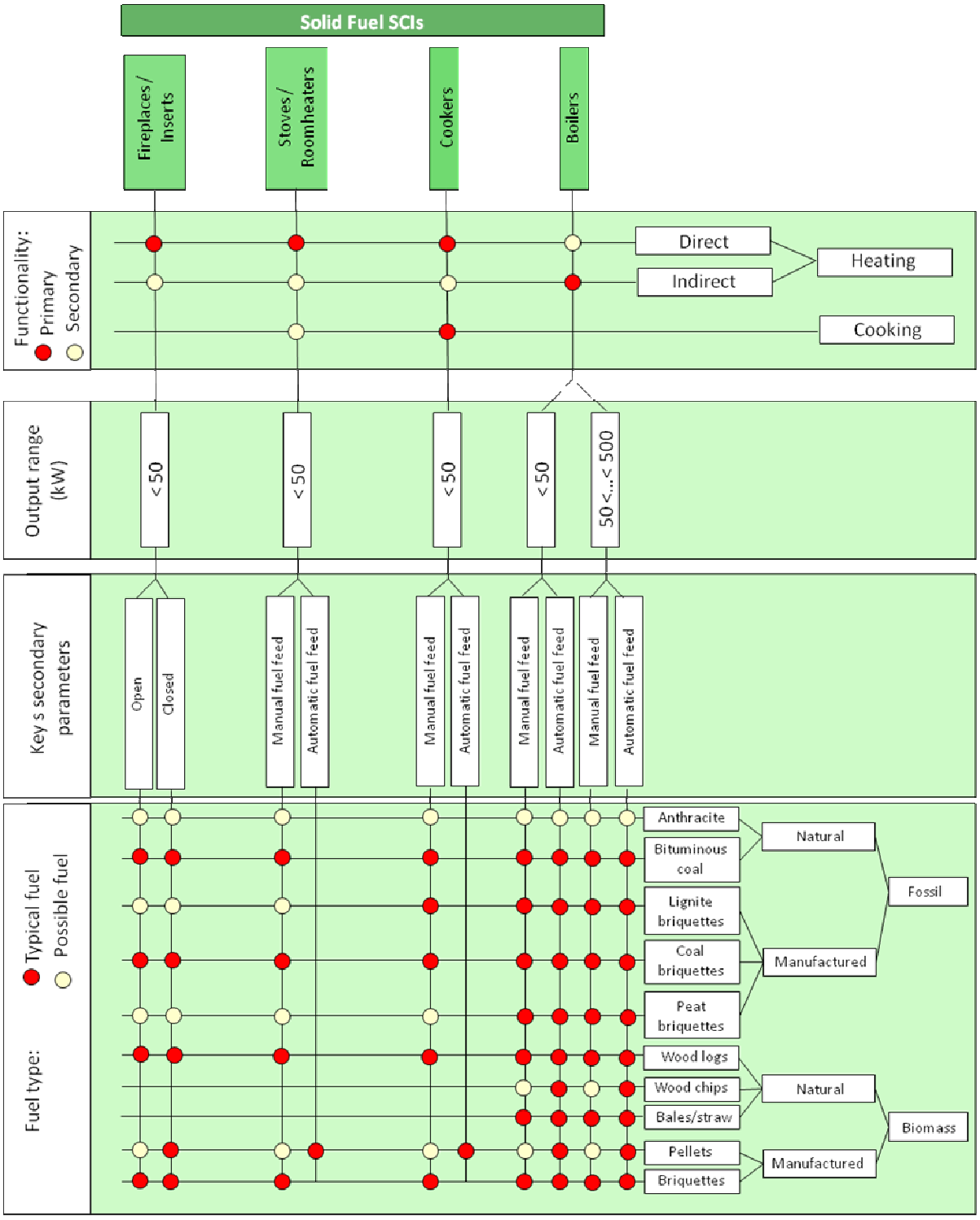

Figure 1-12: Summary of appliances covered by the Lot 15 preparatory study

1.2. TEST STANDARDS

It is important that any product-oriented legislation should preferably refer to harmonised (EN) standards in order to verify the compliance with set measures. The

referenced test standards should be accurate, reproducible and cost-effective, and model as well as possible the real-life performance. If appropriate harmonised standards do not exist, they need to be developed for the relevant parameters in the view of implementing measures – possibly based on existing sector specific procedures.

Hence, this sub-task identifies and describes the harmonised test standards, and where relevant, additional national or sector-specific directions or methods for product-testing, particularly regarding test procedures for functional performance parameters (energy efficiency) and emissions.

1.2.1. EUROPEAN STANDARDS AND TEST METHODS

The European EN standards are documents that have been ratified by one of the three European standards organisations[19]. The standards for SCIs are elaborated by two technical committees (TC) of CEN: TC 57 on Central heating boilers and TC 295 on residential solid fuel burning appliances.

The current EN standards for solid fuel small combustion installations are split up by:

Nominal heat output: up to 50 kW or up to 300 kW;

Functionality: space heating (direct or indirect), water heating, cooking;

Fuel type: wood (logs, chips, briquettes and pellets without binding agents, sawdust) and fossil fuels (coals, coke, anthracite).

These product standards establish requirements relating to the design, manufacture, construction, performance (energy efficiency[20] and emissions of pollutants), safety, use instructions, marking and also provide test methods for appliance type testing. They describe test fuels to be used for testing the heating unit. Regarding solid biofuels, new European standards are under development and these standards are expected to be eventually referenced in the EN appliance (test) standards.

➔ **EN 303-5[21]: Heating boilers for solid fuels, hand and automatically stoked**

Full title: *EN 303–5. Heating boilers – Part 5: Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 300 kW - terminology, requirements, testing and marking.*

Prepared by: CEN TC 57 'Central heating boilers'. Approved on 12 November 1998 and published in April 1999. The standard is to be revised: a first proposal has been elaborated and the discussion at CEN-level started in spring 2008.

Implemented in: EU-27 + Iceland (IS), Norway (NO), Switzerland (CH)

Appliances: Boilers for water central heating systems up to nominal heat output of 300 kW with manual and automatic stoking. It is explicitly stated that the standard does not apply to:

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19 CEN, CENELEC (European Committee for Electrotechnical Standardisation), ETSI (European Telecommunications Standards Institute)

20 The EN standards for SCI measure efficiency on a net calorific value basis

21 This standard is not harmonised.

- Central heating boilers and other heating appliances which do not have minimum heat loss within the requirements of the standard and which are also designed for the direct heating of the place of installation;
- Cooking appliances;
- The design and construction of automatic stoking devices.

Fuels: Wood (logs, chips, briquettes and pellets without binding agents, sawdust) and fossil fuels (coals, coke, anthracite).

Summary: The boilers to which this standard applies should be designed for burning of solid fuels only and they can be used with natural draught or forced draught. The standard contains terminology for solid fuel heating boilers, the design requirement, the technical heating requirements (taking into account the environmental requirements and testing as well as the marking requirements). Heating boilers in accordance with this standard are designed for central heating installations where heat carrier is water and maximum allowable operating temperature is 100°C and which can operate at a maximum allowable operating pressure of 6 bars. For heating boilers with a built-in or attached water heater (storage or continuous flow heater) this standard only applies to those parts of the water heater which are necessarily subject to the operating conditions of the heating boiler.

Methods for determination of functional parameters:

- **Heat output:** refers to EN 304 *Heating boilers - Test code for heating boilers for atomizing oil burners*. Determined on the basis of water stream and temperatures.
- **Efficiency:** direct method as a quotient of heat output and heat input. Indirect methods for checking purposes only (refers to EN 304). The standard defines minimal efficiency (on a net calorific value basis) as a function of nominal heat output for three classes of boilers. Limit error for determination of efficiency is ± 3%. The tolerances for test equipment are defined in EN 304.

Methods for determination of pollutants emission:

- **CO:** the standard defines limits for appliances with different stoking, fuels and heat output. Limit error is not to exceed ±5% of the emission limit. Yet, the standard ***does not define method of measurement***.
- **OGC:** the standard defines limits for appliances with different stoking, fuels and heat output. Limit error is not to exceed ±5% of the emission limit. Yet, the standard ***does not define method of OGC measurement;*** neither does it make reference to any harmonized EN standard regarding the method.
- **Dust:** the standard defines limits of dust for appliances with different stoking, fuels and heat output, to be determined by gravimetric of electrostatic method, or other national methods or practices meeting the error limits requirements defined in the standard. Limit error is not to exceed ±5% of the emission limit. The standard ***does not define method of measurement.*** The standard do contain general scheme of the sampling equipment for dust content and other pollutants. However, presented diagrams are very general. There is no detailed description enabling achievement of appropriate precision of results in one laboratory and repeatability between laboratories.

Quality of test fuels: physico-chemical fuel parameters that are important for testing of appliances are specified. Criteria given for coal are less precisely defined in comparison to those given for solid biofuels[22]. The standard includes a list of the types of currently available commercial fuels.

Further information about this standard, including construction and performance requirements, is provided in Annex (section 1.4.4.)

➔ **EN 12809: Residential independent boilers fired by solid fuel**

Full title: *EN 12809. Residential independent boilers fired by solid fuel - Nominal heat output up to 50 kW - Requirements and test methods.*

Prepared by: CEN TC 295 "Residential solid fuel burning appliances". Approved on 7 April 2001.

Amends: EN 12809:2001/A1:2004.

Implemented in: EU-27[23] + IS, NO, CH.

Appliances: Hand and automatically fired, manual fuelled solid fuel appliances up to nominal heat output of 50 kW for water central heating systems.

Fuels: Solid mineral fuels, peat briquettes or natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer's instructions.

Summary: This standard specifies requirements for residential independent boilers. The primary function of these appliances is to provide hot water for central heating and/or domestic use. In addition to their primary function of providing hot water these appliances also provide space heating to the place of installation. This standard is not applicable to independent boilers for the production of only hot water and having heat outputs of less than 5 kW, neither is it applicable to the design and construction of automatic stoking devices.

Methods for determination of functional parameters:

- **Total heat output:** based on efficiency, fuel stream and calorific value (all formulas are specified within the standard). The mean value for the nominal heat output from at least two separate valid tests shall be not less than the manufacturer's claimed value.
- **Water heating output:** based on water stream and temperatures. The standard provides all the formulas to calculate the water heat output.
- **Space heating output:** difference of total heat output and water heat output.
- **Efficiency:** to be determined by indirect method on the basis of heat losses. The heat losses are determined from the mean values of flue gas and room temperatures, the flue gas composition and the combustible constituents in the residue. The standard provides all the formulas to calculate the efficiency (on a net calorific value basis).

Methods for determination of pollutants emission:

[22] This means that parameters like volatile matter contents for coal are defined as being above some limit value (e.g. >30%) whereas for biofuels they are given as a value with a tolerance (+/-) where this last way of expression is significantly more precise - the range is narrower.

[23] According to the received information, the standard has not yet been implemented in Latvia.

- **CO:** to be determined by measuring the concentration of the products of combustion or substrates of combustion (CO_2 or O_2, and CO) either continuously or at intervals not exceeding 1 min using calibrated instruments meeting the determined uncertainty of measurement requirements. The mean carbon monoxide concentration calculated at 13% oxygen (O_2) content in the flue gas shall be less than or equal to the manufacturer's declared value and shall not exceed 1.0%. The standard contains construction and general arrangement of measurement section for vertical and horizontal flue outlet as well as description of probe for gas sampling and function of gas sampling line, like cooling, cleaning and drying.
- **Dust, OGC:** the standard ***does not provide methods*** for determining these emissions.

Quality of test fuels: physico-chemical fuel parameters that are important for testing of appliances are specified. Criteria given for coal are less precisely defined in comparison to those given for solid biofuels[22]. The standard includes a list of the types of currently available commercial fuels.

Further information about this standard, including construction and performance requirements, is provided in Annex (section 1.4.4.).

➔ **EN 12815: Residential cookers fired by solid fuel**

Full title: *EN 12815. Residential cookers fired by solid fuel – Requirements and test methods*

Prepared by: CEN TC 295 "Residential solid fuel burning appliances". Approved on 7 April 2001.

Amends: EN 12815:2001/A1:2004

Implemented in: EU-27[24] + IS, NO, CH.

Appliances: Hand fired appliances whose primary function is to cook and whose secondary function is to provide heat into the space in which they are installed. In case of connecting these appliances with a boiler, they also provide domestic hot water and/or central heating.

Fuels: Solid mineral fuels, peat briquettes or natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer's instructions.

Summary: This standard specifies requirements for residential cooking appliances fired by solid fuel.

Methods for determination of functional parameters:

- **Total heat output:** determined on the basis of efficiency, fuel stream and calorific value; all formulas given in the standard. The mean value for the nominal heat output from at least two separate valid tests shall be not less than the manufacturer's claimed value.
- **Water heating output:** based on water stream and temperatures. The standard provides all the formulas to calculate the water heat output.
- **Space heating output:** difference of total heat output and water heat output.

[24] According to the received information, the standard has not yet been implemented in Romania.

- **Efficiency:** determined by indirect method on the basis of heat losses. The heat losses are determined from the mean values of flue gas and room temperatures, the flue gas composition and the combustible constituents in the residue. All formulas are given within the standard. The measured total efficiency (on a net calorific value basis) from the mean of at least two test results at nominal heat output shall be greater than or equal to the manufacturer's declared value and shall equal or exceed 60%.

Methods for determination of pollutants emission:

- **CO:** the measurement equipment used shall be selected to ensure uncertainty of the measurement $\leq 6\%$ of the limit value. The mean carbon monoxide concentration calculated at 13% oxygen (O_2) content in the flue gas shall be less than or equal to the manufacturer's declared value and shall not exceed 1.0%. The standard contains construction and general arrangement of measurement section for vertical and horizontal flue outlet as well as description of probe for gas sampling and function of gas sampling line, like cooling, cleaning and drying.
- **Dust, OGC:** the standard ***does not provide methods*** for determining these emissions.

Quality of test fuels: physico-chemical fuel parameters that are important for testing of appliances are specified. Criteria given for coal are less precisely defined in comparison to those given for solid biofuels[22]. The standard includes a list of the types of currently available commercial fuels.

Further information about this standard, including construction and performance requirements, is provided in Annex (section 1.4.4.).

➔ **EN 13229: Inset appliances including open fires fired by solid fuel**

Full title: *EN 13229. Inset appliances including open fires fired by solid fuels – Requirements and testing methods*

Prepared by: CEN TC 295 "Residential solid fuel burning appliances". Approved on 7 April 2001.

Amends: EN 13229:2001/A1:2003, EN 13229:2001/A2:2004

Implemented in: EU-27[25] + IS, NO, CH.

Appliances: Hand fired appliances: freestanding or inset appliances which have functional modification or inset appliances for fireplaces recess and enclosure. Additionally, where fitted with a boiler, they also provide domestic hot water and/or central heating.

Fuels: Solid mineral fuels, peat briquettes or natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer's instructions.

Summary: This European standard specifies requirements for residential open fires and inset appliances fired by solid fuel.

Methods for determination of functional parameters:

[25] According to the received information, the standard has not yet been implemented in Latvia.

- **Total heat output:** determined on the basis of efficiency, fuel stream and calorific value. The standard provides all formulas to calculate the total heat output.
- **Water heating output:** declared by the manufacturer shall not exceed the boilers output measured under the test conditions. Water heat output is determined on the basis of water stream and temperatures. The standard provides all formulas to calculate the water heat output.
- **Space heating output:** declared by the manufacturer shall not exceed the test space heating output. Calculated as a difference of total heat output and water heat output.
- **Efficiency:** determined by indirect method on the basis of heat losses. The heat losses are determined from the mean values of flue gas and room temperatures, the flue gas composition and the combustible constituents in the residue. The standard provides all the formulas to calculate the efficiency (on a net calorific value basis).

  In case of Kachelöfen or Putzöfen inset appliances, the measured total efficiency from the mean of at least two test results at nominal heat output shall be greater than or equal to the manufacturer's declared value and shall be not less than 75%.

  In case of all other appliance types, the measured total efficiency from the mean of at least two test results at nominal heat output shall be greater than or equal to the manufacturer's declared value and shall equal or exceed 30%.

Methods for determination of pollutants emission:

- **CO:** the measurement equipment used shall be selected to ensure uncertainty of the measurement $\leq$ 6% of the limit value. In case of Kachelöfen or Putzöfen inset appliances the mean carbon monoxide content of the dry flue gas shall not exceed 0.2 % related to 13 % O_2. In case of all other appliances with closed doors, the mean carbon monoxide concentration calculated at 13% oxygen (O_2) content in the flue gas shall be less than or equal to the manufacturer's declared value and shall not exceed 1 %.The standard contains construction and general arrangement of measurement section for vertical and horizontal flue outlet as well as description of probe for gas sampling and function of gas sampling line, like cooling, cleaning and drying.

No requirements are set for other pollutants (dust, OGC), hence no determination methods are given.

Quality of test fuels: physico-chemical fuel parameters that are important for testing of appliances are specified. Criteria given for coal are less precisely defined in comparison to those given for solid biofuels[22]. The standard includes a list of the types of currently available commercial fuels.

Further information about this standard, such as construction and performance requirements, is provided in Annex (section 1.4.4.).

➔ **EN 13240: Roomheaters[26] fired by solid fuel**

Full title: *EN 13240. Roomheaters fired by solid fuel - Requirements and test methods.*

Prepared by: CEN TC 295 "Residential solid fuel burning appliances". Approved on 7 April 2001.

Amends: EN 13240:2001/A2:2004

Implemented in: EU-27[27] + IS, NO, CH.

Appliances: This standard is applicable to non-mechanically fired appliances which are listed under categories 1a and 2a of Table 1 in the standard[28]. These appliances provide heat into the space where they are installed. This standard also covers slow heat release appliances having thermal storage capacity such that they can provide heat for a period of time after the fire has gone out. This standard is applicable only to those slow heat release appliances which are supplied either as complete units or as works pre-fabricated sections designed to be built on site and for which the manufacturer provides detailed instructions for construction of the pre-designed unit.

These appliances may burn either solid mineral fuels, peat briquettes, natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer's instructions. Additionally, where fitted with a boiler, they also provide domestic hot water and/or central heating.

Fuels: Solid mineral fuels, peat briquettes or natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer's instructions.

Summary: This standard specifies requirements for residential roomheaters fired with solid fuel.

Methods for determination of functional parameters:

- **Total heat output:** based on efficiency, fuel stream and calorific value. The standard provides all the formulas to calculate the total heat output.
- **Water heating output:** determined on the basis of water stream and temperatures. The standard provides all the formulas to calculate the water heat output. The water heating output declared by the manufacturer shall not exceed that measured under the described conditions.
- **Space heating output:** calculated as a difference of total heat output and water heat output. The space heating output declared by the manufacturer shall not exceed the space heating output measured in described conditions.
- **Efficiency:** determined by indirect method on the basis of heat losses. The heat losses are determined from the mean values of flue gas and room temperatures, the flue gas composition and the combustible constituents in the residue. All formulas are given. The measured total efficiency (on a net calorific value basis) from the mean of at least two test results at nominal heat output shall be

[26] The word "roomheater" is to the terminology used in this standard. In the context of Lot 15 study, it corresponds mainly to the stove category.

[27] According to the received information, the standard has not yet been implemented in Romania.

[28] Table 1 in standard EN 13240:2001 describes Categories 1a (appliances operating with firedoors closed) and 2a (appliances operating with firedoors closed or open).

greater than or equal to the manufacturer's declared value and shall equal or exceed 50%.

Methods for determination of pollutants emission:

- **CO:** measure the concentration of the products of combustion or substrates of combustion (CO_2 or O_2, and CO) either continuously or at intervals not exceeding 1 minute using calibrated instruments meeting the defined uncertainty of measurement requirements. The measurement equipment used shall be selected to ensure uncertainty of the measurement ≤6% of the limit value. The mean carbon monoxide concentration calculated at 13% oxygen (O_2) content in the flue gas shall be less than or equal to the manufacturer's declared value and shall not exceed 1%. The standard contains construction and general arrangement of measurement section for vertical and horizontal flue outlet as well as description of probe for gas sampling and function of gas sampling line, like cooling, cleaning and drying.
- **Dust, OGC:** the standard ***does not provide methods*** for determining these emissions.

Quality of test fuels: physico-chemical fuel parameters that are important for testing of appliances are specified. Criteria given for coal are less precisely defined in comparison to those given for solid biofuels[22]. The standard includes a list of the types of currently available commercial fuels.

Further information about this standard, such as construction and performance requirements, is provided in Annex (section 1.4.4.).

➔ **EN 14785: Residential space heating appliances fired by wood pellets**

Full title: *EN 14785. Residential space heating appliances fired by wood pellets – Requirements and test methods*

Prepared by: CEN TC 295 "Residential solid fuel burning appliances". Approved on 3 May 2006.

Implemented in: EU-27[29] + IS, NO and CH.

Appliances: Residential space heaters fired by wood pellets. Appliances may be freestanding or inset appliances and provide heat into the space where they are installed and may be operated with either natural draught or fan-assisted combustion air. Additionally, where fitted with a boiler, they also provide domestic hot water and/or central heating. These appliances operate with firedoors closed only.

Fuels: Wood pellets.

Summary: This European standard specifies requirements for residential space heaters fired by wood pellets. Nominal heat output of these appliances is up to 50kW.

Methods for determination of functional parameters:

- **Total, nominal and reduced heat output:** the mean value of the measured nominal heat output obtained during the test shall equal or exceed the nominal heat outputs declared by the manufacturer. The mean value of the measured reduced heat output obtained during the test shall be less than or equal to the

[29] According to the received information, the standard has not yet been implemented in Bulgaria.

reduced heat output declared by the manufacturer. The total heat output is determined on the basis of efficiency, fuel stream and calorific value. The standard provides all the formulas to calculate the total and nominal heat output.

- **Water heating output**: the water heating output declared by the manufacturer shall not exceed the boilers output measured under the test conditions. Water heat output is determined on the basis of water stream and temperatures. The standard provides all formulas to calculate the water heat output.
- **Space heating output:** the space heating output declared by the manufacturer shall not exceed the test space heating output. It is calculated as a difference of total heat output and water heat output.
- **Efficiency:** determined by indirect method on the basis of heat losses. The heat losses are determined from the mean values of flue gas and room temperatures, the flue gas composition and the combustible constituents in the residue. All formulas are given. The efficiency of tested appliance (on a net calorific value basis) should be specified at nominal heat output and reduced heat output. The measured total efficiency from the mean of at least two test results shall be at least 75% at nominal heat output and 70% at reduced heat output.

Methods for determination of pollutants emission:

- **CO:** the mean carbon monoxide concentration calculated at 13% oxygen content in the flue gas from the mean of at least two results shall not exceed 0.04% (500 mg/m^3) at nominal heat output and 0.06% (750 mg/m^3) at reduced hest output. The measurement equipment used shall be selected to ensure uncertainty of the measurement $\leq$ 2% of the limit value of 0.06%. The standard contains construction and general arrangement of measurement section for vertical and horizontal flue outlet as well as description of probe for gas sampling and function of gas sampling line, like cooling, cleaning and drying.
- **Dust, OGC:** the standard ***does not provide methods*** for determining these emissions.

Quality of test fuels: physico-chemical parameters that are important for testing of appliances are specified. Criteria given for coal are less precisely defined in comparison to those given for solid biofuels[22]. The standard includes a list of the types of currently available commercial fuels.

Further information about this standard, such as construction and performance requirements, are provided in Annex (section 1.4.4.).

➔ EN 15250: Slow heat release appliances fired by solid fuel

Full title: *EN 15250. Slow heat release appliances fired by solid fuel – Requirements and test methods*

Prepared by: CEN TC 295 "Residential solid fuel burning appliances". Approved on 13 January 2007.

Implemented in: EU-27[30] + IS, NO, CH.

[30] According to the received information, the standard has not yet been implemented in Bulgaria, Czech Republic, Greece, Italy, Luxembourg, Malta and Spain.

Appliances: Hand fuelled intermittent burning slow heat release appliances having thermal storage capacity such that they can provide heat for a declared period of time after the fire has gone out. These appliances can provide heat into the space where they are installed. This standard also specifies a minimum time period from the appliance achieving the maximum differential surface temperature and falling to 50 % of that maximum value.

This standard is not applicable to mechanically fed appliances and appliances having fan assisted combustion air or appliances with boiler.

These slow heat release appliances may be supplied either as an assembled appliance or as a manufacturer's pre-designed unit consisting of pre-fabricated components designed to be built on site in accordance with the manufacturer's specified assembly instructions.

Fuels: Solid mineral fuels, peat briquettes, natural or manufactured wood logs or the appliance may be multi-fuel in accordance with the appliance manufacturer's instructions. Wood pellets which are hand fuelled may also be burned either on the existing appliance bottom grate or in a special basket arrangement which is placed by the user into the existing firebox.

Summary: This European standard specifies requirements for residential slow heat release appliances fired by solid fuel.

Methods for determination of functional parameters:

- **Total heat output:** the total heat output is determined on the basis of efficiency, fuel stream and calorific value. The standard provides all the formulas to calculate the total heat output.
- **Efficiency:** determined by indirect method on the basis of heat losses. The heat losses are determined from the mean values of flue gas and room temperatures, the flue gas composition and the combustible constituents in the residue. All formulas are given. The measured total efficiency (on a net calorific value basis) from the mean of at least two test results shall be greater than or equal to the manufacturer's declared value and shall equal or exceed 70%.

Methods for determination of pollutants emission:

- **CO:** the mean carbon monoxide concentration calculated to 13 % oxygen (O_2) content in the flue gas shall be less than or equal to the manufacturer's declared value and shall not exceed 0.3 %. The standard contains construction and general arrangement of measurement section for vertical and horizontal flue outlet. The standard contains construction and general arrangement of measurement section for vertical and horizontal flue outlet as well as description of probe for gas sampling and function of gas sampling line, like cooling, cleaning and drying.
- **Dust, OGC:** the standard ***does not provide methods*** for determining these emissions.

Quality of test fuels: physico-chemical fuel parameters that are important for testing of appliances are specified. Criteria given for coal are less precisely defined In comparison to those given for solid biofuels[22]. The standard includes a list of the types of currently available commercial fuels.

Further information about this standard, such as construction and performance requirements, are provided in Annex (section 1.4.4.)

➔ EN 15270: Pellet burners for small heating boilers

Note: this standard does not concern an appliance, but only one part of it (burner). It is described here, because it contains a description of measurement for CO, THC and dust, which may be applied to Lot 15 appliances.

Full title: *EN 15270. Pellet burners for small heating boilers – Definitions, requirements, testing, marking.*

Prepared by: CEN TC 57 "Central heating boilers".

Implemented in: AU, DE, EE, FR, IE, LT, NL, PL, SI, SE, and UK.

Summary: This standard specifies requirements for pellet burners having maximum heat input of no more than 70 kW.

The pellet burners in accordance with this standard are intended for fitting with appropriate boilers for hot water, and intended to be used for combustion of high quality pellets in accordance with EN/TS 14961:2005 Annex A. This standard contains requirements and test methods for safety, combustion quality, operating characteristics and maintenance of pellet burners and also covers all external equipment that influences the safety systems.

Further information about this standard, such as construction and performance requirements, is provided in Annex II (section 1.4.4.).

➔ PrEN 15544: Tiled / mortared stoves

Full title: *prEN 15544. One off Kachelgrundöfen/Putzgrundöfen (tiled/mortared stoves) - Calculation method.*

Prepared by: Technical Committee CEN/TC 295 "Residential solid fuel burning appliances". This is a pre-standard currently under elaboration. It has been distributed for review and comments; it is subject to change without notice. It was originally planned to be published in 2010.

Appliances: This standard is valid for one off tiled/mortared stoves (Kachelgrundöfen/ Putzgrundöfen) equipped with fireclay as interior material, with an apparent density between 1 750 and 2 200 kg/m³, a degree of porosity 18 - 33% by volume and a heat conductivity from 0.65 up to 0.90 W/mK (temperature range 20 – 400 °C). The stoves covered by the standard are designed and constructed individually.

The standard can be used for log wood fired tiled stoves (Kachelöfen) that burn one fuel load per storage period with a maximum load between 10 and 40 kg and a storage period (nominal heating time)between 8 and 24 h. The standard is valid for tiled/mortared stoves with sidewise combustion air supply of the combustion chamber.

This standard does not apply to stoves combined with water heat exchangers for central heating or other heat absorbing elements like glass plates greater than 1/6 of the combustion chamber surface, open water tanks etc. Neither does it apply to combinations with heating/fireplace elements (EN 13229) or mass-produced prefabricated or partly prefabricated slow heat release appliances (EN 15250).

Fuels: Log wood.

Summary: This pre-standard contains specifications for the dimensioning of tiled/mortared stoves. The standard does not cover products or product testing as such; it is a design / construction guideline for tiled stoves (Kachelöfen) built on-site by craftsmen.

Calculation method presented in this standard is based on appropriate literature as well as European standard EN 13384-1 *Chimneys – Thermal and fluid dynamic calculation methods – Part 1: Chimneys serving one appliance*, whereat besides physical and chemical formulas also empirically determined correlations are used.

This calculation method can be used to proof requirements of emissions and energy efficiency in case of burning log wood or wood briquettes according to the manual of the producer. Calculation method include in this standard concern:

- The maximum load of fuel,
- Design of the essential dimensions,
- The mean combustion air flow rate,
- The temperature correction factor,
- Flue gas flow rate,
- Combustion air density,
- Flue gas temperature,
- Efficiency of the combustion.

This standard is meant to provide for a minimum energy efficiency of 78% and the emission limit values of CO 1 500 mg/m_n3 (1.000 mg/MJ), NO_2 225 mg/m_n^3 (150 mg/MJ), organically bound carbon 120 mg/m_n^3 (80 mg/MJ) and dust 90 mg/m_n^3 (60 mg/MJ).

Methods for determination of functional parameters:

- **Nominal heat output:** the nominal heat output has to be specified.
- **Efficiency:** the standard defines efficiency (on a net calorific value basis) as a function of inlet temperature into the connecting pipe only.
- **Flue gas temperature:** based on EN 13384-1 Chimneys – Thermal and fluid dynamic calculation methods – Part 1: Chimneys serving one appliance.

➔ Standards for heating systems in buildings

Please note that standards for heating systems in buildings described below do not describe the testing of small size SCIs as a product. Nevertheless, they were analysed because of their relevance for SCIs as they describe requirements of a heat generation system, which can also include a solid fuel boiler.

■ EN 15316-1

Full title: *EN 15316-1. Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies.*

Summary: This standard constitutes the general part of a set of standards on calculation method for determining system energy requirements and system efficiencies of space heating systems and domestic hot water systems. Other parts of

this set of standards cover specific calculation methods related to the various sub-systems of the heating system.

Detail: The calculation method facilitates the energy analysis of different sub-systems of heating system, including control (emission, distribution, storage, generation), through determination of the system energy losses and the system performance factors. This performance analysis permits the comparison between sub-systems and makes it possible to monitor the impact of each sub-system on energy performance of the building. Calculations of the system energy losses of each sub-system of the heating system are defined in subsequent standards (prEN 15316, parts 2-x, 3-x and 4-x). The system thermal losses, the recoverable system thermal losses and the auxiliary energy of the sub-systems of the heating system are summed up. The system thermal losses of the heating system contribute to the overall energy use in buildings (prEN 15603).

Ventilation systems are not included in this standard (e.g. balanced systems with heat recovery), but if the air is preheated or an air heating system is installed, system energy losses of these systems are covered by this European standard.

In this European standard was presented methodology of energy performance indicators and calculation for a space heating and domestic hot water system. The calculations method concerns:

- Energy efficiency[31] of a sub-system,
- Energy losses from the space heating system,
- Energy losses from the domestic hot water system,
- Simplified and detailed methods for calculation of the system energy losses.

Annex B of this standard provides a sample calculation of a space heating system with electrical domestic hot water system.

- **EN 15378**

Full title: *EN 15378. Heating systems in buildings – Inspection of boilers and heating systems*

Summary: This standard specifies procedures and optional measurement methods to be used for the inspection and assessment of energy performance of boilers and heating systems, in order to provide advice to users on the replacement of boilers, other modifications to the heating system and on alternative solutions as required by article 8 of Council Directive 2002/91/EC.

Detail: This standard covers issues related to energy conservation and environmental performance. Moreover it specifies inspection procedures and optional measurement methods for the assessment of energy performance of existing boilers and heating systems. Boiler types covered by this European standard are:

- Boiler for heating, domestic hot water or both,
- Gas, liquid, or solid fuel fired boilers.

[31] In this standard, Part 1: General definition at 3.1.31 Note 2, it states that "according to ISO 13602 –2 the gross calorific value is preferred to the net calorific value and according to the stakeholders this is being used as a basis for efficiency calculations.

The standard describes regular boiler inspection procedures and methods. They are intended to:

- Verify if the boiler is set, operated and maintained correctly with regard to energy efficiency,
- Estimate actual boiler energy performance, and
- When required, support advice on possible boiler energy performance improvements.

In accordance with this standard the boiler and heating system inspection classes shall be specified according to one or more of the following parameters:

- Fuel type,
- Nominal boiler power input or output,
- Boiler type
- Heated space area or volume,
- Type of heat distribution,
- Type of heat emitters, and
- Other relevant properties.

EN 15316-4-7

Full title: *EN 15316-4-7. Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies. Part 4-7: Space heating generation systems, biomass combustion systems.*

Summary: This standard presents methods for calculation of the additional energy requirements of a heat generation system in order to meet the distribution and/or storage subsystem demand. The calculation is based on the performance characteristics of the products given in product standards and on other characteristics required to evaluate the performance of the products as included in a system.

Detail: The method presented in this standard can be used for the following applications:

- Judging compliance with regulations expressed in terms of energy targets;
- Optimisation of the energy performance of a planned heat generation system, by applying the method to several possible options; and
- Assessing the effect of possible energy conservation measures on an existing heat generation system, by calculating the energy use with and without the energy conservation measure.

In this standard, the performance calculation methods of biomass combustion systems are described corresponding to the different types of heat generators. For each type of boiler, the calculation methods are described corresponding to its different applications. The calculation methods differ with respect to:

- Type of stoking device (automatic or by hand),
- Type of biomass fuel (pellets, chipped wood or log wood).

The calculation method for boilers with automatic stoking is comparable to the methods used for automatically fired boilers for oil or gas and is based on the following principles:

- Losses at 100% load,
- Losses at part load (between 30% to 50%, according to specification by manufacturer), and
- Losses at 0% load.

The calculation is based on an evaluation of the outside air temperature. The annual frequency, which is derived from the average values of the outside air temperature, is divided into temperature intervals. For each interval, the heat generation loss is calculated separately.

The efficiency at full load is measured with an average water boiler temperature of 70 °C (according to EN 303-5). This efficiency has to be adjusted to the actual generator average water temperature of the individual installation, only if the operation temperature differs by more than 5 K from the boiler testing temperature.

The calculation method for boilers with stoking by hand is a boiler cycling method. A distinction is made between two types of operation cycles:

- Stand alone operation cycle,
- Permanent operation cycle.

Annex A of the standard provides default values for boiler parameters with biomass combustion systems. Moreover this part specifies equations for determining boiler efficiency and standby losses.

The following referenced documents are indispensable for the application of this standard.

- EN 303-5:1999, *Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 300 kW*
- *CEN/*TS 14588:2003, *Solid biofuels – Terminology, definitions and descriptions.*
- *prCEN/TS* 14961:2005, *Solid biofuels – Fuel specification and classes*
- EN ISO 7345:1995, *Thermal insulation – Physical quantities and definitions (ISO 7345:1987)*
- EN ISO 12241:2008, *Thermal insulation for building equipment and industrial installations – Calculation rules*
- EN ISO 13790:2008, *Thermal Performance of Buildings - Calculation of Building Energy Demand for Heating*

1.2.2. OVERVIEW OF EXISTING METHODS FOR DETERMINING EMISSIONS

CEN Technical Committee 295 carried out a review[32] on methods for determination of OGC[33], dust and NOx emissions, used for SCIs in different countries, which proved existence of significant differences, which will be outlined below.

➔ Measurements of total hydrocarbons

The method is based on EN 13526:2001 *Stationary source emission -Determination of the mass concentration of total gaseous organic carbon in flue gases from solvent using processes- Continuous flame ionization detector method.* This method is intended to determine the total hydrocarbon (OGC) content in flue gases from appliances burning solid fuels. It uses an instrument equipped with a flame ionisation detector (FID). The measurement is continuous. The result obtained is expressed as equivalents of a reference substance, usually methane or propane. The measurement concerns only the total organic compounds, hydrocarbon and other content and does not give any information of separate constituents.

The measurement is extractive, i.e. the test gas flow is drawn from the measuring point and is analyzed in a free-standing instrument. The measuring point shall be in the centre of the flue gas pipe and be placed three diameter after the flue gas outlet of the appliance. If there is a damper or any other device which favours the lack of homogeneity in the flow, the measuring point shall be moved to a position where the flow is homogenous. The measuring system shall be heated to 195 °C.

The measuring system consists of the following components:

Instrument with flame ionisation detector, FID. Measuring range, usually between 0-10 and 0-100 000 ppm. The instrument shall be equipped with a heated filter.

Gas probe with a filter for particulates: The probe shall be made of a suitable material, such as corrosion resistant steel. The filter shall be heated so that condensation is avoided. This requires a temperature in the filter of 195 °C.

Sample line: The sample line shall be heated to the same temperature as the filter. The inner line shall be made of PTFE and be exchangeable. The sample line shall be as short as possible.

The standard (EN 13526) describes how to calculate the content of organic gaseous compounds expressed in mg/dry Nm^3 (in normal condition, i.e. 273 K and 1013 mbar) and with an O_2 content of 13 % in the exit flue gases. The calculation is based on a continuous measurement of total hydrocarbon (THC) content.

The following data must be known to perform the calculation:

Total hydrocarbon content in methane or propane equivalents (mean value);

$O_{2,m}$, $CO_{2,m}$, CO_m content (mean values);

Carbon, hydrogen and moisture content of the test fuel (C, H and W); and

Carbon content of the residue crossing the grate referred to the quantity of the test fuel fired (Cr).

[32] Residential solid fuel burning appliances Emission test methods [CEN/TC 295 WG48REV2 E, 2006 May 4]

[33] OGC: total organically bound carbon. This is all carbon that exists in organic form in flue gases.

The uncertainty of the measurement for total hydrocarbon is ±10 % of the measured value at maximum. The total uncertainty of the calculated OGC value, according to this instruction, is ±15 % of the calculated value.

➔ Measurement of nitrogen oxides

Two methods can be used to determine the content of nitrogen oxides in SCIs flue gases (these methods are not referenced in any measurement standard):

Chemiluminescence's method and

Non-dispersive infrared (NDIR) method.

Both methods are continuous, and the result obtained is expressed as equivalents of nitrogen dioxide (NO_2). The measurement is extractive, i.e. the test gas flow is drawn from the measuring point by the suction pyrometer and is analysed by an arrangement of a complete measuring system. An example of this scheme is presented below (Figure 1-13).

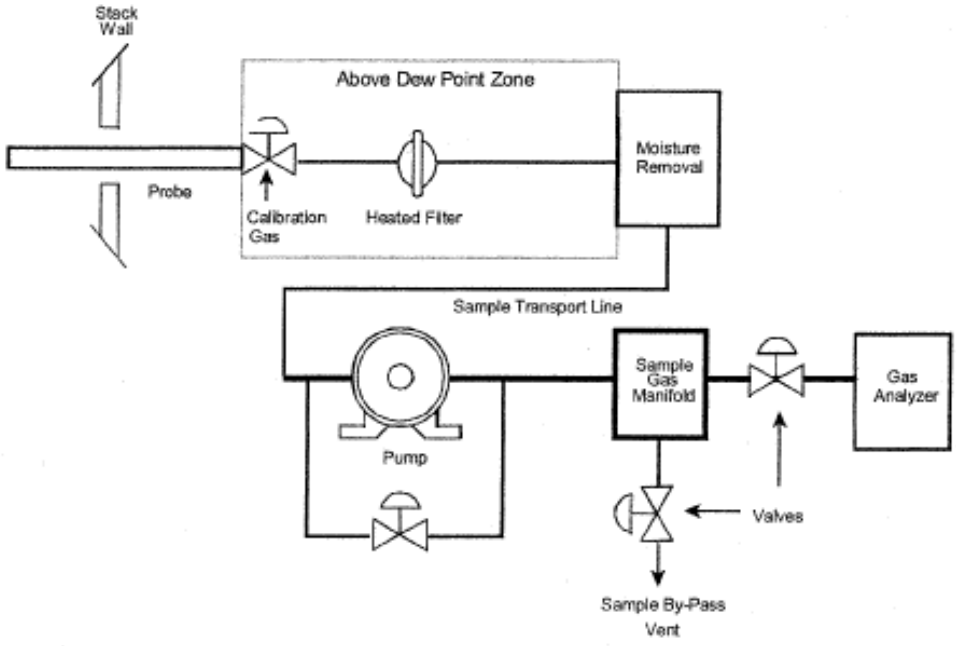


Figure 1-13: Example of the installation for measuring devices[34]

■ Chemiluminiscence method

The chemiluminescence method is based on the reaction of NO with ozone. The measuring range of chemiluminiscence analysers used for emission measurements extends from 10 mg/m³ to 20 000 mg/m³. Figure 1-14 gives an example of a chemiluminescence analyser.

[34] From USEPA Method 7E: http://www.epa.gov/ttn/emc/promgate/method7E.pdf

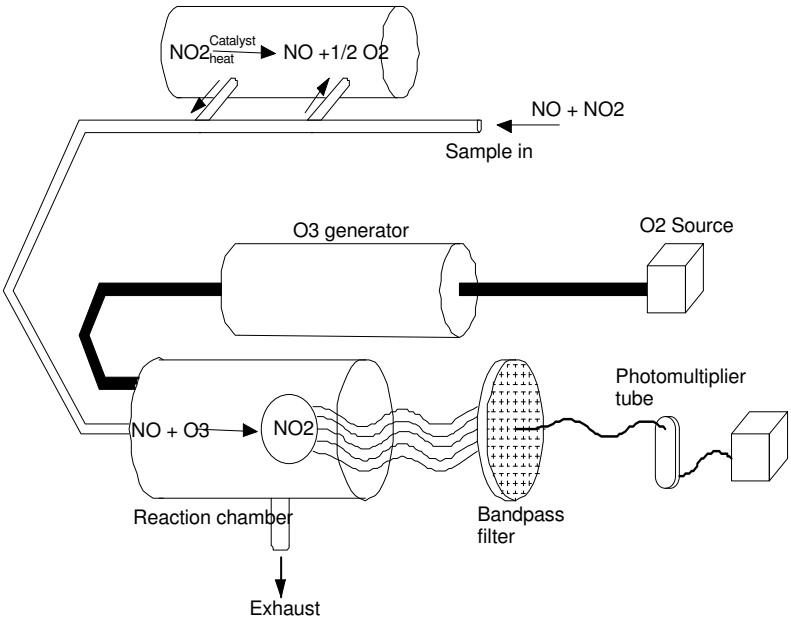


Figure 1-14: Example of arrangement of a chemiluminescence analyser[35]

Non-dispersive infrared (NDIR) method

An example of a NDIR measurement system is presented schematically in Figure 1-15.

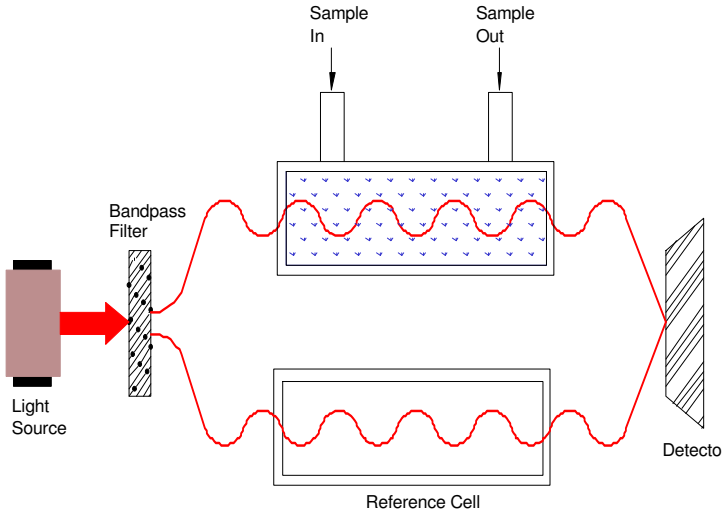


Figure 1-15: Example of a NDIR analyser[36]

The NO_{avg} value shall be converted to a NO_2 content value based on standard oxygen content in the flue gas (13%) according to the appropriate equation.

35 Courtesy of DRC Consultancy Services Ltd. Source: Emission Monitoring Technologies for Combustion and Gasification Plant, DTI Technology Status Report, Cleaner Fossil Fuels Programme, TSR021 MARCH 2004; pp.10 (available at: http://www.berr.gov.uk/files/file20909.pdf).

36 Courtesy of DRC Consultancy Services Ltd. Source: Emission Monitoring Technologies For Combustion And Gasification Plant Report No. COAL R248 DTI/Pub URN 03/1584 November 2003; pp. 11 (available at: http://www.berr.gov.uk/files/file18987.pdf)

Other methods exist for NOx measurement, like non-dispersive ultraviolet (NDUV) method and non-extractive (in situ) method. These methods are described in detail by ISO 10849.

Note that the selection of the measurement method affects the results, thus one needs to be cautious when comparing measurement results done by different methods.

➔ Measurement of particulate and dust emission

Different measurement techniques of particulate matter concentration and related parameters exist. The CEN TC 295 review[32] describes three different test methods for particulate matter (dust) emissions that can be employed for SCIs: "Austrian/German method", "Norwegian method" and "UK method". The user is free to choose the method among these.

■ Discontinuous gravimetric sampling of total particle mass concentration

This is the basic method for measuring PM in flue gases. The particles are collected on quartz or glass fibre filters. The method gives a total mass concentration. By means of precyclone, it is possible to measure fraction PM_{10} and $PM_{2.5}$ (10 µm and 2.5 µm respectively).

Gravimetric method for dust determination in low ranges (up to 50 mg/m^3) is normalised in EN 13284-1:2001[37]. This measurement standard was elaborated and validated for gases emitted from waste combustion installations, but it may be applied for gases which are emitted from other stationary sources and at higher concentrations. The standard contains detailed geometry of the probe and its position in flue channel and, diagrams of different arrangements of measuring systems.

■ Continuous measurement of PM

The measurement is carried out by TEOM instrument (Tapered Element Oscillating Micro-balance), which is often used for control PM in ambient air. In case of combustion application, the ambient air model of the instrument is used together with dilution system.

■ Measurement of particle size distribution

Mass size distribution is determined by means of low pressure cascade impactors, working in range from 30 nm to 20 µm, however it is possible extend the measurement range down to few nm by means of filter. This is an off-line method, and particles may be investigated in additional analyses.

Number size distribution is determined by means of several on-line instruments, together with dilution systems. The main instruments are presented in Table 1-4.

[37] EN 13284-1:2001 'Stationary source emissions - Determination of low range mass concentration of dust - Part 1: Manual gravimetric method'

Table 1-4: Methods of size distribution measurement[38]

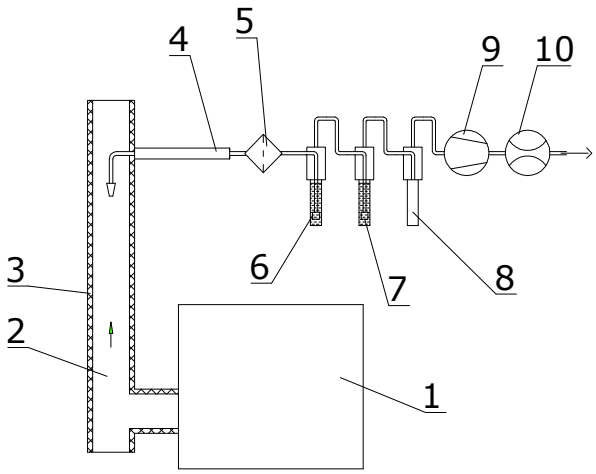
Method	Range
Scanning mobility particle sizer (SMPS)	Few nm to 1 µm
Electric low pressure impactor (ELPI)	7 nm – 10 µm
Aerodynamic particle sizer (APS)	0.5 µm – 10 µm
Fast mobility particle sizer (FMPS)	5.6 nm – 0.56 µm
Optical particle counter (OPC)	0.1 µm to few µm

- **Austrian and German particle test method**

In both Germany and Austria along with measurement carried out according to EN 13240:2005 (*roomheaters)*, EN 13229:2005 (*inset appliances)* and EN 12815:2005 (*residential cookers)* the parallel measurement of PM is required.

The measurement position for particle measurement is to be arranged upstream of measurement positions of CO, CO_2, NO_x and OGC / C_nH_m. Measurement of particulate emissions are to be started 3 minutes after fuel loading and continued for 30 minutes.

A scheme of a particle sampling is presented Figure 1-16.



1 SCI: boiler, stove
2 chimney
3 insulation
4 gas sampling probe and line for particles measurement (heat-insulated)
5 Particles filter (off-line gravimetric measurement)
6 water separator
7 silica gel filter
8 superfine filter
9 pump
10 gas flow meter

Figure 1-16 Scheme of particle sampling (dry particle) direct from hot exhaust gas[39]

The sampling tube with a diameter of 8 mm widens out to 9.74 mm at the specimen inlet. The sampling equipment shall be designed so that in a sampling period of 15 (30)

[38] T. Nussbaumer, C. Czasch, N. Klippel, L. Johansson, C. Tullin, Particulate Emissions from Biomass Combustion in IEA Countries, International Energy Agency (IEA) Bioenergy Task 32, Zurich Switzerland, (2008) www.verenum.ch/Publikationen/IEAReportPM10Jan08.pdf

[39] Prepared on the basic: VDI 1066-Shet 2: Measurement of particulate matter; manual dust measurement in flow gases; gravimetric of dust load

minutes, a waste gas volume 135 ± 6.75 (270 ± 13.5) l relative to normal conditions (273 K, 1013 hPa) is extracted. During the sampling, it shall be possible to control the volume flow by means of a volume flow measurement.

The sampling probes shall be designed for a waste gas temperature of 325 °C and a waste gas speed of approx. 4 m/s at 1013 hPa under the conditions described above.

The attachment for the filter sleeve shall be designed so that the filter cannot be damaged during handling and structurally attached to exclude the possibility of dust entering the pump unit. The measuring filter is inserted in a filter holder at the end of the sampling probe.

The sampling system shall be designed so that a controlled probe heating system excludes the possibility of falling below the dew point in front of or in the filter sleeve. Here, the temperature in the sleeve area shall be maintained at a constant 70 °C, under sampling conditions.

In the event of the waste gas inlet temperature exceeding a value of 225 °C, a cooling apparatus shall be provided to ensure that a temperature of 70 °C is maintained in the sleeve area. The design of the cooler shall not have any negative influences on the result of the measurement.

Suitable measures shall be employed to protect the pump and the volume flow control or limiting device against the action of dust and accumulated condensate.

Taking the complete measuring procedure into account, in the concentration range of the dust limit value of 0.15 g/m^3, the measuring system shall be able to guarantee that the results of the measurement will have a resolution of ± 0.03 g/m^3.

The mechanical stability of the dust collecting sleeve shall be retained even at temperatures of 160 °C and the collecting sleeves shall not suffer mass losses greater than 2 mg.

- **Norwegian particle test method**

Solid fuel appliances are to be tested with natural draft with dilution tunnel and sampling on a plane filter with porosity of 1µm. The test fuel shall consist of air-dried spruce with dimension of 49 x 49 mm and moisture between 16 to 20 % on wet basis. The distance between the logs shall be 10 mm. The fuel charge density shall be 101 - 123 kg/m^3 of burning chamber volume. Arrangements of the test fuel samples, as well as scheme of dilution tunnel are presented in Figure 1-17 and Figure 1-18.

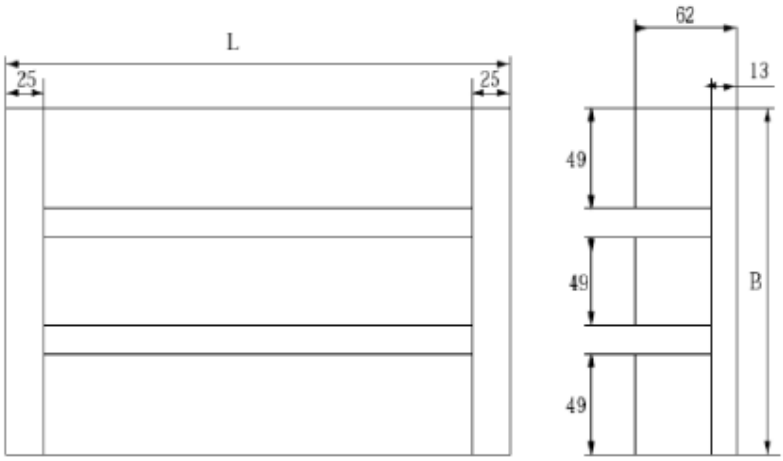
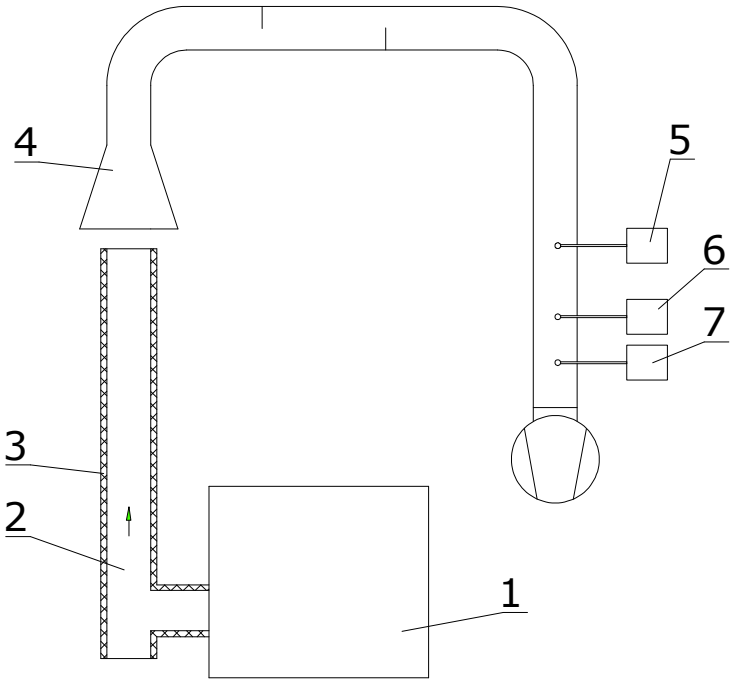


Figure 1-17: Arrangement of the standard test fuel



1 SCI: boiler, stove	5 velocity measurement
2 chimney	6 particulates measurement
3 insulation	7 CO, NOx and CO_2 (and SO_2, OGC, O_2) measurement
4 hood	

Figure 1-18: Scheme of dilution tunnel with hood dilution[40]

The burning rates are fixed in four burning categories (presented in the standard), different for heating of small rooms and larger rooms. The test runs are done from preheated wood heater and the average value of surface temperatures may differ up to 70 °C from start to end of the test run, but not higher.

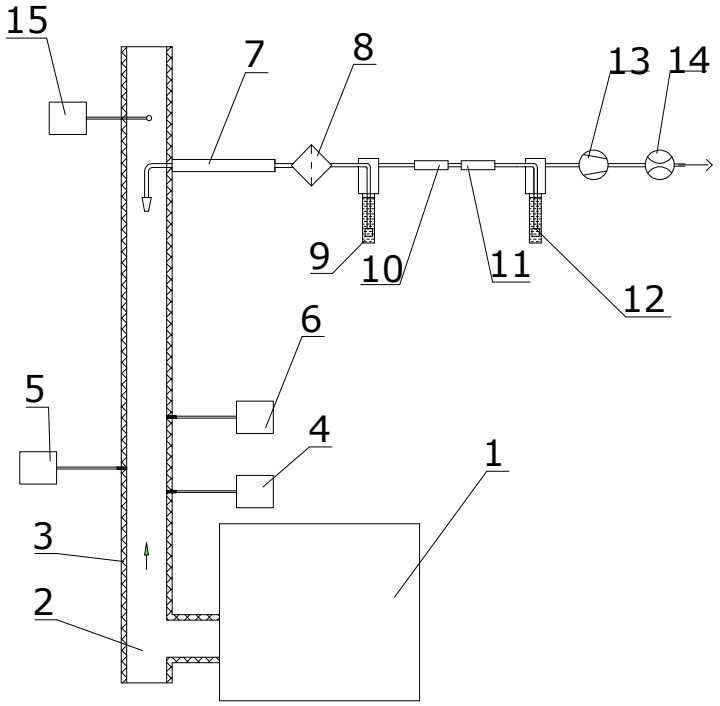
[40] Prepared on the basic: Biomass combustion In residential heating particulate measurements, sampling, and physicochemical and toxicological characterization, Final report of the project funded by ERA_NET Bioenergy Programme 2007-2008; www.biomasspm.fi/Biomass-pm_-report080908.pdf)

The result is calculated as grams of emission per kilogram of fuel on dry basis (g/kg). The reported emission value is calculated in accordance to NS 3059 *Enclosed wood heaters – Smoke emission – Requirements* based upon 4 runs.

- **Particle test method used in Poland for SCIs**

In Poland, along with measurement carried out according to EN 303-5 and voluntary ecological labelling of boilers, the parallel measurement of PM is required. A scheme of a particle sampling is presented Figure 1-19.

The sampling equipment is prepared for continuously isokinetic extraction of dust from flue gas during whole cycle of combustion test.



1	SCIs/boiler, stove	9	water condenser,
2	Chimney	10	XAD2 tube,
3	Insulation	11	activated carbon tube,
4	temperature of flue gases	12	silica gel filter,
5	measurement of NO, SO_2, CO i CO_2 measurement	13	pump,
6	OGC measurement	14	gas flow meter
7	gas sampling probe and line for particles measurement (heat-insulated),	15	velocity measurement
8	particles filter (off-line gravimetric measurement),		

Figure 1-19: Scheme of particle (dry particle) and organic pollutants sampling direct from hot exhaust gas[41]

[41] Kubica K.; Ecological energetic standardization of solid fuels and heating appliances for communal economy (in polish) Karbo-Energochemia-Ekologia, R.41, s. 392, 1996

- **United Kingdom particle test method**

BS 3841 standard describes two methods of measurement of particulate matter emission: one using an electrostatic precipitator, and the other using a dilution tunnel (gravimetric determination).

- BS 3841 test procedure

BS 3841 requires the fuel to be burned on a typical UK design of inset open fire, without a boiler, installed in accordance with British Standard Codes of Practice beneath a 4.6 m high test chimney. The open fire is fitted with a specially designed air inlet plate to enable fine adjustment of the primary air opening between one test and another. Smoke is measured with the electrostatic precipitator and the radiation output from the fire is measured with an instrument known as the British Coal Utilisation Research Association (BCURA) quadrant cage radiometer, which is widely used in the UK for domestic solid fuel appliance testing. The firing cycle consists of an ignition period and two refuel periods (three refuel periods for fuels of low bulk density). Smoke is measured during the refuel periods only and not during the ignition period.

The particulate matter emission is expressed in grams per hour, averaged over the duration of the test period. The mean result of replicate measurements is compared with the maximum emission limit of 5 g/h, which is a limit for an authorised fuel according to the UK regulations.

The standard contains schemes and short descriptions of electrostatic precipitator (Figure 1-20) and dilution tunnel (Figure 1-21 and Figure 1-22).

The mass of particulate matter collected is determined by weighing the precipitator on a suitable balance at the beginning and end of a test period.

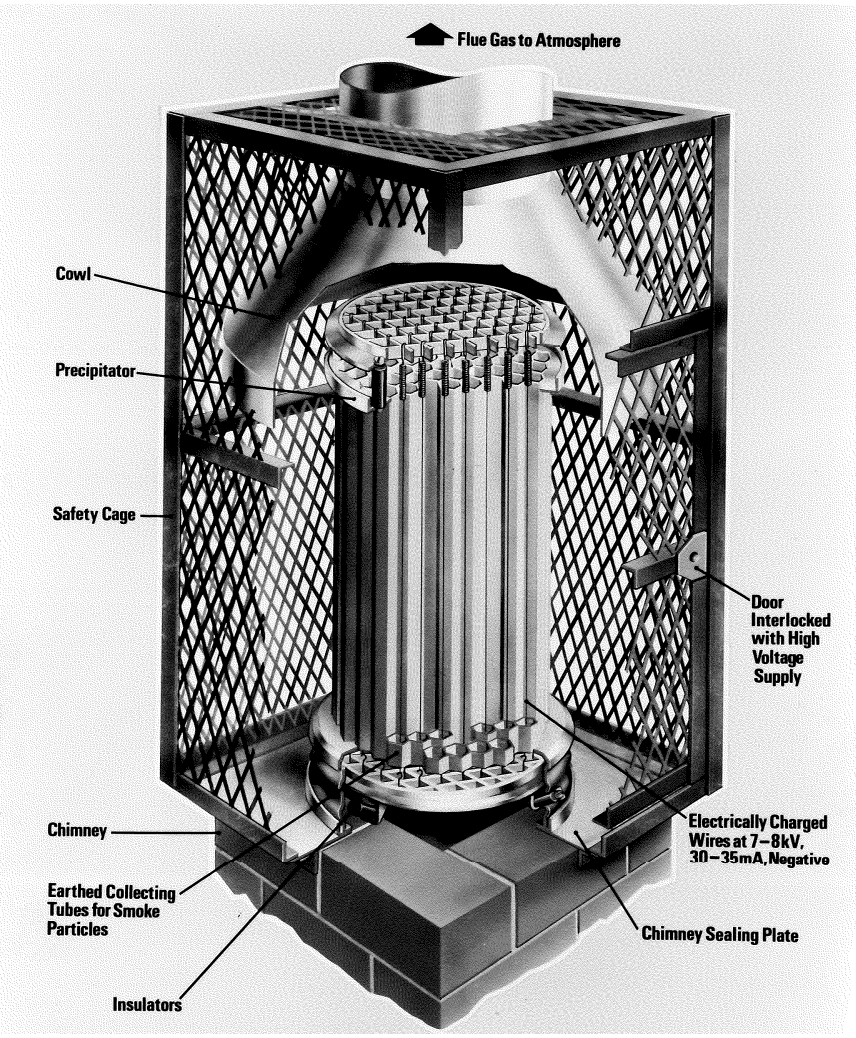


Figure 1-20: Smoke measurement by electrostatic precipitator[42]

The dilution tunnel method involves sampling isokinetically from a duct above the test chimney. The flue gas from the top of the test chimney is mixed with ambient air in a dilution tunnel. A sample of the diluted gas is withdrawn through the sampling train in which the particulate matter is collected on a glass fibre filter maintained at 70 °C. The mass of particulate matter collected is determined. The particular matter emission rate is then calculated in grams per hour using the volume of the gas sampled and the volume flow rate of the tunnel gas.

[42] GASTEC at CRE Ltd.

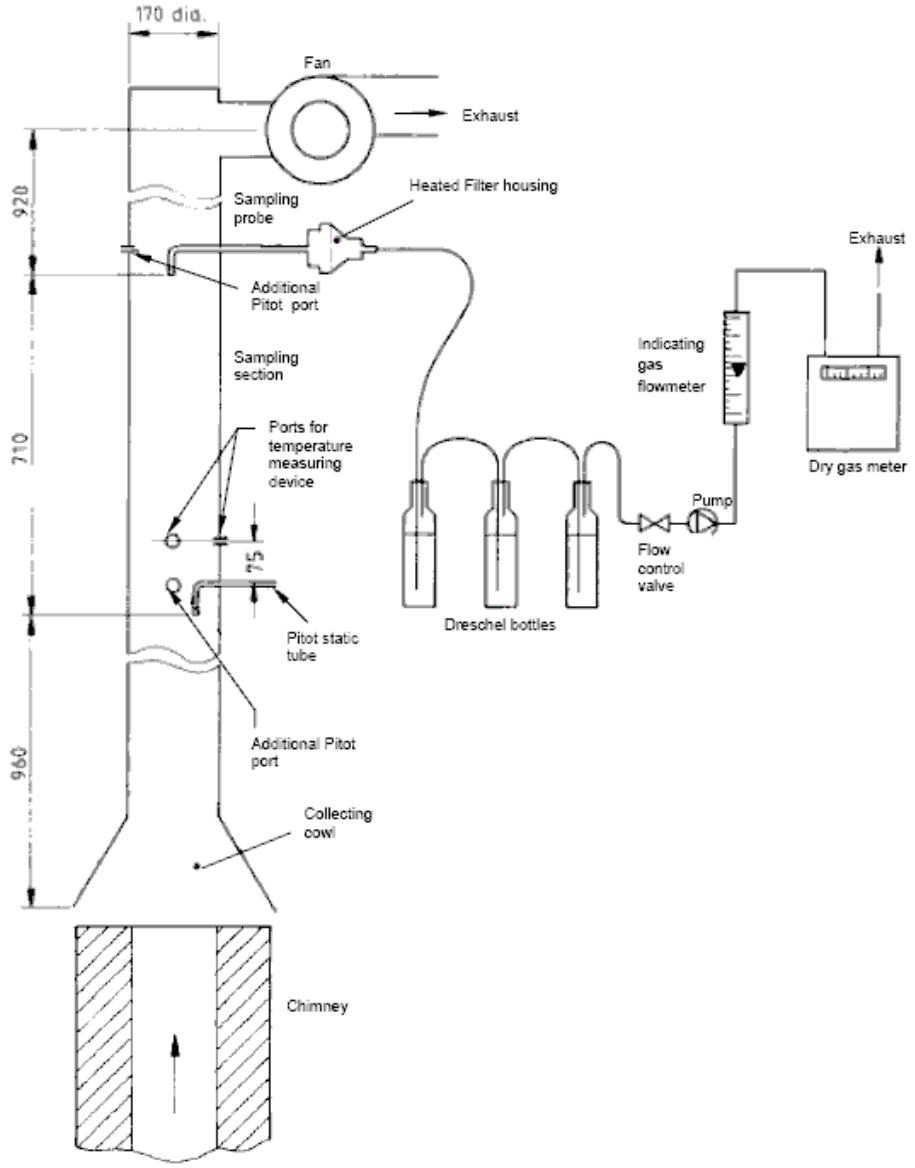


Figure 1-21: General arrangement of dilution tunnel and sampling train[43]

[43] From BS 3841-2:1994. Permission to reproduce extracts from BS 3841-2:1994 is granted by BSI. British Standards can be obtained in PDF or hard copy formats from the BSI online shop: www.bsigroup.com/Shop<http://www.bsigroup.com/Shop> or by contacting BSI Customer Services for hardcopies only: Tel: +44 (0)20 8996 9001, Email: cservices@bsigroup.com<mailto:cservices@bsigroup.com>.

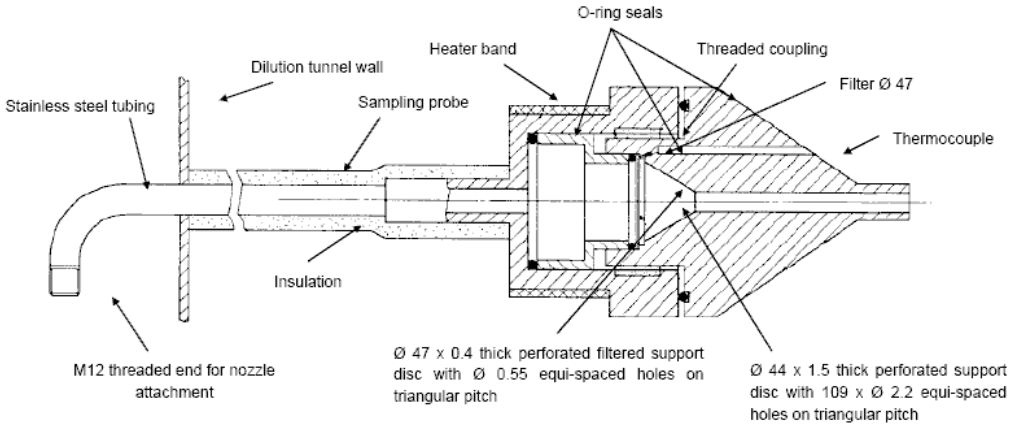


Figure 1-22: Suggested arrangement of dilution tunnel filter housing[43]

- Measurement of particulate matter emission from a smoke reducing appliance

The principles for the testing of 'Smoke Reducing Solid Fuel Burning Domestic Appliances' for particulate matter emissions are given in BS document PD 6434[44]. Whilst PD 6434 gives guidance on appliances which are designed primarily to burn bituminous coal, it acknowledges that there is no reason why appliances designed to burn other solid fuels, such as wood or peat, should not be considered.

PD 6434 adopts the BS 3841 electrostatic precipitator method of smoke collection and measurement but the refuelling interval and firing procedure for fuels is replaced by the refuelling and firing procedure given in the relevant Standard Specification against which the thermal performance and efficiency of the appliance is assessed in accordance with the manufacturer's declared heat output and the appliance's operating instructions. Whilst the particulate matter is collected and measured by means of an electrostatic precipitator the optical density of the smoke is also monitored by a suitable form of meter, working across the chimney.

PD 6434 tests are carried out with the appliance being operated in accordance with the manufacturer's instructions at high (rated) output and at the low end of its output range. If necessary tests are also made at one or more intermediate levels of output to ensure the smoke is within acceptable limits over the full range of performance of the appliance.

In general, five repeat tests are carried out under each output condition and the emission is again expressed in grams per hour averaged over each test period. The heat output from the appliance over the test period is also measured and the average is reported in kW. If the tests confirm that the appliance can operate continuously without undue trouble to the user, and is likely to be so operated, then ignition smoke is ignored.

PD 6434 recommends standards against which the performance of the appliance should be assessed in the main tests, i.e. those made under the conditions of operation recommended by the manufacturer (rated output, low output etc).

For each of the mean values obtained from the five repeat tests the mean smoke emission should not exceed 0.1 g/h for each 0.3 kW of the corresponding mean heat output plus 5.0 g/h.

[44] Recommendations for the Design and Testing of Smoke Reducing Solid Fuel Burning Domestic Appliances

It is also recommended that no individual smoke measurement in each set of five should be more than 50% greater than the permitted mean result for the set; any such result will be reported separately as well as being included in the calculated mean.

The optical density of the smoke, as recorded throughout each test, is examined to check that, in addition to the average rate of smoke emission being within acceptable limits, the emission over short periods, for example at the times of refuelling or de-ashing, does not reach objectionably high levels.

- Remarks

The CEN TC 295 review[32] describes three different methods for particle matter measurement: a gravimetric one, by means of dilution tunnel (two versions, but different geometry of the tunnels), and the one applied an electrostatic precipitator. Each method may give a different result, thus comparison of results from different laboratories, applying a different test methods, is not adequate. The solution of this problem could be a choice of one method, and its detailed description (measurement section geometry, temperatures, flows, filters, accuracy and range of instruments, etc.), or definition of coefficients allowing for recalculation of results obtained from different methods (but also precisely described) into one comparable result.

1.2.3. SUMMARY OF TEST STANDARD REVIEW

➔ Review of the methods used for assessing the main parameters

■ Evaluation of the functional parameters

Thermal capacity of the appliance is the flux of useful energy produced. Energy efficiency of SCIs can be determined by:

Direct method as a quotient of thermal capacity (through the measurement of cold water mass flux and temperature increment) and furnace capacity and

Indirect calculation method based on energetic balance (chemical energy of fuel, chimney loss and incomplete combustion loss taken into account).

For appliances with only indirect heating function (EN 303-5 boilers) efficiency can be measured by the direct method. For appliances which provide only direct space heating (stoves, fireplaces, radiation-convective devices), the indirect method is employed. In case of direct heating devices with a water heating facility (a “boiler”), the hot water output is measured directly whilst the space heating and the total efficiency of the appliance are measured indirectly by the indirect (“flue loss”) method[45].

By indirect method, measurement accuracy is influenced by the precision of measurement of either flue gas composition, flue gas temperature and combustible parts contents in solid residue after combustion.

By direct method, measurement accuracy depends on the precision of measurement of cold water mass flux as well as the measurement of temperature increment. If for the

[45] In these cases, the boiler heat output and direct heat output are quoted separately by the manufacturer and are necessary for the proper design of the system.

measurement of fuel mass decrement a scale is used then its precision will influence the test results.

Precision of temperature and flue gas composition measurement influences determination of thermal capacity and energetic efficiency. Flue gas composition (contents of oxygen and nitrogen, CO_2, CO, NO_x, SO_2) can be carried out by different methods: chemical, electrochemical and spectrophotometric, of which the precision is different and depends on the measurement apparatus type. Therefore measurement standards shall define reference methods and requirements on the precision of determination.

Accuracy of measurement either in case of thermal capacity and energy efficiency of SCIs, especially with water heat exchangers, is defined by parameters of combustion system operation. Therefore for the purpose of their testing, the measurement standards should precisely define parameters of circulating water – inlet and outlet temperature, the flow rate expressed in m^3/s, as well as the precision of measurement apparatus. Fuel quality and physicochemical stability influences the degree to which combustion is incomplete and hence affects the emissions (CO, OGC, dust) and energy efficiency of the product. Therefore, criteria and requirements related to the properties of solid fuels used for testing should be better defined (gross calorific and net calorific value, content of ash, volatile matter, moisture, carbon, hydrogen, sulphur, and nitrogen). Fuel properties need to be determined by means of research methods in compliance with valid ISO standards (which exist in case of coal fuels and are under elaboration in case of solid bio-fuels). In the case of analysed EN test standards, some requirements (like the contents of moisture, ash and volatile matter) for selected fuels (e.g.: bituminous coal and briquettes) used for testing, are not precisely specified (e.g. EN 303-5, EN 12 809).

- **Evaluation of the level of emissions of pollutants**

Assessment of SCIs environmental impact includes analysis of emission levels of carbon monoxide, particulate matter (PM, dust) as well as organic compounds as OGC. Determination of these pollutants can be carried out by different methods. In most cases, they give comparable results and differ only in accuracy, precision (gaseous components of flue gases), but sometimes they employ different measurement principle so they may give incomparable results. It has to be pointed out that magnitude of pollutants emission from SCIs fuelled with solid fuels shall be given for identical reference parameters, e.g. oxygen concentration in flue gases equal to 10%, or 13%, or in reference to 1 GJ (or MJ) of chemical energy in the fuel. The latter reference state seems to be the most appropriate for the environmental impact assessment.

- CO

Analysers currently employed for this determination incorporate spectrophotometric method. Analysers may differ with accuracy class; therefore it would be useful if standards defined their class of accuracy.

- Particulate matter

Particulate matter concentration in the flue gases can be determined by gravimetric, spectrophotometric and optical method as well as with the use of electro-precipitator. These methods do not provide comparable results. In the case of the gravimetric method, the isokinetics of sampling particulates from flue gases has a fundamental

influence on the measurement accuracy. Due to low velocities of flue gases, it is impossible to assure these requirements by means of currently employed measurement apparatus. For such devices and measurement apparatus, a method employing a dilution funnel should be used or gravimetric measurement techniques should be adjusted to meet these requirements.

There is a very strong relationship between the values obtained from measurements and the measurement method used. It should always be understood which type of measurement method was used when expressing particulate concentrations.

- OGC

These pollutants are observed in the aerosol form in flue gas, i.e. in the gaseous phase as well as in the form associated on the surface of particles. The determination of OGC is possible by chromatography, infrared spectrophotometry and flame ionisation (FID detector). These methods do not provide comparable results (validation needed). The results of measurement carried out by these methods depend on the measurement conditions (flue gas sample pre-treatment before the analyser) and calibration parameters, as well as reference states. The method incorporating FID detector allows determination of total hydrocarbons and other organic compounds present in the flue gases with high accuracy, and recalculated to a given organic compound, which is usually propane (C_3H_8). Though the result is not only dependent on apparatus precision, but also on the method of sampling and sample preparation before detection, defined by temperature of sampling (usually around 200°C) and filtration degree (removal of particulates – TSP and PM). Therefore the method should be carefully defined with description of organic compound (hydrocarbon – methane or propane) with use of which the apparatus is subjected to calibration, and results are calculated.

→ Main conclusions of the analysis of test standards

The analysis of EN standards, both existing and being under development, has shown that:

All product categories within the group of small combustion installations fuelled with solid fuels are covered by relevant EN standards (Table 1-5). Most of these standards are harmonised with the main European Directives[46]. The standards include detailed description of relevant appliances along with the specification of fuels used.

They include requirements related to functional parameters – heat output and energy efficiency at a defined nominal power output as well as emissions requirements for selected pollutants given by m^3 at different oxygen contents in flue gases. They also include information on allowable surface temperatures and electrical safety. These are outlined in Annex 1.4.4.

All test standards specify the precision with which the given functional parameters should be measured or calculated, and which enables quality comparison of different appliances, within one category.

[46] In particular, the existing appliance standards for residential solid fuel small combustion appliances produced by CEN/TC 295 (EN12809, 13240, 12815, 13229, 15250 and 14785) have been harmonised to meet the needs of Construction Products Directive. The boiler standard EN303-5, produced by CEN/TC 57, is not harmonised under any Directive.

The harmonised test standards specify quality parameters for test fuels that represent commercial fuel analyses which must be adhered to in the market for the appliances to be confirmed as "clean". The parameters are well specified for solid biomass fuels whereas for coal the parameters are described with less precision, especially regarding the contents of volatile matter, moisture and ash[22]. It is important that the quality of the fuel required to match output, efficiency and clean air performance is quoted by the manufacturer in the operating instructions for his appliance. The standards refer to relevant technical standards of the International Organisation for Standardisation (ISO) and the American Society for Testing and Materials (ASTM International) relevant for quality testing of fuel used for different appliances testing.

All test standards mention testing method (instrumental analysis) and precision of determination of CO emissions for given category of appliances, but they do not specify a reference method. There are also similar testing standards covering the measurement of NOx and VOC which also quote particulate measuring techniques in a number of countries.

Currently, EN 303[20] - 5:1999 is the only EN standard containing specifications on OGC and dust emissions (see Table 1-44 in Annex). However the standard does not contain a detailed description of testing methods (they do not specify a reference method) for these emissions. The alternative methods employed do not provide comparable results and a quality comparison of different boilers is therefore impossible.

Technical Committee CEN/TC 295 "Residential solid fuel burning appliances" is currently working on a test standards "Residential Solid Fuel Burning Appliances - Emission test methods" (TC 295 Work Item 017)[47], which covers the measurement of emissions of NOx and VOCs to add to the measurement of CO given in the suite of appliance ENs. This Technical Specification (CEN prTS15883) is now going through the standardisation process prior to publication. CEN TC 295 has found it the most difficult of tasks to "harmonise" particulate test methods: the proposed draft Technical Specification for gravimetric PM measurement by dilution tunnel has been rejected in the end of 2008. A proposal for a new work item to develop a Technical Specification covering a particle counting technology is under development by CEN/TC 295.

[47] http://www.cen.eu/CENORM/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/WP.asp?param=6276&title=CEN%2FTC+295

Table 1-5: EN standards currently in force and test methods within

	303-5*	12809	13240	12815	13229	15250	14785
Appliance	Boilers for water central heating without direct space heating output	Residential independent solid fuel fired boilers with heat direct to living space	Roomheaters (with or without heat to water)	Cookers (with or without heat to water)	Freestanding or inset appliances	Hand fuelled intermittent burning slow heat release appliances	Residential space heating appliances fired by wood pellets (with and without heat to water)
Fuel	Wood and fossil fuels	Solid mineral fuels, peat briquettes or natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer's instructions.					wood pellets
Heat output	Determined on the basis of water stream and temperatures.	**Total heat output:** based on efficiency, fuel stream and calorific value **Water heat output:** based on water stream and temperatures, all formulas given. **Space heating output:** difference of total heat output and water heat output.				On the basis of efficiency, fuel stream and calorific value	As in case 12809
Efficiency	Direct method as a quotient of heat output and heat input. Indirect methods for checking purposes only. Defines three classes of efficiency as a function of nominal heat output.	Indirect method on the basis of heat losses (the heat losses are determined from the mean values of flue gas and room temperatures, the flue gas composition and the combustible constituents in the residue); in addition, when then appliances includes a boiler, the hot water output is measured directly.					
		Defines efficiency as a function of heat output for: wood logs, bituminous coal, lignite briquettes & peat briquettes, other test fuels	greater than or equal to the manufacturer's declared value and shall equal or exceed:				At least 75% at nominal heat output and 70% at reduced heat output.
			50%	60 %	75% (Kachelöfen or Putzöfen inset appliances), 30% (others)	70 %.	
CO	Limits for different stoking, fuels and heat output are specified. Allowable error does not exceed ± 5% of the emission limit.**[1]**	Less than or equal to the manufacturer's declared value and shall not exceed 1,0% at 13% O_2.			>0.2% at 13% O_2 (Kachelöfen or Putzöfen inset appliances), For other appliances: as in 13240	Less than or equal to the manufacturer's declared value and shall not exceed 0,3% at 13% O_2.	>0.04% 13% O_2 at nominal heat output and 0,06% 13% O_2at reduced heat output.
OGC	See above **[1]**	-	-	-	-	-	-
Dust	See above **[1, 2]**	-	-	-	-	-	-
NOx	**[3]**	-	-	-	-	-	-
Lot 15 category	Boilers	Boilers – with secondary functionality (direct heat)	Stoves	Cookers	Fireplaces / inserts	Stoves sub-category	Stoves

* not harmonized.
[1] reference method not defined
[2] gravimetric or electrostatic method is proposed but reference method not defined.
[3] determination of NOx is only proposed where appropriate and reference method not defined.

➔ **Identified needs in the context of the study of solid fuel SCIs**

The analysis of test standards currently in force for given SCIs categories reveals the following needs:

Elaboration and/or implementation of test methods (in the form of EN Technical Standards) for determination of particulate matter, OGC and NOx emissions for all SCIs within the scope of this study. Their contents should specify measurement methodology and precision, accuracy of measurement devices, combustion cycle conditions.

The test methods should harmonise the reference parameters regarding emission with oxygen concentration in flue gases equal to 10% or 13%, or in reference to 1 GJ (or MJ) of chemical energy in the fuel (the latter option would seem to be the most convenient).

It would be useful to define more precisely the properties of solid fuels used for testing within the test standards, in particular for coal fuels (ash, moisture and volatile matter content), especially in EN 303-5.

The test standards for SCIs with water heat exchangers should precisely define parameters of circulating water – inlet and outlet temperature, the flow rates expressed in m^3/s, as well as the precision of measurement apparatus.

The on-going work by CEN TC 295 "Residential solid fuel burning appliances" on EN test standards for “Residential Solid Fuel Burning Appliances - Emission Test” may already respond to these needs.

1.3. EXISTING LEGISLATION

1.3.1. LEGISLATION AT EUROPEAN COMMUNITY LEVEL, APPLYING TO LOT 15 PRODUCTS

➔ **Construction Product Directive (89/106/EEC)**

Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products. Amended by the Council Directive 93/68/EEC of 22 July 1993 and the Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003.

The purpose of the Construction Products Directive is to ensure the free movement of all construction products within the EU by harmonising national laws with respect to the essential requirements applicable to these products in terms of health and safety. It applies to construction products, i.e. any products produced with a view to their incorporation in a permanent manner in construction works.

The Directive contributes to the energy efficiency as "the construction works and its heating, cooling and ventilation installations must be designed and built in such a way that the amount of energy required in use shall be low, having regard to the climatic conditions of the location and the occupants"[48].

[48] Interpretative document No. 6: Energy economy and heat retention, relating to Council Directive 89/106/EEC, www.ec.europa.eu/enterprise/construction/internal/intdoc/idoc6.htm

Products covered by the Construction Products Directive obtain the CE marking only if they comply with technical specifications described in defined Europe-wide standards. For small combustion installations, seven harmonised standards have been established to date:

- EN 12809:2001 Residential independent boilers fired by solid fuel - Nominal heat output up to 50 kW - Requirements and test methods.
- EN 12815:2001 Residential cookers fired by solid fuel - Requirements and test methods.
- EN 13229:2001 Inset appliances including open fires fired by solid fuel – Requirements and test methods.
- EN 13240:2001 Room heaters fired by solid fuel – Requirements and test methods.
- EN 14785 Residential space heating appliances fired by wood pellets
- EN 15250:2007 Slow heat release appliances fired by solid fuel – Requirements and test methods.
- EN 15544 One-off Kachelgrundöfen/Putzgrundöfen (tiled/mortared stoves) – Calculation method.

➔ Low Voltage Directive (2006/95/EC)

Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to Electrical Equipment designed for use within certain voltage limits.

The directive applies to all electrical equipment designed for use with a voltage rating 50 – 1000 V AC and 75 – 1500 V DC. It requires products to have protection against hazards that could arise from within the product itself or from external influences. All risks arising from the use of electrical equipment, including mechanical, chemical, and all other risks. Noise and vibration, and ergonomic aspects, which could cause hazards, are also within the scope of the directive.

This Directive applies to solid fuel combustion products that incorporate electrical equipment (e.g. thermostat). The European Harmonised Standard applied to these appliances under the LVD is EN 50165:1997 Electrical equipment of non-electric appliances for household and similar purposes – Safety requirements.

The appliances concerned by this Directive must comply with the standard in order to obtain the CE mark.

➔ Machinery Directive (98/37/EC)

Directive 98/37/EC of the European Parliament and of the Council of 22 June 1998 on the approximation of the laws of the Member States relating to machinery. Amended by Directive 98/79/EC.

The Directive applies to machinery and lays down the essential health and safety requirements for them. “Machinery” is partly defined as an assembly of linked parts or components, at least one of which moves, joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material. Regarding the Lot 15 study, for example boilers and stoves with automatic feeding have to comply with this Directive in order to obtain the CE mark.

➔ Pressure Equipment Directive (97/23/EEC)

Directive 97/23/EC on the approximation of the laws of the Member States concerning pressure equipment.

This Directive, whose goal is the safety of pressurised equipment, applies to the design, manufacture and conformity assessment of pressure equipment and assemblies with a maximum allowable pressure greater than 0.5 bar.

However scope of the Directive is further refined considering the volume and temperature (based on Annex II of the Directive), consequently in practice, many of the domestic appliances in the Lot 15 scope may not be concerned by this Directive.

Table 1-6: Relation between the European Directives and small combustion appliances covered by EN standards

Appliances \ Directive	Test Standards	97/23/EC Pressure Equipment Directive – PED	73/23/EEC Low Voltage Directive – LVD	89/336/EEC Electromagnetic Compatibility Directive – EMCD	89/392/EEC Machinery Directive – MD	89/106/EEC Construction Products Directive – CPD
Heating boilers - Part 5: Heating boilers for solid fuels, hand stoked, nominal heat output of up to 300 kW	EN 303-5*	X [1]	X [2]	X [2]		
Heating boilers - Part 5: Heating boilers for solid fuels, automatically stoked, nominal heat output of up to 300 kW	EN 303-5*	X [1]	X [2]	X [2]	X	
Inset appliances including open fires fired by solid fuels	EN 13229	X [1]	X [2]	X [2]		X
Roomheaters fired by solid fuel	EN 13240	X [1]	X [2]	X [2]		X
Residential independent boilers fired by solid fuel - Nominal heat output up to 50 kW	EN 12809	X [1]	X [2]	X [2]		X
Residential cookers fired by solid fuel	EN 12815	X [1]	X [2]	X [2]		X

* not harmonised
1 if the product PS x V > 50 bar x litre
2 if they are equipped with electrical devices

1.3.2. LEGISLATION AT EUROPEAN COMMUNITY LEVEL, RELATING INDIRECTLY TO LOT 15 PRODUCTS

➔ Air quality

A number of EU Directives set requirements or limits regarding the ambient air quality and total national air emissions. These Directives, which concern indirectly Lot 15 products, are listed below.

- Council Directive 2000/69/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air
- Directive 2000/69/EC of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air
- Directive 2002/3/EC of the European Parliament and of the Council of 12 February 2002 relating to ozone in ambient air
- Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air
- Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
- Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants

The first five Directives fix limit values in ambient air for certain pollutants or pollutant precursors. The sixth Directive sets limits for total national emissions, e.g. of Non-Methane Volatile Organic Compounds (NMVOC) and Nitrogen oxides (NO_x).

SCIs contribute to these emissions. In order to fulfil the requirements of these Directives, Member States should keep their legal power to set stricter limit values than those of a possible implementing measure at EU level.

➔ Energy Performance of Buildings Directive

Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

This Directive is a follow-up to the measures on boilers (92/42/EEC), construction products (89/106/EEC) and SAVE programme provisions on buildings.

This framework Directive is to be implemented through national legislation. The Member States must apply minimum requirements as regards the energy performance of new and existing buildings, ensure the certification of their energy performance and require the regular inspection of boilers and air conditioning systems in buildings. These provisions will indirectly encourage the efficiency of small combustion installations.

➔ Directive on the promotion of renewable energy sources

Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, 2008/0016 (COD)

The Directive proposal[49] was adopted on 23 January 2008 as part of the 'Climate Change Energy Package'. The proposed directive deals with many renewable energy source (RES) issues and individual heating is only mentioned in a few places. But two points deserve attention in the context of Lot 15 appliances:

Firstly, to avoid market distortions and to ensure high quality products and service provision for consumers, Article 13 provides that "Member States shall develop certification schemes for installers of small-scale biomass boilers and stoves .... Those schemes shall be based on the criteria laid down in Annex IV. Each Member State shall recognise certification awarded by other Member States in accordance with these criteria."

Secondly, Article 12 requests "Member States shall clearly define any technical specifications which must be met by renewable energy equipment and systems in order to benefit from support schemes. Where European standards exist, including eco-labels, energy labels and other technical reference systems established by the European standardisation bodies, such technical specifications shall be expressed in terms of those standards. Such technical specifications shall not prescribe where the equipment and systems are to be certified."

To date 304 amendments have been made to the original proposal. Discussion on amendments is on-going.The Directive is expected to come into effect in 2010.

1.3.3. LEGISLATION AT EUROPEAN COMMUNITY LEVEL, APPLYING TO RELATED PRODUCTS

The Directives presented below apply to products similar to those covered in Lot 15, but are out of scope.

➔ Boiler Efficiency Directive (92/42/EEC)

This Directive regulates minimum efficiency requirements for boilers and set a mandatory labelling system, which is now superseded by the Ecodesign for Energy-using Products Directive.

However, the Directive does not apply to "boilers capable of being fired by different fuels, including solid fuel", and "boilers designed to be fired by fuels other than the liquid and gaseous fuels commonly marketed".

➔ Large Combustion Plant Directive (2001/80/EC)

This Directive establishes air emissions limits for certain pollutants from large combustion plant. It applies only to combustion plants with a thermal output over 50 MW.

1.3.4. LEGISLATION AND STANDARDS AT MEMBER STATE LEVEL

➔ Member States legislation on Lot 15 products

Many Member States have regulated the air combustion emissions from SCIs at national level. Most of these legislations set emission limit values (ELV) that depend on the fuel burnt and on the thermal output capacity of the installation.

[49] http://ec.europa.eu/energy/climate_actions/doc/2008_res_directive_en.pdf

This part also presents a restricted review of product performance requirements within national programmes or grant support schemes (existing legislation concerning large appliances is not developed in this report).

Please note that the list presented below may still not be exhaustive. Stakeholders are kindly asked to provide further information on any relevant legislation. Information on the legislative changes is also welcome.

Austria

Two regulations currently apply to small combustion installations:

- The *Vereinbarung gemäss Art. 15a B-VG über Schutzmassnahmen betreffend Kleinfeuerungen* sets requirements for small combustion installations < 50 kW output.
- The *Feuerungsanlagen-Verordnung*, BGBl. II Nr. 331/1997, which entered into force on the 1st of June 1998, covers installations of a nominal heat capacity above 50 kW.

For SCIs < 50 kW output, the requirements make a distinction between manually and automatically stoked appliances and between fossil fuel and biofuel. Austrian limits for these appliances are similar to the best emission class for EN standard (CO and CxHy) and equal to or lower than the lowest emission class (particulate matter).

Emission limit values (ELV) which are defined by MJ of heat output are presented in Table 1-7.

Table 1-7: Austrian ELV for appliances of < 50 kW output

Appliance and fuel types		ELV [mg/MJ][1]			
		CO	NO_x	OGC	dust
Stoking by hand	Biogenic solid fuels	1100	150 [2]	80	60
	Fossil solid fuels	1100	100	80	60
Stoking automatically	Biogenic solid fuels	500 [3]	150 [2]	40	60
	Fossil solid fuels	500	100	40	40

[1] In relation to the energy content (net calorific value) of the fuel used.

[2] The NO_x – limits apply only to wood fired boilers.

[3] At partial load with 30% of the nominal heat output, the limit may be exceeded by 50%

For SCIs of >50 kW output, the emission limits are summarised in Table 1-8 and Table 1-9.

Table 1-8: Austrian ELV for coal and coke fired SCIs of > 50 kW

Installation heat capacity [MW]	ELV [mg/m³]			
	CO	NO_x	SO_2	dust
≤ 0.35	1000	-	-	150
> 0.35-1	1000	400	-	150
> 1-2	150	400	-	150
> 2-10	150	400	-	50
> 10-50	150	350	400	50
> 50	150	100	200	50

Table 1-9: Austrian ELV for wood fired SCIs of > 50 kW

Installation heat capacity [MW]	ELV [mg/m^3]					
	CO	NO_x			HC	dust
		w1	w2	w3		
≤ 0.1	800	300	250	500	50	150
> 0.1-0.35	800	300	250	500	50	150
> 0.35-2	250	300	250	500	20	150
> 2-5	250	300	250	500	20	50
> 5-10	100	300	250	350	20	50
> 10	100	200	200	350	20	50
w1: Beech tree, oak tree, untreated bark, brushwood w2: Other untreated wood w3: Leftovers of derived timber products or wooden construction elements free of heavy metal and halogen compounds.						

- **Belgium**

Legislation for residential solid fuel appliances, based on the relevant European standards, is expected to be adopted soon in Belgium. The foreseen requirements regarding minimum output and maximum emission limits are presented in Table 1-10.

Table 1-10: Belgian requirements for SCIs (to be adopted)

Appliance type	Minimum output efficiency[1] [%]				ELV							
					CO*[%]				dust[mg/Nm^3]			
	Step I		Step II		Step I		Step II		Step II		Step III	
	Cont	Inter	Cont	Inter	Cont	Inter	Cont	Inter	Cont	Inter	Cont	Inter
Stove (EN 13240)	≥60	≥65	≥60	≥65	≤1	0.5	≤0.8	0.3	≤300	≤100	≤100	≤100
Insert (EN 13229)	≥60	≥65	≥60	≥65	≤1	0.5	≤0.8	0.3	≤300	≤100	≤100	≤100
	At the nominal output											
Pellet appliance (EN 14785)	≥75		≥75		≤0.12		≤0.04		≤300		≤75	
Boiler stove (EN 12809)	≥65		≥75		≤0.8		≤0.3		≤300		≤75	
Boiler (EN 303-5[2])	≥65		≥75		≤0.8		≤0.3		≤300		≤75	
1 In accordance with applicable standard (on a net calorific value basis) 2 not harmonised Cont = Continuous; Inter = Intermittent Initially, step I was planned to come into force the 1st of July 2007, step II the 1st of January 2009, and step III the 1st of January 2010. Due to a delay in the adoption of this legislation, the whole schedule is likely to be delayed.												

- **Denmark**

The Danish *Guidelines for Air Emission Regulation* (Environmental Guidelines no. 1, 2002) applies to all installations emitting substances to the air. Concerning Lot 15

products, these general Guidelines are completed by the *Statutory Order regulating air pollution from wood burners and boilers and certain other fixed energy-producing installations*. This Statutory Order, which takes into account the technical and financial possibilities of lowering emissions of the relevant substances for the sector in question, applies to combustion installations having a total input effect below 300 kW. The installation can be wood burning stove, central heating boiler, fireplace inserts, wood pellet stove or similar installation for the production of heat through the use of solid fuel in the form of wood, lean coal, coal or plant seeds and other residual products covered by the Statutory Order on Biomass Waste, including burners for such installations.

Table 1-11 below presents the emission limits values for space heaters.

Table 1-11: Danish dust ELV for space heaters

Dust ELV	Measuring principle	Testing method
10 g/kg fuel 20 g/kg fuel in the individual testing intervals	Dilution tunnel	NS 3058-1 and NS 3058-2 (calculated according to NS 3059, class 1 or 2, depending on the size of the firing installation) or a similar measurement standard for measuring particle emissions recognised in the EU, EFTA countries or Turkey.
75 mg/m3 (at 13 % O_2)	Directly in the flue gas pipe	Measuring method in accordance with DIN+, Zertifizierungsprogramm, Kaminöfen für feste Brennstoffe mit schadstoffarmer Verbrennung nach DIN EN 13240 or similar measurement standard for measuring particle emissions recognised in the EU, EFTA countries or Turkey.

Danish requirements for boilers correspond to EN 303-5, class 3 (Table 1-12). The measuring method to be used is the method described in EN 303-5.

Table 1-12: Danish ELV for central heating boilers

Firing principle	Fuel type	Nominal heat output [kW]	ELV at 10% O_2, 0 ºC and 1013 mbar [mg/m^3 dry flue gas]		
			CO	Carbon	dust
Manual	Biomass[1]	< 50	5000	150	150
		> 50 to 150	2500	100	150
		> 150 to 300	1200	100	150
	Fossil[2]	< 50	5000	150	125
		> 50 to 150	2500	100	125
		> 150 to 300	1200	100	125
Automatically	Biomass[1]	< 50	3000	100	150
		> 50 to 150	2500	80	150
		> 150 to 300	1200	80	150
	Fossil[2]	< 50	3000	100	125
		> 50 to 150	2500	80	125
		> 150 to 300	1200	80	125

1 Wood, plant seed and other residual products covered by the Statutory Order on Biomass Waste.
2 Fixed carbon or coal.

The Danish building regulation also requires EN 303-5 class 3 for efficiency for newly installed wood burning boilers.

Finland

Finnish Ministry of the Environment published in 2006 a proposal for the regulation on "emissions and efficiencies for heating appliances using wood fuels"[50] under the building legislation. The key content of the proposal is described below, but it should be noted that the legislative process is still under way and the final regulation may differ from the proposal. Further, the requirements have been freely translated from the Finnish text and should not be taken as the official translation of the proposal.

The regulation is foreseen to apply to appliances using wood fuels that provide heating for new buildings (or completely renovated heating systems), warm domestic water or other energy services, up to a nominal capacity of 300 kW.

The proposal provides two sets of limits, one for primary heating systems (e.g. for a wood boiler that is the sole heat source of the building) and another for secondary systems (e.g. for a boiler where solid fuel is used in addition to oil; or for a stove that is not the primary heat source of the building).

Table 1-13 and Table 1-14 below show the foreseen emission limits and the minimum efficiency (on a net calorific value basis) requirements for boilers and fireplaces[51].

Table 1-13: Finnish proposed requirements for boilers of < 300 kW output

	Nominal capacity [kW]	Efficiency [%]	ELV at 10% O_2 [mg/m^3]	
			CO	OGC
Primary heating system	P ≤ 50 kW	67 + 6logP	3 000	100
	50 kW ≤ P ≤ 150 kW	67 + 6logP	2 500	80
	150 kW < P	67 + 6logP	1 200	80
Secondary heating system	P ≤ 50 kW	67 + 6logP	5 000	150
	50 kW ≤ P ≤ 150 kW	67 + 6logP	2 500	100
	150 kW < P	67 + 6logP	1 200	100

Table 1-14: Finnish proposed requirements for fireplaces[51] of < 50 kW output

	Nominal capacity [kW]	Efficiency [%]	CO ELV at 13% O_2 [%]
Primary heating system	P ≤ 50 kW	70	0.17[1]
Secondary heating system	P ≤ 50 kW	70	0.3[2]
1 corresponds to 3 000 mg/m^3, at 10 % O_2. 2 corresponds to 5 156 mg/m^3, at 10 % O_2.			

The proposal stipulates that fireplaces that do not fulfil the requirements of Table 1-14 are meant only for decorative purposes. Such fireplaces have to be permanently marked as "Suitable only for decorative purposes".

50 Puupolttoaineita käyttävien lämmityslaitteiden päästöt ja hyötysuhteet - Määräykset ja ohjeet 2008, proposal 30/06/2006, www.ymparisto.fi/download.asp?contentid=53214&lan=fi

51 The word « fireplaces » in this context includes a wider range of appliances than when used in the Lot 15 study.

France

The most relevant French regulations ones for the study are:

The Decree n° 98-817 of 11 September 1998, modified on 10 August 1998 and 15 August 2000, applying to boilers whose capacity is between 400 kW and 50 MW and which are fuelled by liquid or gaseous fuel, or hard coal or brown coal.

This Decree sets, for solid fuel fed boilers, the minimum efficiency requirement of 86%.

The NF DTU[52] 24.2 applies to fireplaces (inserts and other fire appliances) fuelled by wood.

Household appliances using solid fuels may be NF marked (NF 009 – Household appliances using liquid or solid fuels). This voluntary mark is delivered by AFNOR (French Organization for Normalization) and it testifies that an appliance meets the quality requirements defined in French, European or international standards. \

Germany

The German government established legal requirements for domestic heating appliances fired by gas, oil and solid fuel with the „1. Verordnung zum Bundesimmissionsschutzgesetz – Verordnung über kleine und mittlere Feuerungsanlagen". An amendment of the ordinance was passed in December 2009 and will presumably enter into force in February 2010.

The ordinance includes a list of fuels permitted in small combustion installations with special regulations for certain fuels (treated wood, grain, other biomass), operation requirements, requirements concerning inspection and monitoring as well as emission limit values.

Table 1-15 contains limit values for solid fuel small combustion installations (except room heaters). The ELVs apply for regular measurements at the installed appliances.

Table 1-15: German ELV for appliances > 4 kW output fired with solid fuels

	Fuel according to § 3 Absatz 1	Rated thermal output [kW]	dust [g/m³]	CO [g/m³]
Step 1: Installations built after coming into force of 1.BImSchV	Black coal, brown coal, turf, charcoal and charcoal briquettes (DIN EN 1860)	≥ 4 - 500	0,09	1,0
		> 500	0,09	0,5
	Non-treated wood in pieces (logwood, woodchips)	≥ 4 – 500	0,10	1,0
		> 500	0,10	0,5
	Pressed untreated wood in form of briquettes (DIN 51731 or equal quality), pellets or other forms	≥ 4 - 500	0,06	0,8
		> 500	0,06	0,5
	Painted, varnished or coated wood and its waste, Plywood, chipboards and fibre boards without wood preservatives and if the coating does	≥ 30 – 100	0,10	0,8
		> 100 – 500	0,10	0,5
		> 500	0,10	0,3

[52] DTU: Documents Techniques Unifiés (unified technical documents)

	Fuel according to § 3 Absatz 1	Rated thermal output [kW]	dust [g/m³]	CO [g/m³]
	not contain heavy metals or halogen organic compounds[53][1]			
	Straw, grain and similar plant products	≥ 4 < 100	0,10	1,0
Step 2: Installations built after 31.12.2014 (for logwood after 31.12.2016);	Black coal, brown coal, turf and charcoal, non-treated wood in pieces and shavings, straw or similar plant products; Pressed untreated wood in form of wood briquettes (DIN 51731 or equal quality), pellets or other forms	≥4	0,02	0,4
	Painted, varnished or coated wood and its waste, Plywood, chipboards and fibre boards without wood preservatives and if the coating does not contain heavy metals or halogen organic compounds[54][2]	≥ 30 – 500	0,02	0,4
		> 500	0,02	0,3
	Straw, grain and similar plant products	≥ 4 < 100	0,02	0,4

Table 1-16 contains ELVs for roomheaters. These limit values apply for test stand measurements.

[53] Only permitted in wood processing enterprises

[54] Only permitted in wood processing enterprises

Table 1-16: German requirements for roomheaters (test stand measurement)

		Step 1: Installations built after coming into force of 1.BImSchV		**Step 2**: Installations built after 31.12.2014 (for logwood after 31.12.2016);		Installations built after coming into force of 1.BImSchV
Appliance type	Standard	CO [g/m³]	dust [g/m³]	CO [g/m³]	dust [g/m³]	Efficiency[55] [%]
Roomheater (intermittent operation)	EN 13240	2,0	0,075	1,25	0,04	73
Roomheater (continous operation)	EN 13240	2,5	0,075	1,25	0,04	70
Slow heat release appliance	EN 15250/A1	2,0	0,075	1,25	0,04	75
Closed inserts	EN 13229	2,0	0,075	1,25	0,04	75
Slow heat release insert (intermittend)	EN 13229/A1	2,0	0,075	1,25	0,04	80
Slow heat release insert (continous)	EN 13229/A1	2,5	0,075	1,25	0,04	80
Cookers	EN 12815	3,0	0,075	1,50	0,04	70
Cookers (with roomheater function)	EN 12815	3,5	0,075	1,50	0,04	75
Pellet stove	EN 14785	0,40	0,05	0,25	0,03	85
Pellet stove with boiler	EN 14785	0,40	0,03	0,25	0,02	90

The ordinance contains requirements for existing installations that will come into force after transition periods.

For larger installations (with wood or coal fuels from 1 MW upwards, for straw and similar plant products from 100 kW upwards), the requirements of the "Technical instruction on Air Quality Control (TA Luft) apply. The TA Luft contains limit values for ambient air and for emissions into the air and applies for installations that are subject to licensing.

- **Ireland**

Air Pollution Act (1987) gives general guidance to prevent or limit air pollution (for example, it prohibits the burning of fuels which does not comply with some specified requirements in fireplaces).

The *Environmental Protection Agency Act (*1992) has been completed by the *Protection of the Environment Act* (2003). The part dealing with air quality describes goals and principles for establishing emission limit values.

The "Greener Homes scheme", which gives grants for the purchase of wood boilers that meet defined requirements, is presented in the section 1.3.5. related to labels and voluntary programmes.

[55] On a net calorific basis

Netherlands

Type approval for small wood combustion appliances, established in 1996, contained emission criteria for CO, comparable to the average limit value of the EN 13 229 standard for inset appliances fired by solid fuels. However, this type approval was abolished in 2004.

Currently, only CE marking in accordance with the European standards for residential solid fuel burning appliances applies, without additional requirements.

Poland

The Order of Polish Ministry of Environment from 20th December 2005 sets ELV for large appliances fuelled with coal, wood, and coke up to 50 MW. But, as this regulation does not refer to combustion installations of capacity below 1 MW, the ELV are not presented here.

Sweden

The Swedish legislation concerning emissions from small scale solid fuel combustion is included in the building regulations (BFS 2006:12). The requirements apply to solid fuel installations with a nominal heat output below 300 kW. The requirements are expressed in terms of organic bound carbon (OGC), in line with European standard EN 303-5. Table 1-17 gives the maximum values for different types of installations.

Table 1-17: Swedish OGC ELV for appliances of <300 kW output

	Nominal heat output [kW]	**OGC at 13% O_2 [mg/m^3]**
Manual charging	≤ 50	150
	> 50 ≤ 300	100
Automatic charging	≤ 50	100
	> 50 ≤ 300	80

It is a general recommendation (not legally binding) that testing of solid fuel installations should be made according to SS-EN 303-5. It is also recommended that boilers etc. with manual charging should be connected to an accumulator tank or equivalent equipment which facilitates energy conservation.

There are no requirements for minimum energy efficiency.

In addition, CO emission limit values have been set for secondary solid fuel installations (Table 1-18), that is to say appliances in a building primarily heated by means of another source.

Table 1-18: Swedish CO ELV for secondary solid fuel small combustion installations

	CO ELV at 13% O_2 [%]
Stoves, fireplaces inserts	0.3
Pellet stoves	0.04

It is a general recommendation (not legally binding) that testing of such secondary solid fuel installations should be made according to the applicable standard (SS-EN 12815, SS-EN 13229, SS-EN 12809, SS-EN 13240 or EN 14785). It is also recommended that the energy efficiency in these cases should be at least 60 % for stoves, 50 % for fireplace inserts and 70 % for pellet stoves (on a net calorific value basis).

The abovementioned CO requirements do not apply to open fireplaces and tiled stoves which are primarily used to create a cosy atmosphere, and also not for emissions from wood-fired kitchen stoves which are primarily intended for cooking.

United Kingdom

The Clean Air Acts of 1956 and 1968 were introduced to deal with the smog of the 1950s and 1960s which was caused by the widespread burning of coal for domestic heating and by industry. These acts are consolidated by the Clean Air Act 1993.

The Building Regulations ADL[56], adopted in 2000 and amended in 2006, requires all conventional space heating and hot water systems provided in new dwellings to meet minimum efficiencies appropriate to their design and type.

These requirements, published in the *Domestic Heating Compliance Guide*[57], are presented in Table 1-19.

Table 1-19: UK requirements for SCIs

Category	Appliance description	Minimum efficiency [%] (gross calorific value)	Feeding
B1	Simple Open fire - Inset	37%	Batch
B2	Open fire - freestanding convector	47%	Batch
B3	Open-fire inset convector	45% (mineral fuels) 43% (wood)	
C1/2	Open fire and boiler (inset or freestanding)	50%	Batch
D1/2/3	Open fire + high output boiler (trapezium)	63%	Batch
D4	Open fire + high output boiler (rectangle)	63%	Batch
E 1	Dry room heater (often known as dry stove)	65%	Batch / Automatic
E 2	Logs only	65%	Batch
E 3	Multifuel	65%	Batch
E 4	Pellet stove	65%	Auto
F1	Roomheater with boiler	67% (mineral fuels and logs) 70% (wood pellets – part load) 75% (wood pellets – nominal load)	Batch / Automatic
F2	Roomheater without boiler	65%(mineral fuels and logs) 65% (wood pellets – part load) 70% (wood pellets – nominal load)	Batch / Automatic
G1	Cooker with boiler not exceeding 7.5kW	65% (mineral fuels - boiler only) 55% (wood fuels - boiler only)	Batch

[56] Approved Document part L. ADL 1A deals with new dwellings, whereas ADL 1B deals with existing dwellings.

[57] The Guide is published by the Heating Equipment Testing and Approval Scheme (HETAS) and available on its website www.hetas.co.uk. The table has been updated according to the Corrigenda to Table 16 of the Compliance Guide.

Category	Appliance description	Minimum efficiency [%] (gross calorific value)	Feeding
J1/2/3	Independent boiler (batch fed)	65%	Batch
J4	Independent boiler - anthracite	70% Up to 20.5kW 75% Above 20.5kW	Auto
J5	Independent boiler – wood logs/pellets/chips	65%	Automatic
	Slow heat release appliances	65%	Batch
	One-off Tiled/ mortared stoves	70%	Batch

The Low Carbon Buildings Programme, launched in April 2006 and administrated by BERR (Department for Business Enterprise & Regulatory Reform), gives grants for the installation of automated wood pellet fed room heaters/stoves and wood fuelled boiler systems.

1.3.5. LABELS AND VOLUNTARY PROGRAMMES IN EUROPE

- **The Blue Angel**

The Blue Angel environmental label is sponsored and administered by the German Federal Environmental Agency and the quality assurance and product labelling institute *RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V.*

The Blue Angel provides criteria for wood pellet stoves (code RAL-UZ111) and wood pellet boilers (RL-UZ112) which are presented in Table 1-20 and Table 1-21.

Table 1-20: General Blue Angel requirements for wood-pellet stoves and boilers

Requirements	Wood-pellet stoves (RAL-UZ 111) and boilers (RAL-UZ 112)
Structural engineering and safety behaviour	As per DIN EN 303-5
Energy efficiency (net calorific value basis)	Efficiency ≥90% at rated load and partial load (determined as per DIN 18 894 or DIN EN 14785)
Auxiliary Power demand	<1% of the produced thermal output at rated thermal output

Table 1-21: ELV for wood-pellets stoves and boilers to be Blue Angel labelled

Appliance	ELV [mg/Nm^3]							
	CO		NOx		Organic substances Total carbon		Dust	
	at rated load	at partial load	at rated load	at partial load	at rated load	at partial load	at rated load	at partial load
Wood-Pellet Stoves (RAL-UZ 111)	180	400	150	NA	10	15	25	NA
Wood-Pellet Boilers (RAL-UZ 112)	90	200	150	NA	5	5	20	NA

- **The Nordic Swan**

The Nordic Swan, official Nordic ecolabel, has been introduced by the Nordic Council of Ministers: it is a common system for Sweden, Norway, Denmark and Finland. It provides criteria for closed fireplaces[58] and solid biomass boilers.

Criteria for closed fireplaces consist of:

- Limit values on air emission presented in Table 1-22;
- Limit values on noise: the noise level from automatically fed fireplaces must not exceed 45 d(B)A during normal use;

Table 1-22: Nordic Swan ELV for closed fireplaces[58]

Appliance type	ELV		
	CO	OGC	Dust [g/kg fuel]
	At 13% O_2; nominal load [mg/m^3 dry gas]		
Slow heat release appliance (manual fuel feeding)	150	2 000	1 (nominal load)
Stove (manual fuel feeding)	150	2 500	< 5 (3 low; nominal) < 10 (for each individual test)
Stove (automatic fuel feeding)	50	1 000	< 5 (2 low loads; nominal) < 10 (for each individual test)
Inset (manual fuel feeding)	150	2 500	< 8 (3 low; nominal) < 15 (for each individual test)

Minimum requirements for efficiency presented in Table 1-23.

[58] The term « closed fireplace" here means any closed direct heating appliance, and not strictly a closed fireplace as understood in the context of the Lot 15 study.

Table 1-23: Nordic Swan minimum efficiency requirements for closed fireplaces[58]

Appliance type	Minimum efficiency* [%]
Slow heat release fireplaces	≥ 78 %
Wood stoves and inset appliances	≥73 %
Pellet stoves	≥75 %
* on a net calorific value basis	

Criteria for solid biofuel boilers consist of:

- Limit values on air emission presented in Table 1-24;
- Minimum requirements for efficiency presented in Table 1-25.

Table 1-24: Nordic Swan ELV for boilers

Appliance		ELV at 10% O_2 [mg/m3 dry gas]			
		CO	NO_2	OGC	dust
Automatically fed boiler	≤300 kW	400	340	25	40
Manually fed boiler	≤100 kW	2 000	340	70	70
	100<P≤300 kW	1 000	340	50	70
Particles and NOx emissions are only tested at nominal load. The limit values for OGC and CO are tested under the following conditions: - Nominal load for manually fed boilers equipped with a hot-water tank. - Nominal load and low load for automatically fed boilers.					

Table 1-25: Nordic Swan minimum efficiency requirement for boilers

Appliance type	Efficiency*
Manually fed boiler	ηk = 73 + 6 log QN (QN is the nominal output of the boiler)
Automatically fed boiler	ηk = 75 + 6 log QN, and ηx ≥ 86%; ηx = (η20 + η40 + η60)/3 where η20, η40 ,η60 stand for the measured efficiency at 20, 40 and 60% load
* on a net calorific value basis	

EFA labelling scheme

EFA is the European association of fireplace-manufacturers. It has introduced a voluntary labelling scheme to ensure high-quality fireplaces in Europe, including requirements for emissions and efficiencies (Table 1-26).

Table 1-26: EFA ecolabelling scheme requirements

Appliance	Applicable standard	Minimum efficiency* [%]	ELV [g/m^3] at 13 % O_2	
			CO	Dust
Room heater type 1	EN 13240	73	2.00	0.1
Room heater type 2	EN 13240	70	2.50	0.1
Slow heat release appliances	EN 15250	75	2.00	0.1
Insert appliance (closed)	EN 13229	75	2.00	0.1
Tiled stove type 1	EN 13229	80	2.00	0.1
Tiled stove type 2	EN 13229	80	2.50	0.1
Pellet stoves (with water)	EN 14785	90	0.45	0.03
Pellet stoves (without water)	EN 14785	85	0.40	0.5
* on a net calorific value basis				

- **Umweltzeichen 37 (Austria)**

Introduced by the Austrian government, the "Umweltzeichen 37" is a voluntary scheme that is based on existing Austrian standards, but with improved emission values.

Emission limit values for automatically fed appliances and for manually fed appliances are presented in Table 1-27 and Table 1-28.

Table 1-27: "Umweltzeichen 37" requirements for automatically fed appliances

Appliance	Type of fuel	ELV [mg/MJ]			
		CO		NOx	Dust
		at nominal load	at partial load		
Boiler	pellet	60	135	100	15
	wood chips	150	300	120	20
Roomheating	pellet	120		100	30
	wood chips		255		

Table 1-28: "Umweltzeichen 37" requirements for manually fed appliances

Appliance	ELV [mg/MJ]			
	CO		NO_x	Dust
	at nominal load	at partial load		
Boiler	250	750	120	30
Roomheating	700	---	120	30

- **Flamme Verte (France)**

"Flamme verte" (Green Flame) is a voluntary agreement created in 2000 by French public authorities and manufacturers of wood combustion installations (closed fires, inserts, stoves, cookers and boilers), in the purpose of improving the performances of

these appliances. To this aim, performance criteria to be "Flamme verte" labelled are continuously improved (Table 1-29). Currently, more than 50 companies sell appliances with the "Flamme Verte" label.

Table 1-29: "Flamme Verte" performance requirements for closed fires, inserts and stoves

Continuing improvements of performances	2004	2005	2006	2007	2008	2009
Minimum efficiency[1] [%]	60	65	65	70	70	70
Maximum CO rate[2] [%]	1	0.8	0.6	0.6	0.6	0.3
1 on a net calorific value basis 2 percentage of smoke volume						

Table 1-30 and Table 1-31 give minimum efficiency and ELV required for appliances to be "Flamme Verte" labelled.

Table 1-30: "Flamme Verte" requirements for domestic SCIs (except boilers), 2006

Independent appliances	Minimum efficiency[1] [%]	Maximum CO rate[2] [%]
Closed fires / inserts / stoves	65	0.6
Cookers	70	0.6
1 on a net calorific value basis 2 percentage of smoke volume		

Table 1-31: "Flamme Verte" requirements for boilers

Boiler type		Efficiency* [%]	ELV [ppm]		
			CO	VOC	dust
Manual	P_n < 50 kW	70	6 500	225	165
	50 kW < P_n < 70kW	70	3 750	150	165
Automatic	P_n < 50 kW	75	4 000	150	165
	50 kW < P_n < 70kW	75	3 500	115	165
P_n = Nominal Power * on a net calorific value basis					

- **Greener Homes Scheme (Ireland)**

The Greener Homes Scheme (GHS), launched in March 2006, sets residential renewable energy grants. The scheme is administered by Sustainable Energy Ireland and aims to increase the use of sustainable energy technologies within Irish homes. Under this scheme, homeowners can avail of grant support towards the cost of installation of wood chip/pellet boilers in addition to other technologies.

Eligible wood pellet/chip boilers have to comply with the requirements described in Table 1-32 below. The eligibility requirements for wood pellet stoves and inserts are described in Table 1-33.

Table 1-32: "Greener Homes" boiler requirements

Nominal heat capacity [kW]	Minimum efficiency*	Emissions
< 10	80%	Not exceeding class 3 ELV from EN 303-5
10 – 200	73.9 kW + 7 log [nominal heat output in kW]	
> 200	90%	
Burn-back protection: the wood-fuel boiler system should be equipped with suitable burn back protection. * on a net calorific value basis		

Table 1-33: "Greener Homes" wood pellet stove or insert requirements

Wood pellet stove or insert	Minimum efficiency[1]	CO ELV [mg/m^3]
At nominal heat output	80%	500[2]
At partial heat output	-	750[2]
1 on a net calorific value basis 2 as per EN 14785. Burn-back protection: the appliance should be equipped with suitable burn back protection.		

- **HETAS certification (UK)**

The Heating Equipment Testing and Approval Scheme (HETAS) is an independent organisation for setting standards of safety, efficiency and performance for testing and approval of solid fuels, solid mineral fuel and wood burning appliances and associated equipment and services for the UK solid fuel domestic heating industry.

The efficiency criteria set by HETAS for Lot 15 appliances have been adopted by the UK government in the Building Regulations (see UK legislation part).

- **DINplus certification (Germany)**

DINplus is a voluntary certification scheme that is based on existing European or German standards, but sets stricter the limit values to decrease the amount of emissions. The certification scheme for solid fuel small appliances sets the emission limit values presented in Table 1-34.

Table 1-34: ELV for DINplus certification for solid fuel small combustion appliances

ELV [mg/Nm^3]			
CO	**NOx**	**C_nH_m**	**Dust**
1 500 (0.12 % at 13% O_2)	200	120	75

- **Danish subsidy scheme**

Subsidy scheme for small biofuel boilers was introduced in 1995. The Danish Energy Agency requires a type approval of the boiler as a precondition for granting subsidies. The requirements in respect of dust and CO emission are listed in Table 1-35. Figure 1-23 presents minimum efficiencies according to the type of boiler and its output.

Table 1-35: Danish subsidy scheme ELV for small biofuel boilers

Fuel and boiler type		**ELV at 10% O_2**		
		CO [%]		**Dust [mg/nm^3]**
		At 30% load	At nominal output	
Fuel wood, pellets, shavings/powder, chips, cereals	Manual feeding	0.50	0.50	300
	Automatic feeding	0.15	0.10	300
Straw	Manual feeding	0.80	0.80	600
	Automatic feeding	0.40	0.30	600

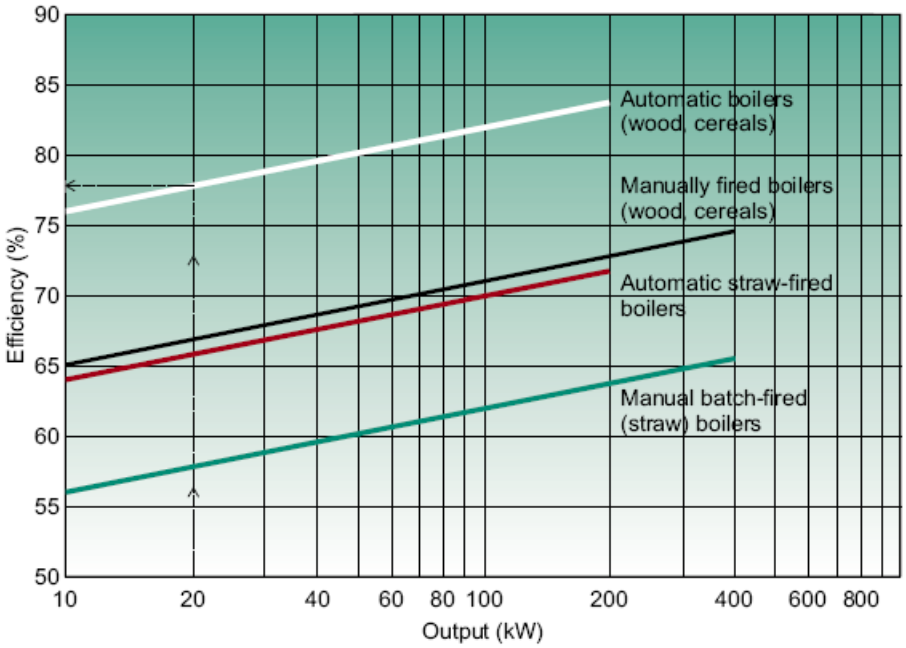


Figure 1-23: Danish subsidy scheme minimum efficiency requirements for small biofuels boilers, according to the type of appliance

Swedish P-marking system

This system does not include only requirements on emission and energy efficiency but also on construction, safety and operational reliability. Certification rules exist for the following product types:

- Pellet fuelled burners and boilers, (CR 028),
- Pellet stoves, max (CR 093),
- Wood-fired room heaters, max (CR 134).

Table 1-36 lists the requirements on emissions and energy efficiency for the different product types.

Table 1-36: P-marking requirements for SCIs using biofuels

Product type	Energy efficiency		ELV at 13 % O_2 [mg/m^3 dry gas]			
	Testing conditions	Minimum values [%]	Testing conditions	CO	OGC	dust
Pellet burner	at nominal heat output and over a test cycle 3 – 9 kW	$(\eta)_{ref}$* – 10	at nominal heat output **and** over a test cycle 3 – 9 kW	1500	50	
Pellet boiler	at nominal heat output	86		1500	50	
	over a test cycle 3 – 9 kW	80				

Product type	Energy efficiency		ELV at 13 % O_2 [mg/m^3 dry gas]			
	Testing conditions	Minimum values [%]	Testing conditions	CO	OGC	dust
Pellet stove	at an heat output of 3–5 kW	75	at nominal heat output **and** at 3-5 kW output	2000	75	100
Wood-fired room heater	at nominal heat output	70	at nominal heat output for CO; at nominal heat output **and** at 3-4 kW output for OGC	0.3 %	200	
* $(\eta)_{ref}$ is the energy efficiency of the reference boiler used at the test, but operated with a reference oil burner.						

- **Voluntary ecolabelling in Poland**

Voluntary ecolabelling in Poland "Attestation as a sign of ecological safety" was elaborated by Institute For Chemical Processing Of Coal (IChPW) in Zabrze. In August 2001, The Voivodeship Fund for Environmental Protection and Water Management (WFOSiGW) in Katowice, set criteria for "Rules of finance of emission to air limitation tasks by application, or utilisation, low-emission heat sources fired by coal in Silesia Voivodeship, co-financed by Government of Switzerland and WFOSiGW in Katowice.

Table 1-37 below gives required values (updated in 2006) for boilers to be "sign of ecological safety" labelled.

Table 1-37: Current minimum energy efficiency and ELV for Polish "sign of ecological safety" for low power boilers fired by solid fuels.

Appliance type and class		Minimum energy efficiency[3] [%]	ELV in dry flue gas, at 10% O_2 [mg/m^3]					
			CO	NO_2	ash	TOC[1]	16 PAH[2]	Benzo-a-Pyrene
Chamber boiler with temporary fuelling	B	75	5000	400	200	150	15	0.150
	A	80	1200	400	125	75	5	0.75
Retort boiler with continuous, automatic fuelling	B	78	3000	600	150	100	5	0.100
	A	80	1200	400	125	75	5	0.75

1 - TOC – total organic carbon

2 - PAH – polycyclic aromatic hydrocarbons, 16 PAH according to EPA.

3 net calorific value basis.

1.3.6. THIRD COUNTRY LEGISLATION

Australia

Some Australian Environmental Protection Agencies propose to introduce mandatory Minimum Energy Performance Standards for solid fuel combustion installations in compliance of the *Environmental Protection Act* (1993) and other legislations such as the Environment Protection Policies.

Reference documents:

- Draft Code of Practice for Environmentally Responsible Wood Heater Use (South Australia).
- Part 2 of the Protection of the Environment Operations (Clean Air) Regulation 2002 (New South Wales).

  This part of the regulation deals with the sale of domestic solid fuel heaters and requires the heaters to be certified as complying with emission limits set out in the relevant Australian standard. It also prohibits tampering with these types of heaters.

New Zealand

National environmental standards relating to wood stoves are regulated under the *Resources Management Regulations* 2004, pursuant to the section 43 of the *Resource Management Act* 1991.

After 1st September 2005, the national environmental standards for air quality require that all wood burners installed on properties less than 2 hectares must have a discharge of less than 1.5 grams of particles per kilogram of dry wood burnt, and a thermal efficiency of at least 65%.

The Ministry of the Environment carries the "Warm Homes" Project to assess the issues related to domestic solid fuel burners which are the main source of fine particles in most urban areas. The main driver of the Warm Homes Project is *National Environmental Standard for Air Quality*. This was introduced in 2004 and requires regional councils and communities to deal with poor air quality in their areas.

- **Switzerland**

In the *Ordinance on Air Pollution Control* (OAPC), the Swiss government has established emission limits for appliances fired by gas, oil and solid fuel (Table 1-38). The OAPC covers NOx, CO soot and VOC.

Table 1-38: Swiss requirements for SCIs, according to OAPC

Appliance type	European standard	ELV			
		CO [mg/m^3]		Dust [mg/m^3]	
		Step 1	Step 2	Step 1	Step 2
Wood log and coal heating boiler, manually fed	EN 303-5* or EN 12809	800	800	60	50
Wood chips and coal heating boiler, automatically fed		400	400	90	60
Wood pellets boiler, automatically fed		300	300	60	40
Solid fuel heating appliances	EN 13240	1 500	1 500	100	75
Wood pellets heating appliances	EN 14785	500	500	50	40
Solid fuel stove	EN 12815	3 000	3 000	110	90
Solid fuel central heating stove		3 000	3 000	150	120
Solid fuel open fireplaces and inserts		1 500	1 500	100	75
Step 1: from 1st January 2008. Step 2: from 1st January 2011. * not harmonised					

Like in Austria and Germany, a voluntary scheme called "Holzenergie" exists, with more stringent values than in the relevant product standards. Table 1-39 below presents the requirements set for appliances of < 300 kW output.

Table 1-39: "Holzenergie" requirements for appliances of < 300 kW output

Appliance	Applicable standard	Energy efficiency[3] [%]	ELV at 13% O_2 [mg/m^3]		
			CO	Hydro-carbons	dust
Wood logs boiler	EN 303-5[2]	83	600	20	50
Wood chips boiler		85	3001	151	60
Wood pellets boiler		85	2501	101	40
Cooker	EN 12815	60	2000	-	90
Central heating cooker		75	3000	-	100
Stove / fireplace	EN 13240	78	1500	-	75
Fireplaces and fireplaces inserts	EN 13229	78	1500	-	75
Pellet stove	EN 14785	83	500	-	40
Slow heat release appliance / Kachelofen	EN 15250 / EN15544	83	1500	-	75

1 for automatic appliances, this requirement apply to partial load condition too.

2 not harmonised

3 net calorific value basis

United States

Under the *Clean Air Act,* the 'Wood Heater Compliance Monitoring Program' established that wood stove model lines that are in compliance with the rules can be referred to as EPA[59] certified wood stoves. EPA's certification process requires manufacturers to verify that each of their wood stove model lines meet the specific particulate emission limit by undergoing independent emission testing at an EPA accredited laboratory. The emission limits for particulate matter are 7.5 grams per hour for non catalytic wood stoves and 4.1 grams per hour for catalytic wood stoves.

All wood heating appliances subject to the New Source Performance Standard for Residential Wood Heaters under the *Clean Air Act* offered for sale in the United States are required to meet these emission limits.

59 EPA: Environmental Protection Agency.

1.4. TASK 1 ANNEXES

1.4.1. SOME EXAMPLES OF SOLID FUEL OUTDOOR DIRECT HEATING AND COOKING APPLIANCES

Note that this section aims at providing some typical examples rather than an exhaustive presentation of these appliances.

➔ **Fire bowls[60] / Fire pits[61]**

These are the **traditional campfire lifted up** using decorative copper and cast iron. ("Solid fuel patio heaters")

A wood burning fire bowl comprising a copper bowl with black wrought iron stand. Include a porcelain grate to improve airflow and heavy mesh spark arrestor.

A wood burning fireplace with a ceramic tile surround. Include a porcelain grate to improve airflow, a heavy-duty wrought iron stand and heavy mesh spark arrestor.

A furnace fire pit designed for wood fires and with a height of over one and a half metres. Made of Cast iron and steel with burnished copper finish; removable ash tray drawer at the base

[60] Photos from http://www.mantelsdirect.com/outdoor_fire_pits.html

[61] Photo from www.sawitfirst.co.uk/media/furnacelf11_1.jpg

An outdoor wood burning fireplace that can be used camping, on a patio or in a garden. Made of heavy-gauge steel coated with porcelain enamel. The heat shield is rust-resistant aluminium, and the support ring is galvanised steel.

Photo from:
www.bbqs2go.co.uk/Fireplace_2726_L119.jpg

➔ Chimineas[62]

These are Mexican-style outdoor fireplaces featuring a chubby base where the fire burns, and a tall narrow chimney to vent the smoke. Traditional chimineas are made from fired clay, but cast iron models are also available. ("Solid fuel patio heaters"). Chimeneas can combine the heating and barbecue functions.

The illustrated cast Iron chiminea is design to be used as chiminea, barbecue & fire pit. Designed to burn wood or coal.

Another model of a chiminea, made from aluminium. Designed be used as a patio heater as well as BBQ by removing the chimney.

[62] Illustrative photos from http://www.foroutdoors.co.uk/acatalog/Cast_Iron_Chimineas.html

➔ Outdoor fireplaces

These are free standing enclosed units with chimneys that vent the smoke and ash, and generally fuelled by wood or briquettes. They can be simple brick constructions or factory made product, as illustrated below. Chimeneas can combine the heating and barbecue functions.

A factory made outdoor fireplace burns charcoal or wood. The model in the photo includes an adjustable 3 position grill

➔ BBQ Grills

Simple charcoal bbq grill

"Modern" charcoal bbq grill

1.4.2. TECHNICAL SPECIFICATIONS FOR SOLID BIOFUELS[63]

Standard reference	Title
EN/TS 14588:2004	Solid biofuels - Terminology, definitions and descriptions
EN/TS 14774-1:2004	Solid biofuels - Methods for determination of moisture content - Oven dry method - Part 1: Total moisture - Reference method
EN/TS 14774-2:2004	Solid biofuels - Methods for the determination of moisture content - Oven dry method - Part 2: Total moisture - Simplified method
EN/TS 14774-3:2004	Solid biofuels - Methods for the determination of moisture content - Oven dry method - Part 3: Moisture in general analysis sample
EN/TS 14775:2004	Solid biofuels - Method for the determination of ash content
EN/TS 14778-1:2005	Solid biofuels - Sampling - Part 1: Methods for sampling
EN/TS 14778-2:2005	Solid biofuels - Sampling - Part 2: Methods for sampling particulate material transported in lorries
EN/TS 14779:2005	Solid biofuels - Sampling - Methods for preparing sampling plans and sampling certificates
EN/TS 14780:2005	Solid biofuels - Methods for sample preparation
EN/TS 14918:2005	Solid Biofuels - Method for the determination of calorific value
EN/TS 14961:2005	Solid biofuels - Fuel specifications and classes
EN/TS 15103:2005	Solid biofuels - Methods for the determination of bulk density
EN/TS 15104:2005	Solid biofuels - Determination of total content of carbon, hydrogen and nitrogen - Instrumental methods
EN/TS 15148:2005	Solid biofuels - Method for the determination of the content of volatile matter
EN/TS 15149-1:2006	Solid biofuels - Methods for the determination of particle size distribution - Part 1: Oscillating screen method using sieve apertures of 3,15 mm and above
EN/TS 15149-2:2006	Solid biofuels - Methods for the determination of particle size distribution - Part 2: Vibrating screen method using sieve apertures of 3,15 mm and below
EN/TS 15149-3:2006	Solid biofuels - Methods for the determination of particle size distribution - Part 3: Rotary screen method

[63] Source : http://www.biomassenergycentre.org.uk/portal/page?_pageid=77,19836&_dad=portal&_schema=PORTAL

Standard reference	Title
EN/TS 15150:2005	Solid biofuels - Methods for the determination of particle density
EN/TS 15210-1:2005	Solid biofuels - Methods for the determination of mechanical durability of pellets and briquettes - Part 1: Pellets
EN/TS 15210-2:2005	Solid biofuels - Methods for the determination of mechanical durability of pellets and briquettes - Part 2: Briquettes
EN/TS 15234:2006	Solid biofuels - Fuel quality assurance
EN/TS 15289:2006	Solid Biofuels - Determination of total content of sulphur and chlorine
EN/TS 15290:2006	Solid Biofuels - Determination of major elements
EN/TS 15296:2006	Solid Biofuels - Calculation of analyses to different bases
EN/TS 15297:2006	Solid Biofuels - Determination of minor elements

1.4.3. PRODCOM CATEGORIES APPLYING TO SOLID FUEL SCIs

A number of PRODCOM categories could apply to solid fuel SCIs (Table 1-40). However, many of them do not cover solid fuel SCIs explicitly. Production quantities and value are already provided to get the first impressions of the size of the market for these products; but market aspects will be more closely looked at in Task 2.

In the table below, product categories are presented according to their relevance towards Lot 15 products, in bold are the two categories that refer to appliances fuelled by solid fuel only.

Table 1-40: PRODCOM categories that could apply to solid fuel SCIs

PRODCOM Code	Description	Production quantity (2007)	Production value, kEuro (2007)	Comment
29.72.11.13	Iron/steel gas domestic cooking appliances and plate warmers, with an oven (including those with subsidiary boilers for central heating, separate ovens for both gas and other fuels)	3 565 852	858 810	Gas plus solid fuel appliances, cooking / indirect heating, domestic
29.72.11.15	Iron or steel gas domestic cooking appliances and plate warmers (including those with subsidiary boilers for central heating, for both gas and other fuels; excluding those with ovens)	3 791 974	317 697	Gas plus solid fuel appliances, cooking / indirect heating, domestic

PRODCOM Code	Description	Production quantity (2007)	Production value, kEuro (2007)	Comment
29.72.11.50	**Iron or steel solid fuel domestic cooking appliances and plate warmers (including those with subsidiary boilers for central heating)**	**992 244 E**	**113 765**	**Solid fuel, cooking / indirect heating, domestic**
29.72.12.33	Iron or steel gas domestic appliances with an exhaust outlet (including heaters, grates, fires and braziers, for both gas and other fuels; excluding cooking appliances and plate warmers)	1 003 606	397 179	Gas plus solid fuel appliances, direct heating, domestic
29.72.12.35	Iron/steel gas domestic appliances (including heaters, grates, fires and braziers, for both gas and other fuels radiators; excluding cooking appliances and plate warmers, those with an exhaust outlet)	1 939 923	204 303	Gas plus solid fuel appliances, direct heating, domestic
29.72.12.70	**Iron or steel solid fuel domestic appliances (including heaters, grates, fires and braziers; excluding cooking appliances and plate warmers)**	**2 008 249**	**1 027 868**	**Solid fuel, direct heating, domestic**
29.72.13.00	Air heaters/hot air distributors	1 620 044 E	584 261	All fuels, indirect heating
29.72.14.00	Non-electric instantaneous or storage water heaters	5 306 250	1 514 618	All fuels, indirect heating
28.22.12.00	Boilers for central heating other than those of HS 8402 (refers to NC classification)	8 104 000 E	5 819 072	All fuels, indirect heating
28.30.11.10	Watertube boilers with a steam production > 45 tonnes per hour (excluding central heating water boilers capable of producing low pressure steam)	2 782 E	1 120 979	All fuels, large boilers, indirect heating, watertube - industrial
28.30.11.30	Watertube boilers with a steam production ≤ 45 tonnes per hour (excluding central heating hot water boilers capable of producing low pressure steam)	3 810 E	195 710	All fuels, indirect heating, watertube - industrial ?
28.30.11.50	Vapour generating boilers (including hybrid boilers) (excluding central heating hot water boilers capable of producing low pressure steam, watertube boilers)	38 398 E	865 463	All fuels, indirect heating, industrial

PRODCOM Code	Description	Production quantity (2007)	Production value, kEuro (2007)	Comment
28.30.11.70	Super-heated water boilers (excluding central heating hot water boilers capable of producing low pressure steam)	4 342 E	173 380	All fuels, indirect heating, industrial
29.53.15.33	Non-electric industrial tunnel ovens (including biscuit ovens)	1 156	103 978	All fuels, cooking
29.53.15.35	Non-electric industrial bakery ovens (including biscuit ovens) (excluding tunnel ovens)	32 347	238 145	All fuels, cooking
29.21.12.30	Non-electric furnaces and ovens for the roasting, melting or other heat-treatment of ores, pyrites or of metals	5 325 E	671 160	All fuels, process
29.21.12.50	Non-electric furnaces and ovens for the incineration of rubbish	8 263 598 E	169 626	Waste
29.21.12.90	Other furnaces and ovens	107 394 017 E	517 749	All fuels
Data are for 2007 and available at Eurostat. 'E' denotes an estimated value.				

1.4.4. GENERAL DESCRIPTION OF STANDARDS

Here further information about product standards is provided, for example construction and safety requirements, not already presented in section 1.2. which focused more on the test methods.

➔ **EN 303-5: Heating boilers for solid fuels, hand and automatically stoked**

Construction requirements

The standard defines safety and design requirements concerning:

- the firing system,
- the thermal insulation,
- the water sections,
- the stoking devices.

The requirements of electrical safety are to be conducted on the basis of EN 60355-1 (type of boiler protection, specifications concerning electrical component).

The construction requirements covered by this standard include method of welding work and type of materials used in manufacture of the boiler. Moreover in this part there is information about production documentation and manufacturing controls.

The standard defines two kinds of materials to be used for heating boilers construction. They shall be made of steel and non-ferrous materials or of cast materials. The minimum wall thicknesses have been specified according to fuel type

used (biogenic fuel, fossil fuel), and in view on nominal heat output. The minimum wall thicknesses listed in Table 1-41 apply to boilers made of steel and non-ferrous materials.

Table 1-41: Minimum wall thicknesses (in mm) for steel boilers, according to EN 303-5

Nominal heat output Q_N [kW]	Carbon steels					Stainless and corrosion protected steels				
	a	b	c	d	e	a	b	c	d	e
boilers for biogenic kinds of fuel										
$Q_N \leq 100$	5	4	3.2	3	4	3	2	1.5	2	3
$100 < Q_N \leq 300$	5	4	3.2	4	4	3	2	1.5	2	3
boilers for fossil kinds of fuel										
$Q_N \leq 100$	4	4	3.2	3	4	2	2	1.5	2	3
$100 < Q_N \leq 300$	5	4	3.2	4	4	3	2	1.5	2	3
Column a: for walls of the filling and combustion chamber in contact with fire and water Column b: for walls of the convection heating surfaces outside the combustion chamber (except circular tubes) Column c: for circular tubes in the convection heating surface area outside the combustion chamber Column d: for walls which are only in contact with water Column e: for water cooled grate tubes										

The boiler made of cast materials has to pass a suitable material test (accordance with ISO 185, EN 10003-1). The mechanical properties of cast iron used for parts subject to pressure shall, as a minimum, correspond to the values listed in Table 1-42.

Table 1-42: Minimum requirements for cast iron boilers, according to EN 303-5

Cast Iron with lamellar graphite (see ISO 185)	
- Tensile strength R_m - Brinell hardness	≥ 150 N/mm^2 160 HB to 220 HB; 2.5/187.5
Spheroidal graphite iron (ferritically annealed)	
- Tensile strength R_m - izod impact	≥ 400 N/mm^2 ≥ 23 J/mm^2

The minimum wall thicknesses of the boiler sections and other parts subject to pressure and manufacturing of cast materials listed in Table 1-43.

Table 1-43: Minimum wall thicknesses for cast iron boilers, according to EN 303-5

Nominal heat output Q_N [kW]	Minimum wall thicknesses[1] for cast iron boilers	
	lamellar graphite [mm]	spheroidal graphite/annealed ferritic [mm]
$Q_N \leq 30$	3.5	3.0
$30 < Q_N \leq 70$	4.0	3.5
$70 < Q_N \leq 300$	4.5	4.0
[1] heating boilers for fossil fuels; for biogenic fuels: add 0,5 mm		

Surface temperatures

Temperature of different parts shall not exceed the room temperature by more than the following values:

- 35 K for metals and similar materials,
- 45 K for porcelain and similar materials,
- 60 K for plastics and similar materials.

Electrical safety

The requirements of electrical safety are to be conducted on the basis of EN 60335–1 *Safety of household and similar electrical appliances – Part 1: General requirements.*

Boiler performance requirements

To determine the heat output, boiler efficiency, composition of the combustion gas, the boiler shall be operated throughout the tests within the heat output range. At nominal heat output the boiler is to be operated in such a way that continuous operation is possible. The minimum heat output can be regulated manually or automatically by a control device. In this standard the requirements for the boiler efficiency and the emission limits are divided into 3 classes. The boiler class efficiency (net calorific value basis) is determinate by the following equations:

1) for class 1, $\eta_k = 67 + 6\log Q_N$,

2) for class 2, $\eta_k = 57 + 6\log Q_N$,

3) for class 3, $\eta_k = 47 + 6\log Q_N$,

where Q_N: nominal heat output in kW, η_k: boiler efficiency in %.

During the test, the boiler efficiency shall be determined by the direct method. Indirect method the boiler efficiency can be used only for checking purposes. Moreover the efficiency is determined on basis of the net calorific value.

Determining the emission values shall be realized at nominal and minimum heat output. The velocity of the flue gas at the measurement point used to determinate dust emissions shall be calculated from the volume of combustion gas, taking into account pressure and temperature. There are different testing periods for boilers with manual stoking and automatic stoking. The emission requirements shall be satisfied if the emission values in Table 1-44 are not exceeded.

Table 1-44: Emission limits and classes definitions according to EN 303-5

Stoking	Fuel	Nominal heat output [kW]	Emission limits at 10% O_2* [mg/m^3]								
			CO			OGC			dust		
			class 1	class 2	class 3	class 1	class 2	class 3	class 1	class 2	class 3
manual	biogenic	≤ 50	25000	8000	5000	2000	300	150	200	180	150
		> 50 to 150	12500	5000	2500	1500	200	100	200	180	150
		> 150 to 300	12500	2000	1200	1500	200	100	200	180	150
	fossil	≤ 50	25000	8000	5000	2000	300	150	180	150	125
		> 50 to 150	12500	5000	2500	1500	200	100	180	150	125
		> 150 to 300	12500	2000	1200	1500	200	100	180	150	125
autom.	biogenic	≤ 50	15000	5000	3000	1750	200	100	200	180	150
		> 50 to 150	12500	4500	2500	1250	150	80	200	180	150
		> 150 to 300	12500	2000	1200	1250	150	80	200	180	150
	fossil	≤ 50	15000	5000	3000	1750	200	100	180	150	125
		> 50 to 150	12500	4500	2500	1250	150	80	180	150	125
		> 150 to 300	12500	2000	1200	1250	150	80	180	150	125
* referred to dry exit flue gas, 0°C, 1013 mbar											

The error limits for test equipment do not exceed:

- For efficiency ±3% points,
- For CO, OGC and dust ±5% of the emission limits.

The dust content is to be determined with the use of a gravimetric or electrostatic method. Fuel of commercial quality is used for testing heating boilers and characteristics of the type of fuel as declared by the manufacturer according to Table 1-45 (see table 8 of EN 303-5).

Each heating boiler shall be labelled with a data plate. The boiler data plate shall be written in the language of the boiler's destination country and be affixed in an accessible spot. In accordance with EN 303-5 the boiler plate shall contain at least the following:

- Name and company domicile, the manufacture's symbol,
- Nominal heat output and heat output range in kW for the each type of fuel,
- Boiler class,
- Maximal allowable operating pressure in bar,
- Maximal allowable operating temperature in °C,
- Water content in l,
- Electrical connection (V, Hz, A) and wattage in W,
- Trade designation, type under which the boiler is marketed,
- Production number and year of construction.

Table 1-45: Test fuels according to EN 303-5

	Bituminous coal		Brown coal (incl. briquets)		Coke		Anthracite	Log wood		chipped wood		compressed wood	Sawdust
								Softwood	Hardwood				
	a1	a2	b1	b2	c1	c2	d	A1	A2	B1	B2	C	D
Water content (as fired basis)	≤ 11 %		≤ 20 %		≤ 5 %		≤ 5 %	12 % to 20 %	12 % to 20 %	20 % to 30 %	40 % to 50 %	≤ 12 %	35 % to 50 %
Ash content (as fired basis)	2 % to 7 %		5 % to 20 %		5 % to 15 %		5 % ± 3 %	≤ 0,4%	≤ 0,4%	≤ 0,4%	≤ 0,4%	≤ 0,5 %	≤ 0,5 %
Volantile matter (as fired basis)	15 % to 30 %	> 30 %	40 % to 50 %	50 % to 60 %	< 6 %	8 % ± 2 %	< 10 %						
Net (lower) calorific value H_{uwf} (waterfree)	> 28 000 kJ/kg		> 12 500 kJ/kg		> 28 000 kJ/kg		> 28 000 kJ/kg	19 000 kJ/kg ± 5 %	18 000 kJ/kg ± 5 %	18 000 kJ/kg ± 5 %	18 000 kJ/kg ± 5 %	18 000 kJ/kg ± 5 %	18 000 kJ/kg ± 5 %
Size/Length	according to manufacturer's instruction*)												

$$H_{uw} = \frac{H_{uwf} \cdot (100 - w) - 2{,}44\, w}{100}$$

H_{uw} Net calorific value of the fuel (MJ/kg)
H_{uwf} Net calorific value of the fuel free of moisture (MJ/kg)
w Water content as proportion of total mass (%)

*) A maximum of 5 % of mass of the test fuel shall be oversized and undersized

Remarks:

The EN 303-5:2002 standard, related to SCIs with a capacity below 300 kW is not harmonised with Council Directive 89/106/EEC of 21 December 1988. Such devices are installed in domestic sector, industry (SME) as well as commercial and institutional, especially in New Member states of EC. The apparent advantage of the standard is that it takes into account allowable emission factors of CO, PM and OGC. These pollutants, being the products of incomplete combustion (PICs) are the characteristic parameters defining the rate of optimization of combustion process parameters, hence the quality of technological solution applied for the boiler design (in view of BAT requirements). NOx emissions limits may not be appropriate, since in the combustion temperatures of the traditional appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen. However NOx emission level can become a concern in case of automatically fuelled boilers where concentration of this particular pollutant in flue gases increases significantly. .

The standard should be subjected to revision, within the scope of activities undertaken by Technical Committee CEN/TC 57 „Central heating boilers", in the scope of:

- Qualitative requirements related to fuel used by tests, taking into account especially moisture contents and volatile matter contents, which have significant influence on the emission level of CO, NMVOCs, TSP (and PM) as well as POPs (i.e. PICs), hence influencing energy efficiency.
- Unification of flue gas reference conditions (13% O_2, 10% O_2 or to introduce emission factor for the unit of heat produced MJ or GJ) for determination of emission factors. Introduction of allowable NOx emission level would also be advisable in the future[64].

➔ **EN 12809: Residential independent boilers fired by solid fuel**

Construction requirements

In this standard there are specifications of the steel materials which shall be used for the manufacture of those parts of the appliance that are subjected to water pressure.

- The firing system,
- The water sections,
- The control devices.

This standard defines two kinds of materials to be used for production of the heating boiler parts. They shall be made of steel and non-alloy steel or of cast iron. The minimum wall thicknesses have been specified according to part destination or nominal heat output. The minimum wall thicknesses listed in Table 1-46 apply to boilers made of non-alloy steel.

[64] It is understood that in the new techniques of combustion in solid fuel boilers, conditions of combustion process are changed in comparison to traditional techniques. Local and average combustion temperature increases, therefore thermal NOx can become a concern, at which point NOx regulations should be introduced.

Table 1-46: Minimum wall thicknesses for non-alloy steel boilers, according to EN 12809

Application/Usage	Nominal minimum wall thickness* [mm]
Walls of combustion chamber in contact with fire and/or water	5
Walls of convection heating surfaces outside combustion chamber (except circular tubes)	4
Circular tubes used in convection part of heat exchanger	3.2
Water cooled grate tubes	4
Surfaces not in contact with the fire or the products of combustion	3
*The nominal minimum wall thicknesses listed for a particular application/usage have been specified taking into consideration: - the permissible maximum water operating pressure (stated by the manufacturer); - the material properties; - the heat transfer location.	

The boiler wall thicknesses made of cast iron shall be not less than the minimum thickness listed in Table 1-47 .

Table 1-47: Minimum wall thicknesses for cast iron boilers, according to EN 12809

Nominal heat output [kW]	Minimum wall thicknesses [mm]	
	Grey cast iron	Spheroidal graphite cast iron
< 30	3.5	3.0
30 < …< 50	4.0	3.5

The minimum mechanical properties of cast irons used for parts subject to water pressure shall be in accordance with the values listed in Table 1-48.

Table 1-48: Minimum mechanical requirements for cast iron boiler, according to EN 12809

Grey cast iron (In accordance with EN 1561:1997)	
Tensile strength $\mathbf{R_m}$	> 150 N/mm2
Brinell hardness	160 HB to 220 HB
Spheroidal graphite cast iron (In accordance with EN 1563:1997)	
Tensile strength $\mathbf{R_m}$	> 400 N/mm2
Elongation	18% A3

Surface temperatures

An operating tool shall be provided where it would otherwise be necessary to touch any surface having a temperature above ambient by more than the following values:

- 35 K for metals,
- 45 K for porcelain, vitreous enamel or similar materials,
- 60 K for plastics, rubber or wood.

Electrical safety

The appliance shall comply with the electrical safety requirements of EN 50165 *Electrical equipment of non-electric appliances for household and similar purposes - Safety requirements* if mains operated electrical equipment is fitted as part of the appliance.

Boiler performance requirements

This standard establishes refuelling interval at nominal heat output and at slow combustion. In the beginning test the refuelling interval at nominal heat output, on one charge of test fuel, shall be not less than the values given in Table 1-49.

Table 1-49: Minimum refuelling interval at nominal heat output, according to EN 12809

Appliance type	Test Fuel Type (as detailed in Table B.1 of EN 12809)	Minimum refuelling interval hours
Batch fed appliances	Wood logs or peat briquettes	2
	All other test fuels	4
Hopper fed appliances	Anthracite	10

If the manufacturer claims that the boiler is capable of slow combustion, the minimum refuelling intervals are given in Table 1-50, using one charge of test fuel with a mass equivalent to that used for the performance test at nominal heat output test and calculated as detailed in A.4.2 of EN 12809.

Table 1-50: Minimum refuelling interval at slow combustion, according to EN 12809

Appliance type	Test Fuel Type (as detailed in Table B.1 of EN 12809)	Minimum refuelling interval hours
Batch fed appliances	Wood logs or peat briquettes	10
	All other test fuels	15
Hopper fed appliances	Anthracite	28

The measured total efficiency (net calorific value basis) from the mean of at least two separate test results at nominal heat output shall be not less than the values given in Figure 1-24 as appropriate to the test fuel used. During the test, the boiler efficiency

shall be determined by the indirect method. Suitable equations were presented in Annex A.6.2 of the standard.

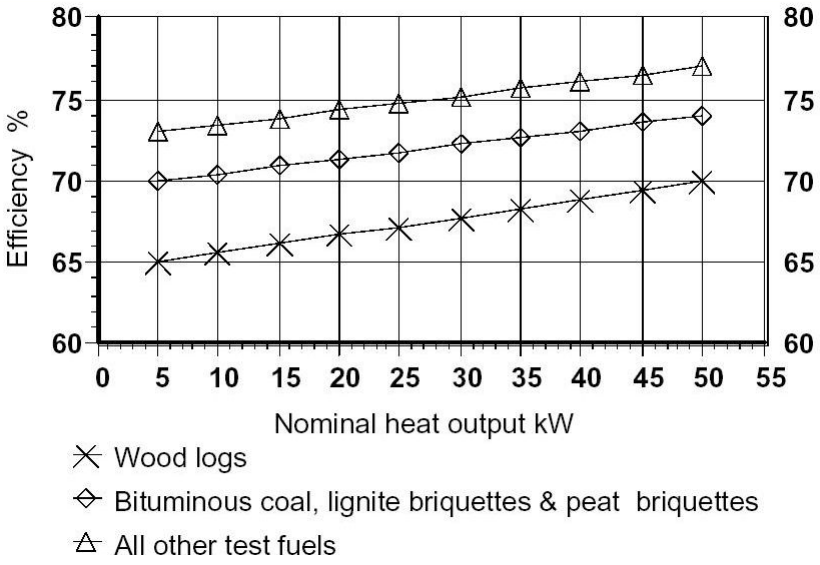


Figure 1-24: Boiler efficiency, according to EN 12809

The mean carbon monoxide concentration calculated to 13 % oxygen (O_2) content in the flue gas shall be less than or equal to the manufacturer's declared value and shall not exceed 1.0% at 13%O_2. This standard does not define PM and OGC (VOCs, NVOCs) emission limits. In some countries national laws also require limits for particulates and organic compound emissions, emissions under slow combustion conditions and for weighted values for emissions to be used. In some countries clean air legislation is based on the use of certified fuels.

The amendment EN 12809:2001/A1:2004 adds new chapter concerning evaluation of conformity. The compliance of a residential independent boiler appliance with the requirements of this standard and with stated values shall be demonstrated by:

- Type testing,
- Factory production control by the manufacturer, including product assessment.

The uncertainty of measurement results is specified in Annex A of the standard in Table A.1. Moreover in Annex A there are presented test methods in detail. In this part there are requirements applicable to:

- Test environment,
- Flue gas temperature measurement,
- Flue gas sampling,
- Heat losses and efficiency (net calorific value basis).

Annex B of the standard gives information about selection, preparation and analysis of the test fuels. Table B.2 in annex B gives a list of the types of currently available commercial fuels against each test fuel type as well as specifies their typical characteristics. The tests for suitability of a recommended fuel are described in B.3 (annex B) of the standard, and presented in Table 1-51.

Table 1-51: Test fuels, according to EN 12809

Commercial fuel types	Anthracite Dry steam coal	Hard Coke	Low Temp Coke	Briquetted fuel for closed appliances	Briquetted fuel for open fires	Bituminous coal	Lignite briquettes	Peat briquettes	Wood logs
Test fuel Designation	A	B	C	D	E	F	G	H	Beech, birch or hornbeam
Moisture content (as fired basis) ISO 331:1983 and ISO 687:1974	< 5 %	< 5 %	< 5 %	< 5 %	< 5 %	(8 ± 2,5) %	(18,5 ± 2) %	(11 ± 2) %	(16 ± 4) %
Ash content (as fired basis) ISO 1171:1997	(5 ± 2) %	(7 ± 2) %	(7 ± 2) %	(8 ± 3) %	(5 ± 2) %	(6 ± 2) %	< 6 %	< 4 %	< 1 %
Volatile matter (dry, ash-free basis) ISO 562:1998	< 14 %	< 2 %	(8 ± 2) %	< 13 %	< 18 %	> 30 %	< 55 %	(68 ± 3) %	(84 ± 4) %
Hydrogen content (as fired basis) ISO 609:1996	(4 ± 1) %	< 0,5 %	< 3 %	< 4 %	< 4 %	(4 ± 1) %	≤ 4 %	(5,2 ± 0,7) %	(5 ± 1) %
Carbon content (as fired basis) ISO 609:1996	(82 ± 5) %	(90 ± 5) %	(78 ± 3) %	(82 ± 5) %	(80 ± 5) %	(72 ± 5) %	(50 - 55) %	(48,5 ± 4,5) %	(40 ± 5) %
Sulfur content (as fired basis) ISO 351:1996 and ISO 334:1992	< 1 %	< 1,4 %	< 2 %	< 1,8 %	< 1,8 %	≤ 2 %	≤ 1 %	< 0,3 %	< 0,1 %
Net (lower) calorific value (as fired basis) ISO 1928:1995	> 28 980 kJ/kg	> 26 630 kJ/kg	> 28 500 kJ/kg	> 29 690 kJ/kg	> 29 690 kJ/kg	> 26 500 kJ/kg	≤ 21 000 kJ/kg	> 17 000 kJ/kg	$H_{uw} = (H_{uwf}(100-w)-2{,}44w) / 100$
Size, length	commercial size in accordance with manufacturer's instructions *								
Swelling index ISO 501:1981						according to manufacturer's instructions			

* A maximum of 5 % oversize and undersize only is permissible in the test fuel.

NOTE Some countries have national regulations on the type and quality (e.g. sulfur content) of fuels which have to be complied with in those countries.

In accordance with EN 12809 each heating boiler shall be permanently and legibly marked, in a place where it is accessible so that the information can be read when the appliance is in its final location, with the following minimum information:

- The number of this European standard,
- The manufacturer's name or registered trade mark,
- The measured CO concentration at 13% oxygen content,
- The model number and/or designation or type to enable the appliance to be identified,
- The nominal boiler and space heating outputs, in kW and efficiency (and range of outputs or efficiencies dependent on fuel type, as applicable); water content in litre,
- The permissible maximum water operating pressure, in bar,
- The minimum clearance distances from combustible materials, in mm, as appropriate,
- A permanent safety warning label bearing the following wording.

Remarks:

This EN 12809 standard related to residential independent boilers fired by solid fuel with nominal heat output up to 50 kW is harmonized with Council Directive 89/106/EEC of 21 December 1988. It includes quality requirements for boilers considering environmental performance of devices, but only for emission of CO. As it was specified in the description of the EN 303-5 standard, emissions of these pollutants describes quality of boilers within the scope of environmental performance. The standard should be subjected to revision amending requirements related to fuel used by tests, taking into account especially moisture contents and volatile matter contents, which have significant influence on the emission level of CO, NMVOCs, TSP (and PM) as well as POPs (i.e. PICs), hence influencing energy efficiency. Unification with 303-5 standard, concerning flue gas reference conditions (13% O_2, 10% O_2 or to introduce emission factor for the unit of heat produced MJ or GJ) for determination of emission factors, should also be taken into account. There are currently no NOx limit and introduction of such limit may not be appropriate since in the combustion temperatures of EN 12809 appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen[64].

➔ **EN 12815: Residential cookers fired by solid fuel**

Construction and safety requirements

In this standard there are specifications of the steel materials which shall be used for the manufacture particular parts of the appliance.

The appliance can be made of steel material and or of cast iron. An appliance constructed of non-alloyed steel shall have a nominal minimum thickness of 4mm for water-backed surfaces in contact with the fire or products of combustion whilst surfaces elsewhere shall have a nominal minimum thickness of 3mm. Boiler constructed of alloyed or stainless steel shall have a nominal minimum thickness of 2mm.

Boiler constructed of cast iron shall have a minimum wall thickness of 5mm. The mechanical properties of the cast irons shall meet the material requirements in accordance with Table 2 of the standard EN 12815

The safety requirements contain in this standard concern:

- Volume of limited temperature in integral fuel storage container, which shall be less 65K,
- Volume of limited temperature in of adjacent combustible materials, which shall be less 65K,
- Volume of limited temperature of operating tools (which are made of; metals, porcelains, vitreous enamel or similar materials, plastics, rubber or wood.

These temperature requirements shall be assessed with the appliance in normal operation during the nominal heat output test in accordance with Annex A of this standard.

Surface temperatures

Temperature measured in any integral fuel storage container, if provided, shall not exceed the ambient temperature by more than 65 K.

Temperature of trihedron hearth and walls or other structure surrounding the appliance e.g. ceiling comprising combustible material shall not exceed the ambient temperature by more than 65 K.

An operating tool shall be provided where it would otherwise be necessary to touch any surface having a temperature above ambient by more than the following values:

- 35 K for metals,
- 45 K for porcelain, vitreous enamel or similar materials,
- 60 K for plastics, rubber or wood.

Electrical safety

The appliance shall comply with the electrical safety requirements of EN 50165 *Electrical equipment of non-electric appliances for household and similar purposes - Safety requirements*, if mains operated electrical equipment is fitted as part of the appliance.

Performance requirements

The mean carbon monoxide (CO) concentration calculated at 13% oxygen (O_2) content in the flue gas shall be less than or equal to the manufacturer's declared value and shall not exceed 1.0%. When tested in accordance with EN 12815, the measured total efficiency (net calorific value basis) from the mean of at least test results at nominal heat output shall be greater than or equal to the manufacture's declared value and shall equal or exceed 60%. The efficiency should be determined by indirect method in accordance witch Annex A. There are currently no NOx limit and introduction of such limit may not be appropriate, since in the combustion temperatures of EN 12809 appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen[64].

Each appliance shall be permanently and legibly marked in a place where it is accessible so that the information can be read when the appliance is in its final location, with the following minimum information:

- The number of suitable European standard (in this case - EN 12815),
- The manufacturer's name or registered trade mark,
- The measured CO concentration at 13% oxygen content,
- The determined appliance efficiency at nominal heat output,
- The model number and/or designation or type to enable the appliance to be identified,
- The nominal boiler where relevant and space heating outputs, in kW (or a range of outputs dependent on fuel types, as applicable),
- The permissible maximum water operating pressure (in bar), if applicable,
- The minimum clearance distances from combustible materials, in mm, as appropriate,
- Whether or not the appliance can be used in a shared flue,
- “read and follow the operating instructions”,
- “use only recommended fuels”,
- Whether the appliance is capable of continuous or intermittent operation.

The amendment EN 12815:2001/A1:2004 adds new chapter concerning evaluation of conformity. The compliance of cooker with the requirements of this standard and with stated values (including classes) shall be demonstrated by:

- type testing,
- Factory production control by the manufacturer, including product assessment.

The test and recommended fuels with their various specifications are detailed in Annex B of the standard. In Annex C there is a figure with browning chart oven heating test.

➔ **EN 13229: Inset appliances including open fires fired by solid fuel**

Table 1-52 lists the appliances concerned by this standard.

Table 1-52: Categorisation of the appliances, showing the EN 13229 appliances

	Freestanding or inset appliances without functional modification*	Freestanding or inset appliances which have functional modification	Inset appliances for fireplace recess and enclosure
appliances operating with firedoors closed	EN 13240	EN 13229	EN 13229
appliances operating with firedoors closed or open	EN 13240	EN 13229	EN 13229
open fires without firedoors	EN 13229	EN 13229	EN 13229
*Without functional modification means a modification of the surround of an appliance, that only changes the transmission of heat, without effect on combustion.			

Construction and safety requirements

In this standard there are specifications of the steel materials which shall be used for the manufacture particular parts of the appliance. The material type and its designations are presented in Table 2 of this standard.

The appliance can be made of steel material and or of cast iron. The minimum wall thicknesses have been specified according to part destination or nominal heat output. The minimum wall thicknesses listed in Table 1-53 apply to boilers made of steel.

The minimum wall thicknesses of cast iron parts given in the production drawing presented in standard EN 13229 are in accordance with Table 1-46 and Table 1-54 which was taken from EN 12809 and EN 13240. Wearers, the minimum mechanical properties of cast irons used for parts of this appliance are in accordance with Table 1-48 and Table 1-56 with was taken also from EN 12809 and EN 13240.

In the part 5 of EN 13229 there are safety requirements which concerning the cut-off device for appliances without doors and admissible temperature in different places of appliance.

Table 1-53: Nominal minimum wall thicknesses for steel boilers, according to EN 13229

Application	Non-alloy steels [mm]	Stainless and corrosion protected steels [mm]	Non-alloy steels for appliances burning wood only and having maximum water operating pressures up to and including 2 bar [mm]
Walls of water backed surfaces of the combustion chamber in contact with burning fuel or products of combustion	5	2	3.5
Walls of convection heating surfaces outside combustion chamber (except circular tubes)	4	2	3
Circular tubes used in convection part of heat exchanger	3.2	1.5	3.2
Water cooled grate tubes	4	3	3
Surfaces other than those above	3	2	3
The nominal minimum wall thicknesses apply to pressure loaded sheets and tubes, being part of the boiler construction. The nominal minimum wall thicknesses listed above, have been specified taking into consideration the following parameters: - the permissible maximum water operating pressure (as stated the manufacturer), - the material properties, - the heat transfer location.			

Surface temperatures

Temperature of any adjacent walls and/or floors constructed of combustible materials should not exceed the ambient temperature by more than 65K.

An operating tool shall be provided where it would otherwise be necessary to touch any surface having a temperature above ambient by more than the following values:

- 35 K for metals,
- 45 K for porcelain, vitreous enamel or similar materials,
- 60 K for plastics, rubber or wood.

In case of air grilles for Kachelöfen or Putzöfen inset appliances the temperature recorded at the central flow at a distance of 15 cm from outside of the air grilles shall not be greater than 85 ºC when referenced to an ambient temperature of 25 ºC.

Electrical safety

The appliance shall comply with the electrical safety requirements of EN 50165 *Electrical equipment of non-electric appliances for household and similar purposes - Safety requirements.*

Performance requirements

This standard establishes the mean carbon monoxide (CO) content of the dry flue gas for Kachelöfen or Putzöfen inset appliances, which shall not exceed 0,2% at 13% O_2. In case of other appliances with closed door, the mean CO concentration shall be less than or equal to the manufacturer's declared value and shall not exceed 1.0% at 13% O_2. There are currently no NOx limits and introduction of such limit may not be appropriate since in the combustion temperatures of the appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen[64].

The efficiency (net calorific value basis) from the mean of last two test results at nominal heat output for Kachelöfen or Putzöfen inset appliances shall be greater than or equal to the manufacturer's declared value and shall be not less than 75% when tested in accordance with the test conditions in Annex A of EN 13229. The efficiency (on a net calorific value basis) for all other appliance types from the mean of last two test results at nominal heat output shall be greater than or equal to the manufacturer's declared value and shall equal or exceed 30%.

The efficiency should be determined by the indirect method which is presented in detail in annex A (A.6.2.1) of the standard. Moreover Annex A of the standard gives information about test procedures, requirements applying to laboratory and measurement equipment. In this Annex there are indispensables equations which are using during the calculations.

Each appliance shall be legibly marked, with the information enumerating in part 8 of this standard.

The test and recommended fuels with their various specifications are detailed in Annex B of the standard.

➔ EN 13240: Roomheaters[26] fired by solid fuel

Construction requirements

The roomheater shall be constructed from cast iron and/or steel. In this standard there are specifications of the steel materials which shall be used for the production of roomheater parts. Roomheater constructed of mild steel shall have the appropriate wall thickness set out in Table 1-54.

Table 1-54: Nominal wall thicknesses, according to EN 13240

Application	Non-alloy steels [mm]	Stainless and corrosion resistant steels [mm]
Walls of the firebox which are in contact with fire and/or water	5	3
Walls of convection heating surfaces outside combustion chamber (except circular tubes)	4	2

Application	Non-alloy steels [mm]	Stainless and corrosion resistant steels [mm]
Circular tubes used in convection part of heat exchanger	3.2	2.5
Water cooled grate tubes	4	3
Surfaces not in contact with burning fuel or products of combustion	3	2
The nominal minimum wall thicknesses apply to pressure loaded sheets and tubes other than immersion coils, safety heat exchangers. Thinner wall thicknesses are only permissible with proof of equivalent corrosion resistance, heat resistance and strength. The nominal minimum wall thicknesses listed have been specified taking into consideration: -the maximum water operating pressure (4 bar), -the material properties, -the heat transfer location.		

The mechanical properties of cast iron used for parts subjected to water pressure shall, as minimum, correspond to the values listed in Table 1-55.

Table 1-55: Minimum mechanical requirements for cast iron appliances, according to EN 13240

Gray cast iron (In accordance with EN 1561:1997)	
Tensile strength R_m	> 150 N/mm^2
Brinell hardness	160 HB to 220 HB
Spheroidal graphite iron (In accordance with EN 1563:1997)	
Tensile strength R_m	> 400 N/mm^2
Elongation	18%A_3

The wall thickness of the casting section shall be not less than the minimum thicknesses listed in Table 1-56.

Table 1-56: Minimum wall thicknesses for cast iron appliances, according to EN 13240

Nominal heat output [kW]	Grey cast iron [mm]	Spheroidal graphite cast iron [mm]
< 30	3.5	3.0
≥ 30 and < 50	4.0	3.5

The remaining data applicable to materials, design and construction of the roomheater are presented in part 4 of EN 13240. These data concern requirements of combustion air supply device, roomheater waterways systems. Safety requirement regarding to the particular parts of the appliance are described in part 5 of this standard.

Surface temperatures

If the manipulation of the operating components does not require the assistance of tools, the surface temperatures, measured only in the areas to be touched, shall not exceed the ambient room temperature by more than the following:

- 35 K for metals,
- 45 K for porcelain, vitreous enamel or similar materials,
- 60 K for plastics, rubber or wood.

Electrical safety

The appliance shall comply with the electrical safety requirements of EN 50165 *Electrical equipment of non-electric appliances for household and similar purposes - Safety requirements*, if mains operated electrical equipment is fitted as part of the appliance.

Roomheater performance requirements

This standard establishes refuelling interval at nominal heat output and at slow combustion. The values of refuelling interval on one charge of test fuel are presented in part 6.6 of EN 13240.

In the annex A 4.7 of the standard there is information referring to test methods of pollutants emission and efficiency of tested roomheater. In accordance with this standard, the mean carbon monoxide contents of the dry combustion gases shall not exceed 1% at 13% O_2. When tested in accordance with EN 13240, the measured total efficiency (net calorific value basis) from the mean of at least two test results at nominal heat output shall be greater than or equal to the manufacturer's declared value and equal or exceed 50% (on a net calorific value basis). The efficiency should be determined by the indirect method which is presented in detail in annex A (A.6.2.1) of the standard.

Each roomheater shall be legibly marked, with the minimum information enumerating in part 8 of this standard.

The amendment EN 13240:2001/A2:2004 adds new chapter concerning evaluation of conformity. The compliance of roomheater appliance with the requirements of this standard and with stated values shall be demonstrated by:

- Type testing,
- Factory production control by the manufacturer, including product assessment.

Annex A of the standard gives information about test procedures, requirements relevant for laboratory and measurement equipment. Moreover in this annex there are all equations necessary to carry on the calculations.

The standardised test fuels and their various specifications are detailed in Table B.1 of annex B of the standard. Selection, preparation and analysis of the test fuel is described in B.2 (annex B).

Remarks:

This EN 13240 standard relevant for roomheaters fired by solid fuel is harmonised with Council Directive 89/106/EEC of 21 December 1988. It includes quality requirements for roomheaters considering environmental performance of devices, but only for

emission of CO. As it was specified in the description of the EN 303-5 standard, emissions of these pollutants describes quality of roomheaters within the scope of environmental performance. The standard should be subjected to revision amending requirements related to fuel used by tests, taking into account especially moisture contents and volatile matter contents, which have significant influence on the emission level of CO, NMVOCs, TSP (and PM) as well as POPs (i.e. PICs), hence influencing energy efficiency. Unification with 303-5 standard, concerning flue gas reference conditions (13% O_2, 10% O_2 or to introduce emission factor for the unit of heat produced MJ or GJ) for determination of emission factors, should also be taken into account. There are currently no NOx limits and introduction of such limit may not be appropriate, since in the combustion temperatures of the appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen[64].

➔ **EN 14785: Residential space heating appliances fired by wood pellets**

Construction and safety requirements

In this standard there are specifications of the steel materials which shall be used for the manufacture particular parts of the appliance. The material type and its designations are presented in Table 1 of this standard.

The appliance can be made of steel material and or of cast iron. The minimum wall thicknesses have been specified according to part destination or nominal heat output. The minimum wall thicknesses listed in Table 1-57: apply to boilers made of steel.

Table 1-57: Nominal minimum thicknesses for steel appliances, according to EN 14785

Application	Non-alloy steels [mm]	Stainless and corrosion protected steels [mm]	Non-alloy steels for appliances burning wood only and having maximum water operating pressures up to and including 2 bar [mm]
Walls of water backed surfaces of the combustion chamber in contact with burning fuel or products of combustion	5	2	3
Walls of convection heating surfaces outside combustion chamber (except circular tubes)	4	2	3
Circular tubes used in convection part of heat exchanger	3.2	1.5	3.2
Water cooled grate tubes	4	3	3
Surfaces other than those above	3	2	3
The nominal minimum wall thicknesses apply to pressure loaded sheets and tubes, being part of the boiler construction. The nominal minimum wall thicknesses listed have been specified taking into consideration the following parameters: — the permissible maximum water operating pressure (as stated by the manufacturer); — the material properties; — the heat transfer location.			

The minimum wall thickness as well as minimum mechanical requirements of cast iron are the same as in case EN 12809 *Residential independent boilers fired by solid fuel - Nominal heat output up to 50 kW - Requirements and test methods,* which are presented here in Table 1-47 and Table 1-48.

Surface temperatures

The temperature of the test hearth and walls and/or any other structure surrounding the appliance comprising combustible material shall not exceed the ambient temperature by more than 65K. An operating tool shall be provided where it would otherwise be necessary to touch any surface having a temperature above ambient by more than the following values:

- 35 K for metals,
- 45 K for porcelain, vitreous enamel or similar materials,
- 60 K for plastics, rubber or wood.

Electrical safety

The appliance shall comply with the electrical safety requirements of EN 50165 *Electrical equipment of non-electric appliances for household and similar purposes - Safety requirements*, if mains operated electrical equipment is fitted as part of the appliance."

Electric demand

Each appliance should be marked with information regarding to consumption of electrical auxiliary energy.

Performance requirements

This standard establishes the mean carbon monoxide (CO) content of the dry flue gas. The mean CO concentration calculated to 13 % oxygen (O_2) content in the flue gas from the mean of at least two results shall not exceed 0,04 % (500 mg/m³) at nominal heat output and 0,06 % (750 mg/m³) at reduced heat output. There are currently no NOx limits and introduction of such limit may not be appropriate since in the combustion temperatures of the appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen[64.]

The measured total efficiency (net calorific value basis) from the mean of at least two test results at nominal heat output and at reduced heat output shall be at least 75 % at nominal heat output and 70 % at reduced heat output (on a net calorific value basis).

The efficiency should be determinate by the indirect method which is presented in detail in annex A (A.6.2.1) of the standard. Moreover Annex A gives information about test procedures, requirements applying to laboratory and measurement equipment. In this Annex there are indispensables equations which are using during the calculations.

Each appliance shall be legibly marked, with the information enumerating in part 8 of this standard.

The test and recommended fuels with their various specifications are detailed in Annex B of the standard.

➔ EN 15250: Slow heat release appliances fired by solid fuel

Construction requirements

This standard does not cover detailed information on the wall thickness and types of materials for manufacturing. Design is described very generally and states:

Shape, dimensions of device elements and outfit as well as design and assembly methods shall assure that under operations during the testing according to presented standard the appliance will operate reliably and safely so that under regular operations there is no risk of flue gas and/or glow release.

The safety requirements contained in this standard concern:

- Temperature rise in the fuel storage container and operating components,
- Temperature of adjacent combustible materials,*
- Electrical safety in accordance to EN 50165.

When tested in accordance with annex A of this standard, the temperatures measured in fuel storage container shall not exceed the ambient room temperature by more than 65K. If manipulation of the operating components does not require the assistance of

tools, the surface temperatures, measured only in the areas to be touched, shall not exceed the ambient room temperature by more than the following:

- 35 K for metal,
- 45 K for porcelain, vitreous enamel or similar materials,
- 60 K for plastics, rubber or wood.

Surface temperatures

Because the entire heat dissipating surfaces of the appliance including the flue spigot/socket and the flue gas connector are working surfaces, there is no requirement for limiting the surface temperature of the appliance.

Temperatures measured in the fuel storage container shall not exceed the ambient room temperature by more than 65 K.

If the manipulation of the operating components does not require the assistance of tools, the surface temperatures, measured only in the areas to be touched, shall not exceed the ambient room temperature by more than the following:

- 35 K for metal,
- 45 K for porcelain, vitreous enamel or similar materials,
- 60 K for plastics, rubber or wood.

If these temperatures are exceeded, the manufacturer shall indicate in the instructions the need to use an operating tool. This tool shall be supplied with the appliance.

Electrical safety

The appliance shall comply with the electrical safety requirements of EN 50165 *Electrical equipment of non-electric appliances for household and similar purposes - Safety requirements* if mains operated electrical equipment is fitted as part of the appliance.

Performance requirements

In accordance with this standard the mean carbon monoxide (CO) concentration calculated at 13% oxygen (O_2) content in the flue gas shall be less than or equal to the manufacture's declared value and shall not exceed 0.3%. There are currently no NOx limits and introduction of such limit may not be appropriate since in the combustion temperatures of the appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen[64].

The measured total efficiency (net calorific value basis) from the mean of at least two test results shall be greater than or equal to manufacturer's declared value and shall equal or exceed 70%. In accordance with this standard the efficiency is calculated by indirect method.

In annex A of this standard there are test methods. These methods concern measurement equipment and give calculation equations which are needed to determinate volume of carbon monoxide and efficiency performance.

Annex B of this standard refers to test fuels specifications.

➔ **EN 15270: Pellet burners for small heating boilers**

Construction and safety requirements

In this standard there are general information concerning quality of materials using to production pellet burners. It does not define minimum wall thicknesses and type of materials, but describes materials requirements which have to be fulfilled to assure safety and functionality of the appliances. The materials which can be used as lining and insulation of firebox are characterized in annex B.

Detailed information relevant to the equipment of pellet burners is presented further. This part of EN 15270 gives requirement applying to:

- Motors and fans,
- Burners controls,
- Ignition devices,
- Fuel hopper,
- Cell feeder or fire damper,
- Water sprinkler system,
- Interface to boiler.

Moreover this standard defines device safety requirements. These requirements contains three safety levels (A, B, C) with are described in clause 5.2. This part mentioned of risk analysis applying to:

- Back burning,
- Interruption of fuel supply,
- Leakage of combustion product,
- Electrical parts.

Performance requirements

This standard establishes allowable emissions of carbon monoxide (CO), organic compound (OGC) and dust in five classes. There are currently no NOx limits and introduction of such limit may not be appropriate since in the combustion temperatures of the appliances "thermal nitrogen" is not formed and NOx comes from the fuel nitrogen[64]. The test methods for determination of pollutants emission is presented in clause 6.6.2.2 for maximum test output and in clause 6.6.2.3 for minimum heat input. The burner has to meet the emission limits for all three parameters of Table 1-58 appropriate to the emission class.

Table 1-58: Emission classes according to EN 15270

Emission class	Emission limits at 13% O_2* [mg/m^3]		
	CO	OGC	dust
1	15 000	1750	200
2	5 000	200	180
3	3 000	100	150
4	1 000	75	75
5	500	50	30
* referred to dry exit flue gas, 0°C, 1013 mbar			

The emission classes given in the table above only refer to the burner in isolation out-with a boiler to which it may be matched. Only when the burner is sold as a unit with a

boiler can the combined unit's nominal heat output, efficiency and emission values be measured.

Besides emission class this part of the presented standard gives information concerning to:

- Proportion of unburned fuel in the residue,
- Excess air ratio,
- Electrical consumption,
- Start ignition,
- Noise.

In the clause 6 there are testing requirements with regards to:

- Test boiler rig,
- Test fuel,
- Measurement and calculation parameters of measurement accuracy.

The part 7 of the EN15270 brings information about established marking of the burner. A large majority of marking requirements is the compliant with the one described in EN 303-5.

In Annex C there are requirements for electronic burner start up functions and pellet air ratio controls. The Annex D and E of the standard are connected with clause 5.2 and they bring example of risk assessment during the burner works. The Annex G includes in detail measurement methods for some physical parameters. The Annex H includes a description of method calculation of organic gaseous compounds (OGC).

1.4.5. EXAMPLES OF "HEATING SOLUTION PRODUCTS"

A number of manufacturers offer advanced "heating solution products" i.e. heating system which can be purchased as a one integrated package. Such systems may be built around a solid fuel combustion installations (e.g. a boiler) combined with other fuels resources (diesel fuel, natural gas, LPG, electricity and solar energy).

Figure 1-25 presents a relatively simple example of such a system, comprising of a wood/pellet-burning firebox with a traditional gas boiler to supply low-temperature heat for floor-heating and at a fixed location for towel warmers. This version includes a pre-assembled unit connected to an outdoor probe; an ambient control unit; the gas boiler for integrated production of hot domestic water; the wood, wood-pellets or pellet-burning firebox; two heating circuits of which one has a variable temperature and one a fixed and direct temperature.

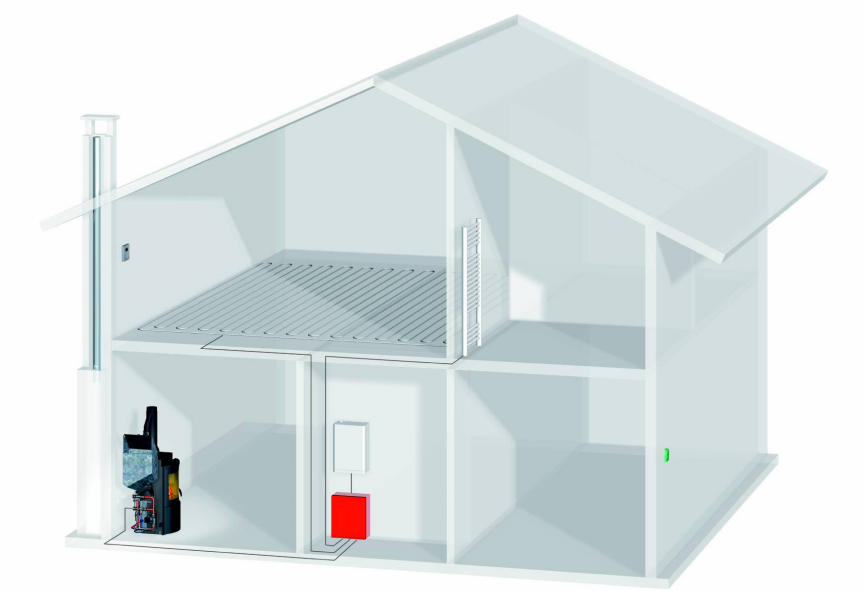


Figure 1-25: Choro Easy heating system by Palazzetti

An example including a solar panel for the production of hot water for domestic use is depicted in Figure 1-26.

Such integrated heating system solutions may well be a "commercial product" (i.e. it is a ready solution provided as a package) but it is not considered to be a product from the point of view of Lot 15 study. The solid fuel combustion appliance is only a small part of the overall heating system, other parts of which are or may be covered by separate EuP preparatory studies (e.g. the gas/oil/electric boilers and water heaters are already covered by Lot 1 and 2, respectively).

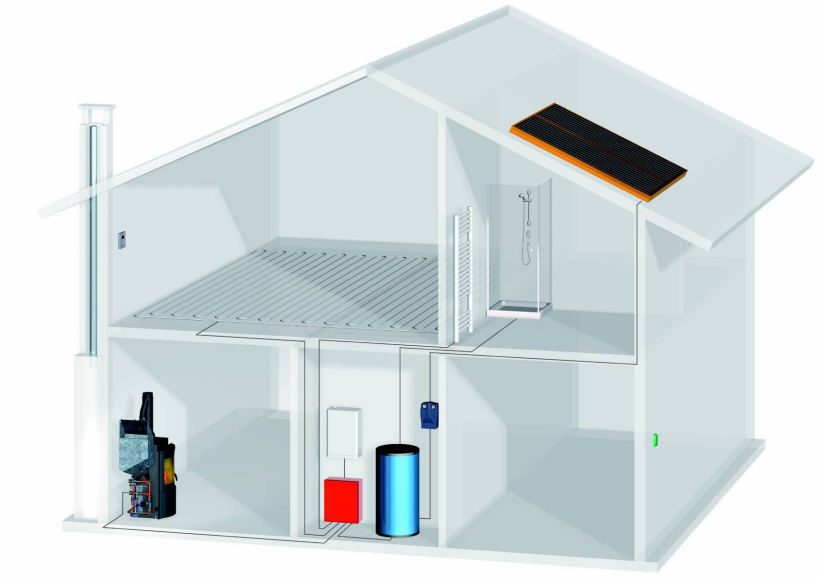


Figure 1-26: Choro Plus heating system by Palazzetti