Nordic Ecolabelling of stoves
Background document

Version 3.0, 12 October 2010

Nordic Ecolabelling

In November 1989, the Nordic Council of Ministers adopted a measure to implement an official voluntary ecolabelling scheme, the Nordic Ecolabel, also known as the Swan. The organizations/companies listed below administer the Nordic Ecolabelling scheme on assignment from their national governments.

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Criteria for stoves
078/Version 3.0

Summary

Nordic Ecolabelled stoves are intended for use with solid biofuels, i.e. wood, pellets or other biofuels. A biofuel, when burnt, releases an amount of carbon dioxide equivalent to the CO2 absorbed during its growth cycle and is thus considered to be carbon neutral, leading to a limited "global warming" impact.

Life cycle analyses show that the dominant environmental impact occurs during use of stoves.

Stricter requirements, mainly with regard to emissions and energy efficiency, are proposed in this revision. Emissions have a negative impact on health and the amount of particles emitted varies greatly between different types of stove. Additionally do we stricter requirements on used chemicals thorough to restrict a possibility to use chemicals with risk phrases. We add also the duty for documentation for manufacturer considering information on which suppliers they use with buying of chemical products.

A review of recorded values for emissions and efficiency of Nordic Ecolabelled stoves shows that introducing more stringent requirements compared to criteria version 2 is technically possible - that is, eco-labelled products can achieve a possible 30% share of the Nordic market following a tightening of the requirements. A part which meets requirements is some higher for wood stoves for temporary firing. This should be considered in light of the stringent requirements imposed in other European countries and by the EU's RES Directive on promoting the use of renewable energy (2009/28/EC) as well as the forthcoming EuP Directive. In addition, the German Blue Angel and Austria's ecolabelling scheme (Umweltzeichen) have both adopted stricter requirements.

Nordic Ecolabelling has, as a consequence of the information gathered on Nordic Ecolabelled stoves, chosen to increase the stringency of emissions requirements. For hand fed stoves these include specification of levels of OGC (Organic Gaseous Carbon) according to DIN+ norms, as well as new stricter requirements for CO and particle emissions. Nordic Ecolabelling emissions standards for mechanically fed stoves and wood stoves for continuous firing are higher than for wood stoves for temporary firing and inset stoves.

In addition, higher standards of efficiency for hand fed stoves are proposed, leading to a requirement of at least 75% efficiency for both wood stoves for temporary firing and inset stoves. The efficiency requirement for mechanically fed stoves and wood stoves for continuous firing is set at 85% and for slow heat release stoves at 83%.

In this revision Nordic Ecolabelling proposes higher standards than are required in the forthcoming EuP Directive. This means that 54% of wood stoves, and 40% of inset stoves, currently in the Nordic Ecolabelling scheme already meet specified requirements in criteria version 3 in relation to emissions and efficiency.

Nordic Ecolabelling intends, in line with the RES directive relating to EU activities promoting renewable energy sources, to consider the feasibility of requiring higher efficiency standards for all types of stove in the future. None of the current Nordic Ecolabelled wood stoves meet the required standards for emissions and efficiency (85%). It may only be possible for a handful of Nordic Ecolabelled wood stoves for continuous firing or pellet stoves to be able to meet these stricter requirements (85%). Since so very few wood stoves for continuous firing have the potential to achieve the 85% efficiency specification, Nordic Ecolabelling has chosen to introduce the 85% efficiency requirement for these stoves in the current revision.

New requirements have also been placed on the production of stoves, constituent materials and chemicals, surface treatments as well as on waste management.

A quality standard for reliability has also been considered. It places requirements on the durability of a stove's interior, as well as stipulating desirable durability standards for an entire stove.

The latest methods of testing have been observed when performing tests of stoves.

Installation and operating instructions have been clarified.

Basic facts about the criteria

Products that qualify for labelling (product group definition)

The product group includes a range of differing products, but all are stoves fired on solid biofuels, and are designed to be placed in an interior space and which, when in operation, emit a radiant heat. These are "**enclosed stoves"**, which means that the burning fuel is contained within an enclosed space or fire chamber. Inset stoves, wood stoves, sauna stoves and slow heat release appliances, such as tile or stone-clad stoves, all belong to this product group. The stoves can also be connected to water or air-borne central heating systems.

Products qualifying for Nordic Ecolabelling are fired on solid biofuels such as wood, pellets or other biomass derived fuels. Stoves fired on liquid biofuels are not included in the product group. Open fireplaces, where the fire burns in an open space, are also not included in the product group.

A stove heats the room in which it is placed directly. One option is for a stove to have a water-jacket. These can provide both room heating and hot water at the same time, but may be used even with an empty water tank. They are tested according to the same method as standard stoves and are not defined as slow heat release stoves.

Those stoves, such as tile stoves, that store heat in a water reservoir do meet the definition of slow heat release appliances. These differ from water-jacketed stoves since they cannot be fired without water in the reservoir.

Stoves can either be fed mechanically or by hand. The term "mechanically fed stove" refers to pellet stoves.

The criteria for enclosed stoves apply to stoves used both as direct heat sources and as part of a heat distribution system. As a rule, a room heating stove does not provide the majority of a building's heating requirement. Certain room heating stoves are designed for only occasional use, while others can be operated continuously. Stoves meant for continuous use are often highly efficient and are significantly more expensive than stoves manufactured for occasional use only.

In energy efficient houses, however, a stove may cover all heating needs as well as meeting highly demanding environmental standards. Such a stove could, for example, be a water-jacketed stove connected to a solar thermal collector. Solar powered water heating panels provide hot water in the summer when high room temperatures prevent the use of the stove. Solar thermal collectors delivered together with a stove must be approved according to the appropriate EN standard (see Section 9).

The stoves are dealt in the criteria document in several groups which are based on their function as follows:

- A slow heat release appliance is a stove which stores heat usually in stone but in certain cases stores heat in the water reservoir.
- A hand fed stove for temporary firing is a stove which has be manufactured for to replenish the other heat source. A that kind of stove must not be fired round the day.
- A hand fed stove for continuous firing is a stove which can be fired round the day and which can be function as a main heat source e.g. in the low energy house. A that kind of hand fed stove is usually water-jacketed.
- A mechanically fed stove has been manufactured for pellet firing.
- An inset stove for open firing place.
- A sauna oven is wood fired sauna stove.

Justification for Nordic Ecolabelling

Nordic Ecolabelled stoves are intended for use with solid biofuels, i.e. wood, pellets or other biofuels. A biofuel, when burnt, releases an amount of carbon dioxide equivalent to the CO_2 absorbed during its growth cycle and is thus considered to be carbon neutral.

Life cycle assessments[1,2] show that a stove's environmental impact is greatest during the use phase due to the emissions it produces. Requirements have, therefore, been focussed on the issue of emissions. The Norwegian study to which we refer concerns

[1] Solli, Chr. et al. "Life Cycle Assessment of Wood Based Heating in Norway" Int J Life Cycle Assess
[2] Cleaner Product Development Based on Life Cycle Assessment: Lithuanian Experience", Jurgis Staniskis, Visvaldas Varzinskas, Institute of Environmental Engineering (APINI), Kaunas University of Technology, 2005

"input-output" data with a focus on the production of birch firewood (forestry management and logging, timber processing and transportation to the consumer) as well as production and day-to-day operation of a stove. Results showed that the use phase accounts for just over 60% of a stove's environmental impact. The adoption of new stove technology leads to a marked improvement (28-80%) for all of the environmental impact parameters studied.

Limits on the use of chemicals in stove production are also contained in the criteria. These requirements have been introduced in order to prevent unnecessary environmental contamination. The environmental impact of stove manufacturing varies depending on the material used, partly as a result of the amount of energy required for production. Material choices are also critical for stove characteristics such as durability, heat transfer and thermal efficiency. There are presently no express prohibitions on the use of certain types of material in stove manufacture (for example cast iron, steel, ceramic tiles etc.), but relevant data on production techniques and energy consumption is to be reported in order that material requirements may be considered at the next criteria review.

Substances with adverse effects on health, e.g. carcinogens and nitrogen oxides, are formed during the combustion process. These particles can cause cancer, adversely affect breathing and contribute to heart and lung diseases. Nitrogen oxides, NOx, are a contributor to the creation of ground-level ozone, to eutrophication and increased acidification of land and water, and can also irritate respiratory airways and lead to impairment of the immune system. Levels of emissions are especially high when combustion is poor. Measuring the concentration of carbon monoxide, CO, is one means of determining the quality of combustion. Biofuels are classed as carbon neutral, but methane, a greenhouse gas twenty-one times more powerful than carbon dioxide, is released when combustion is poor. Dust (fly ash) and OGC (Organic Gaseous Carbon - hydrocarbons expressed as organic gaseous carbon), in addition to NOx and CO concentration and particle emissions, are among the parameters regulated by labelling rules and public authorities . Fly ash is a combination of the residues from incomplete combustion (soot) and non-combustible substances. Different methods of measurement are used for particular parameters.

Local authorities have the powers to limit the use of stoves, and do so in several urban areas. Nordic Ecolabelling, by setting a clear standard for emissions and illustrating differences in regards to emissions between stoves, has an important role to play in providing information for selecting which stoves are to be preferred in built-up areas.

Use of biofuels ameliorates the greenhouse effect by reducing the consumption of electricity and fossil fuels. Stoves are, therefore, to be preferred due to the fact that they help to reduce the impact of global warming. It is vital that biofuels are utilised as effectively as possible since they are less energy efficient that fossil fuels. Moreover, there is expected to be great demand for biofuels in the future. It is, therefore, especially important that energy efficiency requirements are set very high for the use of stoves.

Criteria revision and validity

The criteria were adopted for the first time on the 6 June 2001 and this version 1.0 was valid until the 5 June 2004.

On the 15 June 2003 the criteria were extended to include wood burning sauna stoves, and amendments were made to Section 7.3.3 "Alternative test methods". The period of validity for version 1.1 was extended to June 2005.

The criteria were evaluated in the autumn of 2004 and a few minor changes were made. The documentation requirement regarding emissions was adjusted and an option of using alternative methods of measuring was introduced, version 1.2.

On the 10 May 2005 the period of validity for the criteria was extended to the 3 March 2007, version 1.3. Revised criteria, version 2.0, were adopted on the 23 March 2006, with a period of validity stretching to March 2009.
This review resulted in more stringent emissions standards.

On the 6 February 2008 the period of validity for the criteria was extended by a year, running to March 2010.

A new method of measurement, with another threshold value for particle emissions for slow heat release stoves, was introduced in paragraph R19 on the 3 December 2008. The designations of several designated methods were amended at the same time. The period of validity for the criteria, version 2.2, was extended, by a year, to March 2011.

A version 3 was confirmed 12th October 2010. In this revision it was restricted requirements of air emissions and efficiency. It was set the new requirements on manufacture of stoves, including materials and chemicals, surface treatment and waste treatment. Actual test methods were considered and instructions of installation and operation were clarified.

The Nordic Market

Two licenses had been issued for the product group at the time of 2005 revision of the criteria. A Swedish licence for pellet stoves and Danish licence for wood stoves. There are now, for version 2 of the criteria, 15 Nordic Ecolabelling licences covering many types of stove, see Table 1.

In recent years an intense discussion has been conducted in the Danish media concerning the health risks associated with particle emissions. The Nordic Ecolabelling scheme was called into question, and critical voices were raised regarding ecolabelling of solid biofuels.

The National Environmental Research Institute in Denmark has performed regular tests of emissions from stoves in residential areas and published a number of reports[14]. The Danish Environmental Protection Agency has drafted a new policy document for

[14] From the report “Partikler og organiske forbindelser i træfyring” working report from DMU nr. 235

the regulation of air pollutants from installations such as stoves and boilers. Tougher regulations regarding particle emissions from stoves (intended for heating) are introduced. Executive Order (Bek. No. 1432) came into force on the 1 January 2008.

Ecolabelling Denmark, in co-operation with the Danish Environmental Protection Agency, mounted in 2007/2008 a countrywide campaign with the slogan "Burn fuel sensibly" in which Ecolabelling Denmark distributed informational literature about Nordic Ecolabelled stoves. The campaign captured the attention of the national media.

Table 1: Overview of licensing and registration of stoves (criteria version 2), 31 August 2010.

License holder	Wood stove	Pellet stove	Slow heat release stove	Registrations in Finland	Registrations in Sweden	Registrations in Norway	Registrations in Denmark
Danish							
Varde ovne A/S	X				X	X	
Rais A/S	X			X	X	X	
Aduro A/S	X			X	X	X	
Morsö Jernstöberi	X				X	X	
Lotus Heating System	X				X		
Hwam AS	X			X	X	X	
Scan A/S	X			X	X	X	
Thermatek A/S	X					X	
Hunter Stoves Ltd	X						
Jydepejsen A/S	X					X	
Norwegian							
Jötul AS	X				X		x
Swedish							
Narvells AB / Wodtke		X					
Nibe AB Brasvärme	X			X		X	
Specht GmbH & Co	X						
Kakelugngspanna AB			X			X	

The Nordic market for stoves comprises Nordic manufacturers and importers of wood and pellet stoves. The wood stove is a traditional product, and there are still factories in operation making cast-iron stoves. In recent years a number of producers have started to make stoves from steel sheets of varying thickness and quality. Stove manufacturers in the Nordic countries seem to co-operate successfully in smaller industry associations, even over national borders.

Wood and pellet stoves are normally sold in shops specialising in stoves or in builder's merchants or they are delivered to the building project directly from the manufacturer.

Stoves are sold to private customers for home installation or directly to building projects where wood and pellets stoves are included as part of the fitted equipment.

Current stove installations in the Nordic countries are as follows.

Table 2: Overview of installations of stoves in the Nordic countries.

Country	Number of installations
Denmark	550,000
Finland	744,500 (including 478,000 stoves in holiday homes)
Norway	1,243,700 (Fireplaces: 106,400, enclosed stoves, outdated technology 688,500 and enclosed stoves, clean-burning 448,800)*
Sweden	992,000
Total	

* Statistics Norway, 2007. The number of cottages and holiday homes comes to 394,102 and stoves installed in these are included in the statistics.
http://www.ssb.no/magasinet/miljo/ttab-2007-11-05-01.html

According to Statistics Sweden (SCB) there are circa 1.4 million biofuel burning units installed in Swedish homes (2005), but only 0.992 million of these are in regular use, of which 7% are pellet stoves, 8% slow heat release stoves, 62% ordinary stoves and 23% wood boilers (of which, in turn, 15% are old models without accumulator tanks, 1% are old models with accumulator tanks and 7% modern boilers with accumulator tanks).

Firewood consumption declined in Norway by 10% from 2006 to 2007. This could be due to an increased use of clean-burning stoves that are able to give out more energy per kilogram of wood. It has been calculated that 42% of all firewood consumed is burnt in clean-burning stoves[3]. Given a degree of energy efficiency of 40 per cent for traditionally designed enclosed stoves, 75 per cent for enclosed stoves equipped with new technology and 15 per cent for open fires, firewood consumption in Norway is calculated to generate 3.1 TWh for 2007.

Sales figures for the Nordic market are approximate. Sales in Sweden totalled 40,000-50,000 units in Sweden. During 2007 stoves were sold for a value of around 120-150 million euro in Finland. In Norway 60,000-70,000 units are sold per year. In Denmark it is estimated that 7-8% of all installations are replaced with new stoves each year.

A majority of the Nordic countries have adopted revised technical specifications that place more stringent requirements on the energy efficiency of buildings and the choice of energy source. These developments, alongside recent greater public interest in environmental issues and the threat of climate change, have encouraged the launching of new heating systems on to the market. With these new systems it is possible attach a stove to a hot water heating system, or to a solar thermal collector, that meets heating needs during the sunnier periods of the year. Stoves have been developed that can heat up to four different rooms on each floor of the house at the same time. The stove is set into a "heating pipe" around which the rooms are built. In this way, the stove can serve as the primary heating source for the building. By building venting systems that spread warm air from the stove via ventilation channels or floor pipes, the stove can be used as the heating source for a central heating system.

[3] Statistics Norway see: http://www.ssb.no/magasinet/miljo/tab-2007-11-05-02.html (visited 2009.11.30

Other labels

Three other certification schemes with energy efficiency and emissions requirements as their main parameters – quality standard P-mark, the German environmental label Blue Angel and the Austrian environmental label Ummweltzeichen - are described below. Different standards for measuring emissions are employed; in some cases measurements are required at nominal (actual) heat output, in some cases at partial heat output and, in some cases, at both nominal and partial heat output. Measurements are usually made at 13% O_2. Version 2 of the Nordic Ecolabelling criteria contains requirements regarding emissions of OGC (organic gaseous carbon), CO and particles as well as energy efficiency standards. Blue Angel and Ummweltzeichen set additional requirements regarding the emission of NOx (nitrogen oxides).

None of other label has a requirement on use of chemicals or duty of information on suppliers. It is still usual that the requirement of durability according to notices in standards is included.

P-mark

The so-called P-mark is a voluntary certification scheme administered by SP Technical Research Institute of Sweden. SP's own home page[4] describes the standards required by their certification in the following way: "To get a product P-marked, it has to pass a type test. The manufacturer's inhouse inspection is also reviewed by our auditors. The requirements are set up in certification schemes, individual for each product type. The certification schemes are based on national or international standards, in order to fulfil national and legal requirements." Five manufacturers have at present chosen to P-mark certify their stoves. Several wood stoves and a pellet stove are P-mark labelled. Two of these manufacturers currently label their stoves with the Nordic Ecolabel. Rules regarding P-mark labelling of stoves have not been revised since 2002. The following requirements must be met:

Table 3: Emission requirements for P-mark labelling of stoves.

	Wood stoves: (13% O_2) EN 13240	**Pellet stoves: (13% O_2) EN 14785 (SP2453)**
CO	O, 3% / 3750 mg/m^3	1455 mg/m^3
OGC*	< 200 mg/m^3 (CEN/TS 15883, SP1695)	55 mg/m^3 (CEN/TS 15883, SP1695)
Particle emissions	separate test points < 100 mg/m^3 (NS3058, NS3059)	separate test points < 100 mg/m^3 (NS3058, NS3059)
Energy efficiency	>70%	minimum 75% at 3-5 kW

* Organic gaseous carbon

The P-mark rules (SPCR 134) cover wood-burning room-heating stoves such as wood stoves, inset stoves, inset stoves with frame, kitchen ranges and ceramic tile stoves. Room-heating stoves that provide hot water are also covered by the regulations, whereas heavy slow heat release stoves (tiled stoves) fall outside their scope. The scope of the regulations also stretches to connecting pipes between stove and chimney or flue pipe if they are delivered together with the stove with the purpose of room heating, but stops short of venting systems and accompanying components for managing air-flow. The requirements placed on a P-mark labelled room heating

[4]SP, Technical Research Institute of Sweden. See: http://www.sp.se/en/units/certification/product/p_mark/Sidor/default.aspx (visited 2010.03.30).

stove concern emissions and efficiency (see table 3), construction, safety, technical documentation and the contents of operating instruction, as well as quality assurance in the manufacturing process.

There are also rules for pellet stoves (SPCR 093) with a specified output of a maximum 15 kW. These regulations also apply to pellet stoves with boilers. The rules do not extend to external fuel feeding systems, which may, for example, transport fuel from a storage place to the stove. Flue pipes are not covered by the rules.

Blue Angel

The criteria for labelling a pellet stove with the Blue Angel environmental label are contained in a document entitled Wood-Pellets stoves RAL-UZ 111[5]. The Blue Angel label is presently used by four manufacturers for a number of pellet stoves. One of these also bears the Nordic Ecolabel.

Blue Angel's requirements correspond to those of the Nordic Ecolabel in regard to emissions of carbon monoxide, OGC and particles and as concerns energy efficiency, which is tested at several levels of heat output. In addition, the Blue Angel label has requirements concerning nitrogen oxides. Standards for emissions and energy efficiency required by the Blue Angel label are very high and are significantly more stringent than those set by the Nordic Ecolabel (version 2).

Table 4: Blue Angel's requirements regarding pellet stoves, tested according to DIN 18894 (EN 14785).

	Nominal heat output	Partial heat output
Energy efficiency	≥ 90%	≥ 90%
Nox	≤ 150 mg/Nm^3	
CO	≤ 180 mg/Nm^3	≤ 400 mg/Nm^3
OGC	≤ 10 mg/Nm^3	≤ 15 mg/Nm^3
Particle emissions	≤ 25 mg/Nm^3	-

Umweltzeichen 37 in Austria

The criteria for the Austrian environmental label are documented in Austria's Ummweltzeichen 37, wood heating[6]. The label is presently used by ten different manufacturers of wood burning stoves and heaters. One of these stoves also bears the Nordic Ecolabel. The Austrian environmental label has requirements that correspond to those laid out by the Nordic Ecolabel in regard to emissions of carbon monoxide, OGC and particles and as concerns energy efficiency, which is tested according to several levels of heat output. In addition, the label has requirements concerning nitrogen oxides. The standards for emissions and energy efficiency required are set very high and significantly more stringent than those laid down by the Nordic Ecolabel (version 2.2).

[5] www.blauer-engel.de (2008-03-28)
[6] http://ecolabelling.org/ecolabel/sterreichisches-umweltzeichen-austrian-ecolabel

Table 5: The Austrian Environmental label's requirements for room heating stoves, tested according to EN 13240.

5a) For mechanically fed stoves

Mechanically fed stove	Nominal heat output	Partial heat output
Efficiency	≥ 90 %	-
NOx	≤ 100 mg/MJ (≈150 mg/Nm^3)	
CO	≤ 120 mg/MJ (≈180 mg/Nm^3)	≤ 265 mg/MJ (≈397 mg/Nm^3)
OGC	≤ 6 mg/MJ (≈9 mg/Nm^3)	≤ 10 mg/MJ (≈15 mg/Nm^3)
Particles	≤ 20 mg/MJ (≈30 mg/Nm^3)	-

5b) For hand fed stoves

Hand fed stove	Nominal heat output
Energy efficiency	≥ 80%
NOx	≤ 120 mg/MJ (≈180 mg/Nm^3)
CO	≤ 700 mg/MJ (≈1050 mg/Nm^3)
OGC	≤ 50 mg/MJ (≈75 mg/nm^3)
Particles	≤ 30 mg/MJ (≈45 mg/Nm^3)

Legal requirements

The RES Directive

On the 17 December 2008 the European Parliament voted to adopt the European Commission's proposed directive on renewable energy sources *(2008/0016(COD), Energy and climate change: promotion of the use of energy from renewable sources RES-E).* The RES Directive was published in June 2009 and enters into force eighteen months after the date of publication. The RES Directive is part of the EU's climate and energy reform package, which has the objective of increasing the share of the EU's energy consumption generated from renewable sources to 20 per cent by 2020. The path towards achieving this common goal of 20 per cent of energy coming from renewable sources is laid out by assigning goals for each member country. The RES Directive also contains an objective of increasing biofuels share of the transport sector's energy consumption to 10 per cent.

There is also guidance contained in the directive regarding how member countries can act to support purchasing of products that increase the use of renewable energy sources. In regard to use of biofuels those heating appliances with a degree of energy efficiency of over 85% are to be promoted by, for example by financial support systems. Article 13, paragraph 6[7] reads:

> With respect to their building regulations and codes, Member States shall promote the use of renewable energy heating and cooling systems and equipment that achieve a significant reduction of energy consumption. Member States shall use energy or eco-labels or other appropriate certificates or standards developed at national or Community level, where these exist, as the basis for encouraging such systems and equipment.

[7] DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

> In the case of biomass, Member States shall promote conversion technologies that achieve a conversion efficiency of at least 85% for residential and commercial applications and at least 70% for industrial applications.

The Directive is not yet implemented in the individual Member States. The deadline for implementation has been set to December 2010. This creates an uncertainty as to whether the Nordic countries will adopt an energy efficiency requirement for stoves of 85% or above.

The Ecodesign Directive

EuP Directive (Ecodesign for Energy-Using Products) sets out regulatory requirements for stoves. The Directive establishes requirements regarding emissions and energy efficiency. The criteria for stoves are contained in the report of the LOT 15 study group[8], ”Solid fuel small combustion installations” and covers use of both fossil (e.g. coal) and biomass based fuels. The LOT 15 report deals with emissions of particles, CO, OGC, SO_2 and NOx. Methods of measurement used in the report conform to those laid out in EN standards for various types of stove as well as DIN+ methods.

BAT criteria for stoves are also evaluated. The preparatory study was scheduled to be finalised in September 2009, but publication was subsequently postponed to December of that year. The preparatory study will provide the information necessary for the following 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 EuP". These requirements will be settled upon at a later stage.

RoHS Directive and REACH Regulations

The RoHS Directive (*Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment*) (2002/95/EU) places limits on the use of dangerous substances in electrical and electronic installations. The RoHS Directive is **not** considered to place any regulatory requirements on stoves.

A list of hazardous substances is contained in the REACH Regulations *(Registration, Evaluation, Authorisation and Restriction of Chemicals)* (Nr.C 1907/2006), which draws upon the European Chemical Agency's (ECHA) "candidate list" of substances that have been identified as ”Substances of Very High Concern (SVHC)”. (http://echa.europa.eu/chem_data/candidate_list_en.asp" The candidate list is published by the ECHA and the substances on the list will be subject to regulation once their status as hazardous substances had been confirmed by the European Commission. The REACH system possesses regulatory authority.

Austria

Austrian regulatory requirements are similar to those contained in the Nordic Ecolabel criteria, both in regard to emissions of carbon monoxide, OGC and particles and as concerns energy efficiency, which is tested according to several levels of heat output.

[8] Preparatory Studies for Eco-design Requirements of EuPS, Solid Fuel Small Combustion Installations, i.e. Lot 15

Nitrogen oxides are also subject to environmental regulation. Regulatory requirements for CO and OGC are about on same level as requirements laid down by Nordic Ecolabel, version 3 for wood stoves and pellet stoves. The requirement of particles is easier than requirement for Nordic Ecolabel, version 3. The regulatory requirement of efficiency is more stringent for wood stoves and easier for pellet stoves than the requirement laid down by Nordic Ecolabel version 3. See chapter 10.3

Requirements are applied to both hand fed wood stoves and mechanically fed pellet stoves.

Table 6 Regulatory requirements in Austria (Art.15a B-VG), tests are carried out according to EN 13240 for hand fed stoves and EN 14785 for mechanically fed stoves.

	Hand fed stove	**Mechanically fed stove**
Energy efficiency	≥ 78%	≥ 78%
Nox	≤ 150 mg/MJ (≈225 mg/Nm^3)	≤ 150 mg/MJ (≈225 mg/Nm^3)
CO	≤ 1100 mg/MJ (≈1650 mg/NM^3)	≤ 500 mg/MJ (≈750 mg/Nm^3)
OGC	≤ 80 mg/MJ (≈120 mg/Nm^3)	≤ 40 mg/MJ (≈60 mg/Nm^3)
Particle emissions	≤ 60 mg/MJ (≈90 mg/Nm^3)	≤ 60 mg/MJ (≈90 mg/Nm^3)

Germany

The regulatory requirements of the German authorities cover emissions of carbon monoxide, particles and energy efficiency, which are tested at several levels of heat output.

The regulatory requirements of efficiency, CO and particles are about on the lower level than the requirements laid down by Nordic Ecolabel version 3 for slow heat release appliances and wood stoves. The requirements of CO and particles are more stringent for pellet stoves than those laid down by Nordic Ecolabel version 3. The regulatory requirement for efficiency lies about at the same level as the requirement for Nordic Ecolabel version 3 for pellet stoves. See chapter 10.3.

German regulatory requirements (BimmSchV Stufe1, valid until 31.12.2014) are as follows:

Table 7. Regulatory requirements in Germany, tested according to EN 15250 for slow heat release stoves, EN 14785 for pellet stoves and EN 13240 for wood stoves

	Slow heat release stove	**Pellet stove**	**Wood stove**
Energy efficiency	≥ 75%	≥ 85%	≥ 73%
CO	≤ 2000 mg/Nm^3	≤ 400 mg/Nm^3	≤ 2000 mg/Nm^3
Particle emissions	≤ 100 mg/Nm^3	≤ 50 mg/Nm^3	100 mg/Nm^3

The Nordic Countries

The Danish Ministry of the Environment's guidelines for stoves stipulate two alternative requirements for particle emissions (Executive Order no. 1432):

Table 8. Danish regulatory requirements for stoves

Stoves	Particle emissions	Test method
Particles I	10 g/kg fuel (average value) 20 g/kg fuel (individual test)	NS 3058, NS 3059
Particles II	≤ 75 mg/Nm^3	DIN EN 13240

There are no regulatory requirements for emissions or energy efficiency in Finland. Regulations regarding emissions and energy efficiency have been drafted in 2006 (Building Regulations D8). Finnish authorities are awaiting the results of the EuP process before finalising the adoption of the D8 regulations.

In Norway requirements are placed on particle emissions (SBE 2007, §8-51) from stoves.

Table 9. Norwegian regulatory requirements for stoves

Stoves	Particles, average value	Test method
For stoves with catalytic converter	5 g/kg fuel (average value)	NS 3058, NS 3059
For stoves, other technology	10 g/kg fuel (individual test)	NS 3058, NS 3059

In Sweden certain standards for stoves are required by building regulations (BFS 2006:12). These include specific requirements regarding OGC and CO for installations of secondary, or complementary, heating sources.

Table 10 Swedish regulatory requirements for stoves

Stoves	Hand fed	Mechanically fed	Test method
OGC	150 mg/m^3	100 mg/m^3	CEN TS 15883 (SP 1695)
CO (secondary)	0,3% (3750 mg/m^3)	0,04% (500 mg/m^3)	EN 13240, EN14785, EN15250

Health and safety legislation

National legislation has been passed in the Nordic countries in regard to health and safety at work. It is important that local health and safety regulations are always followed in the manufacture of Nordic Ecolabelled stoves (i.e. also in Asia or Eastern Europe), since these stoves are, in many cases, produced overseas. Moreover, this is a consideration which is taken up in the regulations (R20). This is the new requirement. It is known that health and safety legislations are different between countries. Many stoves which today own Nordic Ecolabel have been manufactured in Poland, in Czechoslovakia and also in Turkey. It shall be controlled that it is followed local legislation.

About the revision

Aims and objectives of the revision

Development of the criteria has, above all, been focussed on the operation of stoves since the results of Life Cycle Assessments[1,1], as well as present day regulations, emphasise that the adverse effects on health (cancer, respiratory problems, heart and lung diseases) resulting from particle emissions should be a prioritised over, for example, the negative environmental impact of manufacture. Consequently, legislation has been drafted for the regulation of stove use, especially in built-up areas. A stove is in use relatively often and for a relatively long period of time, which means that reducing the adverse health effects of emissions has been of critical importance.

It is also done more stringent requirement for use of chemicals thorough by restrict a possibility to use chemicals with risk phrases and by claim information about used suppliers of chemical products. Besides it also set the requirement to document that the local health and safety regulations are followed also in fabrics outside Nordic countries.

The increasing political attention directed towards the issue of global warming has strengthened the desire to enable the use of heating systems based on renewable energy sources in built-up areas. Obstacles are placed in the way of such a development by air quality guidelines that restrict the emission of particles. As a result of regulatory limits on emissions, for reasons of health and environmental protection, local environmental oversight authorities have powers to prevent the use of room heating stoves.

It is, therefore, of the utmost importance for the use of room heating stoves run on biofuels, that emissions are kept very low. National ordinances are already in place in several European countries, but new and more stringent regulations are under implementation in several states, including Denmark.

An evaluation of current Nordic Ecolabelling requirements for enclosed stoves (2008) resulted in a proposal for a revision of the criteria, above all through a tightening of the limits on emissions, and in increase in required standards of energy efficiency, to appropriate levels.

The revision, which is based on the evaluation and its conclusions, has the following aims and objectives.

- To review options for a tightening of the requirements in regard to emissions and energy efficiency
- To evaluate requirements placed on material and production
- To consider adopting quality assurance standards for stoves
- To bring testing methods up to date
- To increase the clarity of information concerning the installation and operation of stoves.

About this revision

The team working with the product group consists in Thomas Christensen, Denmark, Randi Rödseth, Norway and Marianne Pettersson, Sweden with Harri Hotulainen, Finland as project manager. Kalle Wall has contributed information on the Swedish market. Elisabeth Magnus from Norway acts as area co-ordinator.

Justification for the revised requirements

An evaluation of the requirements for Nordic Ecolabelling of stoves that was performed in 2008 showed that the issue of environmental norms for stoves is, more and more, coming to the fore, as there is great potential for further environmental gains and it seems to be possible to steer manufacturers towards a more environmentally sound production.

It is realised thorough to restrict use of classified chemicals and control that the manufacturer will get the declarations from chemical producers. Besides it has happened that a lot of manufacture has moved to Poland, Turkey and Czechoslovakia. They have other kinds of health and safety regulations than we (in Nordic countries) have and so it shall be controlled by Nordic Ecolabel.

Various kinds of stove may receive the Nordic Ecolabel, and Nordic Ecolabelling has chosen, in connection with the draft circular for comment, to tighten requirements on different product types, divided into the following groups: mechanically fed stoves (pellet stoves), hand fed stoves (including wood stoves for temporary or continuous firing, inset stoves, slow heat release stoves) and sauna stoves.

On the whole, many stoves meet the norms of the Nordic Ecolabel version 2 and there is scope for a tightening of these requirements. Consequently, there is potential for further environmental gains.

Since the above mentioned Life Cycle Assessments establish that the use phase (particle and flue gas emissions) of a stove's life cycle is that which has the greatest negative impact on the environment, Nordic Ecolabelling has chosen to tighten requirements on emissions and energy efficiency and had proposed stricter rules as concerns emissions of CO, OGC, NOx and particles. Such a tightening of Nordic Ecolabelling's requirements is in line with the chosen strategy of focussing on global warming and environmental contaminants by means of requiring higher standards in regard to energy efficiency and particle emissions.

It is stipulated in EuP Directive, Lot 15, that emissions of small particles, NOx, SO_2 and CO are the most important parameters of environmental concern in relation to stoves. The EuP directive additionally focuses on efficiency improvements to combustion (energy efficiency). Lot 15 includes reference to emissions of SO_2, which, however, is not a matter of concern for wood based fuels, but is of concern when using other fuels, i.e. coal.

In order to prevent the spread of environmental contaminants, Nordic Ecolabelling has placed requirements on material used in production (see Section 8).

There follows below an explanation of the background to the proposed new requirements for enclosed stoves in the criteria version 3.

Product requirements (Section 1.1)

The required norms for stoves are specified in this section.

Material requirements – introduction

The following materials are used in the manufacture of stoves: cast iron, steel/iron, stone, tiles, ceramic material, glass, insulating material and sealants. Plaster is rarely used, and then only in smaller quantities. Metals are sometimes surface treated with paint, lacquers or other coatings, such as chrome or nickel coatings. Glass is a prominent, but relatively small, part of a stove's construction. Glass used in stoves contains boron. Insulation is used in small quantities (in terms of weight) in enclosing flue pipes. Ceramics, silicate material and other special materials used in the plates in the interior of the fire chamber.

The report "Task 4: Technical Analysis of Existing Products", which forms part of the preparatory study to the EuP Directive LOT contains a compilation of various materials (bill of materials, BoM) for the different kinds of stove. According to the report , wood stoves that are mainly constructed from steel contain, on average, 72% steel, 6% cast iron, 22% stone/ceramic material and 1.2% glass, with the final circa 1% being made up of surface treatments and insulating material (Task 4, table 4-9). Cast iron stoves contain 91% cast iron, 5% steel and 2% stone/ceramic material, with glass and other materials accounting for less than 1% of the total material (Table 4-13). Pellet stoves consist in 82% steel, 10% cast iron, 7% stone/ceramic materials, and less than 1% glass (Table 4-15). This type of stove is made up of less than 1% electronics.

Nordic Ecolabelling has considered introducing requirements on the materials used in the manufacture of stoves, as well as on production processes. Further information on environmental problems associated with stove manufacture, as well as regarding options for placing requirements on the production of stoves, is presented in Appendix 1. However, only a small number of requirements on the processes and materials used in the manufacturing of stoves have been added to the proposed new version of the criteria. Most of the material requirements relate to the use of chemicals.

Nordic Ecolabelling has taken the view that an evaluation of the introduction of any additional requirements on the manufacturing process should be undertaken in time for the next revision of the criteria. For example, the casting of iron stoves from scrap iron can cause problems in terms of local emissions, and raises health and safety at work issues. A great deal of energy is consumed in the manufacture of iron and steel. Coating stoves, with for example lacquer, can cause undesirable emissions of volatile organic compounds (VOCs) in the interior and exterior environments. Dry processes cannot be employed in the manufacture of stoves due to the high temperatures attained during operation. There are good reasons to introduce requirements on the emission of VOCs at the next revision.

Current material requirements according to the criteria

Material requirements contained in the current criteria (see Section 1.4 of version 2.2) include reference to dangerous substances such as heavy metals, phthalates, flame retardants in plastics and heavy metals used in surface treatments.

For these it is manufacturer of stove who declares that the requirements of chemicals and surface treatment are met. For small manufacturer it is as rule difficult to get declaration from big chemical producers but they can thorough handling requirement to order the products needed for to meet the requirement. By this matter a manufacturer is able to write the declaration to Nordic Ecolabel.

Revised criteria and new requirements on materials

R1 Description of the manufacturing process

The requirement in the criteria document:

R1 Description of the manufacturing process

A manufacturing process of the ecolabelled stove shall be described. A description shall least include the following information:

- *A name and place for*
  - *the fabric(s) for manufacturing of stove*
  - *suppliers for surface treatment and metal coating*
  - *suppliers for other components which are dealt by the requirements.*
- *A description of the manufacturing process for the stove specifying the various phases of process including cleaning technology. A production technology and cleaning technology for surface treatment and metal coating shall be given.*
- *Copy of environmental authorization/agreement or control reports of environmental authorities for manufacturing. Give amounts of actual emissions from the past year.*

Manufacturing does not include the primary production of steel, glass or plastic parts. Cast iron production is considered to occur if the producer of cast iron manufactures cast iron stoves. Cast iron parts for other stoves are not subject to the requirements.

A description of the manufacturing process according to the requirement.

Background to the requirement:

This is a new requirement. Manufacturers of stoves have, in recent years, experienced stiffening in competition in established markets. This has resulted in mergers and acquisitions of competitors, but also in the re-location of production to, in the main, eastern European manufacturers. According to Nordic Ecolabelling there are at present a number of licensees obtaining semi-finished products (e.g. combustion chambers, etc.) but also finished stoves from subcontractors in Eastern Europe. Production is, in many cases, spread over several sub-contractors. The new

requirements will enable Nordic Ecolabelling to gain a complete overview of the processes and used suppliers involved in manufacturing.

A full description of the manufacturing process should be submitted to Nordic Ecolabelling, covering the entire production flow (production planning, technical drawings, purchase of components, assembly of components, after-treatment (washing, surface treatment), final assembly, storage and transportation). Additional documentation may consist in production diagrams illustrating particular production cycles (including specification of raw materials and semi-finished goods). In order to gain a better overview of the used suppliers, it is desirable that subcontractors with surface treatment and metal coating and other subcontractors for other components which are dealt with requirements (suppliers of materials, semi-finished goods and finished stoves) are given. This information should include details of suppliers (name and place of production), as well as a description of the goods produced by the each specified subcontractor.

Nordic Ecolabelling is committed to dealing with the issue of energy / energy consumption and its associated environmental impact, including global warming, acidification, eutrophication etc. As mentioned earlier, Life Cycle Assessments have shown (Section 7) that the majority of a stove's environmental impact is felt during the period of its use (> 60%). Energy consumption during the production of an enclosed stove represents a minor, albeit still significant, part of the product's overall environmental impact. New requirements regarding energy consumption in the manufacture of stoves has been discussed. These requirements could, for instance, be presented in terms of energy consumption per unit produced. Since stove manufacturers make use of many different suppliers, it is very difficult for licensees to collate energy data for the various constituent materials and semi-finished goods used in stove production. A more precise definition of the elements of production covered by any new norms would be needed. Introducing a requirement for limiting energy consumption in production has come under discussion, but the fact that there are so many subcontractors involved in the chain of production presents a problem in this context. Requirements in regard to energy and energy consumption should, in accordance with current proposals, be considered in more detail in time for the next revision of the criteria.

It has been made a requirement of the Nordic Ecolabel that information is provided concerning environmental authorization/agreements between stove manufacturers and environmental authorities subcontractors, in regard to manufacture of stoves or control reports of environmental authorities and concerning emissions of various Substances (environmental contaminants) according to the environmental agreement. This is the sort of data that Nordic Ecolabelling wishes to collate, in order that, at the next revision, it will be possible to make an evaluation of relevant and appropriate environmental requirements in relation to the manufacture of stoves.

R2 Material requirements

The requirement in the criteria document:

R2 Material requirements

Manufacturers shall submit a complete list of parts in the stove that specifies the constituent materials of each part. The list shall include small parts such as screws, bolts, rivets, plugs, washers, hinges and suchlike.

The materials and design shall comply with the pertinent requirements of the applicable standard: EN 13240 (wood stoves), EN 14785 (pellet stoves), EN 13229 (inset stoves), EN 15250 (slow heat release appliances) or prEN 15821 (sauna stoves). The requirements cover parameters such as thickness, strength and permitted surface temperature (safety).

The description of materials approved by the test laboratory in connection with testing (see Section 1.1 of Appendix 1) may be used.

For material and fabrication faults on the carrying construction of the stove, excluding internal components shall have a minimum guarantee of 5 years under normal usage.

Description on materials of the parts of the stove for example the description of the materials which test laboratory approves in connection with testing. Declaration from the manufacturer that the material and design requirements are fulfilled. Appendix 3.2 may be used.

Background to the requirement:

The new requirement ensures that Nordic Ecolabelling can obtain a thorough overview of all materials used in the production of stoves and that all constituents are properly documented; thus facilitating the setting of appropriate requirements for materials. Nordic Ecolabelling wishes to compile a list of all constituent parts of each particular stove. The description of materials and technical drawings approved by the test laboratory in connection with testing (may be used to comply with documentation requirements. A full test report is required, in advance, by Nordic Ecolabelling (Section 2). Lists of material and technical drawings approved by the testing laboratories are today regarded as an important element in the work of a laboratory.

Norwegian authorities previously set requirements in regard to thickness of stoves, as a guarantee of quality and durability, and in regard to type and quality of material, in order to ensure that the products remained free from defects in the long term. The European standard has replaced Norwegian regulations.

The inner plates are among those spare parts that are most often purchased by customers. A plate costs around SEK 150 – 200 in Sweden. A similar plate in Norway costs 1,500–2,000 kronor. It is referred that in Sweden it can be bought single plates but elsewhere it shall be bought all (four) plates at the same time. The plates are made of, amongst other things, a silicate material called Vermiculite[9]. Suspicions of occurrences of asbestos have circulated, but these have not been verified. Chamotte is another material that absorbs heat, which may mean that it takes longer to achieve a

[9] ”Das Industriemineral Vermiculit − Einfluß der Rohstoffmineralogie auf die Deund Rehydratation bei der Herstellung von Hochtemperaturdämmstoffen” , Thomas Doege, Der Fakultät für Bergbau, Hüttenwesen und Geowissenschaften der Rheinisch-Westfälischen Technischen Hochschule Aachen. Rheinisch-Westfälischen Technischen Hochschule Aachen.

high combustion temperature. Yet another material is Termott, which is strong and has good fireproof properties.

Comments have been made that cheap stove might not have the same durability as more expensive ones. Deficiencies in stove air-proofing can have an adverse effect on emissions. This type of problem can be minimised by testing stoves according to standard.

Requirements for materials and construction are specified in EN 13 230 (wood stoves), EN14785 (pellet stoves), EN 13229 (inset stoves), EN15250 (slow release heat stoves), prEN 15821 (sauna stoves), e.g. in regard to material quality, thickness, strength (though not for Chamotte), and to temperatures and electrical safety. The manufacturer shall make a declaration that the materials meet the requirements of the relevant standards.

Requirements are additionally placed on the durability of stove interiors (interior plates of, for example, Chamotte). Materials commonly used in fire chambers have been shown to have relatively poor durability. A guarantee shall be given on the carrying construction of the stove for material and fabrication faults, as a minimum of 5 years under normal usage (guarantee shall be given in operating and maintenance instructions in R16). The exception is given for interior components. The glass, surface coating material and other components which are dealt with wearing can be exempted from the requirement.

It is in order to ensure that the adverse environmental impact of stove use is kept low in the long term, that the criteria specify that certain materials and certain construction techniques shall become established as norms. It is important to ensure that the quality of a stove does not deteriorate, and that it continues to meet Nordic Ecolabelling requirements for the entirety of the licence period. Annual laboratory testing is an excellent means of demonstrating the continued quality of the stove. Nordic Ecolabelling considers it important to ensure that the material used in Nordic Ecolabelling are characterised by high standards of quality and safety.

R3 Classification of chemical products

The requirement in the criteria document:

R3 Classification of chemical products

Manufacturer shall submit a list of chemicals used during the manufacture and surface treatment of the stove.

Chemical products such as adhesives, sealants, cleaning agents, paints and lacquers that are used during the manufacture and surface treatment of the stove, must not be classified according to the risk phrases in the following table.

Manufacturing does not include the primary production of raw material such as steel, cast iron, glass or plastic parts.

Metal coating of parts is exempt from this requirement. Metal coating of parts must fulfil R6.

Table 2: Classification of chemical products

Classification	*EU classification until 1 December 2010*	*EU classification from 1 December 2010*
Dangerous for the environment	*N with R50, R50/53, R51/53 or R59*	*Aquatic 1 with H400* *Chronic 1/2/3/4 with H410, H411, H412, H413*
Very toxic	*Tx (T+ in Norway) with R26, R27, R28, R39*	*Acute Tox. 1/2 with H330, H310, H300,* *STOT SE 1 with H370*
Toxic	*T with R23, R24, R25, R39 or R48*	*Acute Tox. 2/3 with H331, H301* *STOT SE 1 with H370* *STOT RE 1 with H372*
Sensitising	*Xn with R42, Xi with R43*	*Resp. sens. 1 with H334 or Skin sens 1 with H317*
Carcinogenic	*Xn with R40 or T with R45, R49*	*Carc 1A/1B/2 with H350, H350i and/or H351*
Mutagenic	*T with R46 or Xn with R68*	*Mut 1B/2 with H340 and/or H341*
Toxic for reproduction	*T with R60 and/or R61. Or Xn with R62 and/or R63*	*Repr 1A/1B/2 with H360F, H360D, H361f, H361d, H360FD, H361fd, H360Fd, H360Df* *Lact with H362*

**Classification in accordance with Council Directive 67/548/EEC and Council Directive 1999/45/EEC (until 1 December 2010 and during the transition period 2010-2015) or Regulation 1272/2008/EEC (as of 1 December 2010). The requirement also applies to combinations of risk phrases, such as T+ R26/R27/R28.*

List of chemical products used during the manufacture and surface treatment of the stove.

The material safety data sheet shall comply with applicable legislation in the country of application, e.g. Annex II of REACH (Council Regulation 1907/2006/EC) for all chemical products.

Background to the requirement:
This is a new requirement and it is presented in a manner that emphasises those characteristics of chemicals that are of particular concern for Nordic Ecolabelling. This requirement applies to the classification of the chemical products that are used in stove manufacturing. It may include substances with the same classification, but that are present in such small quantities that the chemical product is not classified. The requirement is not very stringent as it is the first time that such a requirement has been made under the criteria for stoves. According to current practice, surface treatments classified as environmentally hazardous are used in the coating of stoves. These substances are classified as: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R52/53). Products with this classification are not prohibited in the present proposal.

Requirements are limited to the final manufacture of stoves and surface treatment, on the grounds of the difficulties that stove manufacturers may have in obtaining information from all suppliers (who may, for example, be up to 20 in number) concerning which particular substances have been used in production. Manufacturers of stoves can regulate their own production. Requirements in regard to substances can be placed on the final producers of stoves: for example, requirements applying to chemicals such as adhesives, sealant (silicone putty), cleaning product, paints and lacquers. Requirements are not placed on the production of raw materials, neither casting of iron.

Manufacturer of stoves did not need to get the safety data sheets for chemicals before and therefore it may exist a need for information and training.

R4 Chemical substances (in manufacturing)

The requirement in the criteria document:

R4 Chemical substances

The following substances must not be actively added to chemical products such as adhesives, sealants, cleaning agents, paints and lacquers that are used during the manufacture and surface treatment of the stove:

- *Lead (Pb), mercury (Hg), hexavalent chrome (Cr^{VI}), cadmium (Cd) and their compounds*
- *Halogenated organic compounds*
- *Alcylephenols, alkylphenolethoxylates or other subtances which may form alcylephenols or alkylphenolethoxylates*
- *Phthalates*

Manufacturing does not include the primary production of steel, cast iron, glass or plastic parts.

Metal coating of parts is exempt from this requirement. Metal coating of parts must fulfil R6.

Substances that are not actively added by a chemical producer or their suppliers and that are not found in concentrations exceeding 100 ppm are exempt from the requirement.

Declaration or other respective clarification (documentation) for example written routines from the chemical producer (or the chemical supplier) as to fulfilment that the given substances are not actively added to the chemical product.

Background to the requirement:
Prohibitions on the use of lead (Pb), mercury (Hg), hexavalent chrome (Cr^{VI}), Cadmium (Cd) and their compounds, previously applied to paint only, but have now been extended to all important used chemical substances. Restrictions apply to the occurrence of contaminants that have not been actively added to the chemical substances. Thus Cr, which is a constituent part of cement-based products, may occur in quantities exceeding 100 ppm.

The RoHS Directive prohibits the use of harmful substances in electrical and electronic equipment. These substances should be banned in the manufacture of stoves. The substances in question include lead, mercury and hexavalent chromium. It has been proposed that chemical products containing these hazardous substances, in compliance with the RoHS Directive, be prohibited in the manufacture of stoves.

Norway's Climate and Pollution Agency has proposed regulation of those substances, amongst others, listed in R4.

Halogenated organic compounds are organic compounds containing halogenated compounds such as chlorine, bromine, fluorine or iodine. Halogenated organic compounds are hazardous to health and the environment, highly toxic to organisms living in water and are, furthermore, carcinogenic or harmful in other respects. Halogenated organic compounds degrade with difficulty, which increases the risk of harmful effects from these substances. Consequently, chemical products containing halogenated organic compounds may not be used in the manufacture of stoves, according to the proposed criteria. This prohibition means that, substances such as, halogenated flame retardants, chlorinated paraffins, perfluoroalkyl compounds (such as PFOA and PFOS) and halogenated organic solvents may not be added.

Alkylphenol ethoxylates (APEO) and alkylphenol derivatives, i.e. substances that produce alkylphenols when degrading, may not be used in ecolabelled furniture and built-in ovens. The presence of APEOs is permitted in detergents, adhesives, dispersants, thickeners, siccative driers, defoamers, pigment pastes, wax, etc. APEOs have a number of problematic and environmental and health properties. APEOs do not readily biodegrade according to current standardised tests. They have a tendency to bioaccumulate; they are found to be present in high concentrations in effluent sludge, degradation products from APEOs, alkylphenol and APEOs with one and two ethoxy groups. They are highly toxic to organisms living in water and some alkylphenols are suspected of having hormone-disrupting effects - alkylphenols and Bisphenol A are counted among the more potent of the estrogenic substances occurring in sewage.

Products containing APEOs can be replaced by APEO-free alternatives, based on three categories of surfactants: alkyl sulphonates, alkyl ether sulphates and alcohol ethoxylates. These three groups of surfactants are readily biodegradable under both aerobic and anaerobic conditions, but these surfactants are either toxic or highly toxic for organisms living in water. Alkyl sulphonates and alkyl ether sulphates are not considered to be bioaccumulative, while alcohol ethoxylates (in long chains with few ethoxylate units) have the potential to bioaccumulate. Despite the fact that these surfactants are toxic or highly toxic to organisms living in water, there are environmental advantages to using them instead of alkylphenol ethoxylates since the surfactants can

quickly biodegrade. In addition, by replacing APEOS, use of the degradation product nonylphenol, which can affect hormones, can be avoided.

The phthalates group consists in many different substances, such as bis(2-ethylhexyl)phthalate (DEHP), dibutyl phthalate (DBP), butyl benzyl phthalate (BBP), di-isodecyl phthalate (DIDP), di-isononyl phthalate (DINP) and di-isobutyl phthalate (DIBP). Some phthalates are classified as harmful to reproduction, while others are additionally classified as environmentally hazardous substances. Phthalates occur in many places in the environment, including freshwater, seawater, wastewater, and air and in organisms, such as mussels and fish. Phthalates are mainly used as plasticizers, especially in PVC, but are also to be found used in other products such as sealants, adhesives paint and lacquers.

It is important that a chemical producer secure through declaration or equivalent documentation e.g. written measures that these dangerous substances are not found in used chemical products.

R5 Surface treatments containing organic solvents

The requirement in the criteria document:

> *The application and curing processes of surface treatments containing organic solvents shall be enclosed or shall be done in the enclosed room.*
>
> *The emission of organic solvents (VOC) during surface treatment*
>
> *a) must not exceed 20% of the applied solvent or VOC emissions must not exceed 100 mg/m^3*
>
> *or*
>
> *b) producer shall give the plan for reduction of VOC emissions.*
>
> *If the alternative b is chosen and the consumption of the organic solvents (VOC) by surface treatment of the Nordic Ecolabelled products is 500 kg per year or more it must be documented that it is not possible by application to install a cleaning apparatus*
>
> *Volatile organic compounds (VOC) are defined as organic compounds that at 293.15 K have a vapour pressure of 0.01 kPa or greater.*
>
> *Description of the surface treatment process and settlement of emission of organic solvents (VOC) during surface treatment by calculations or measurements (see Appendix 3.2) or plan for reduction of VOC emissions if exception is used. Possibly a description on why it is not possible to install a cleaning apparatus.*

Background to the requirement:

Nordic Ecolabelling wishes to limit the amount of aromatic and organic solvents used in products such as paint. These are volatile organic compounds that pose particular problems because of their intrinsic properties. "Organic solvents can be absorbed through the lungs and skin and cause damage to multiple organs. The damage caused can be acute or chronic. Acute injuries due inhaling vapour manifest themselves in the form of headaches, fatigue, etc. Organic solvents can also cause irritation of the mucous membranes of eyes, nose and throat. Organic solvents degrease the skin and can cause eczema. Prolonged exposure to organic solvents may cause chronic damage to the brain and nervous system. In addition, certain organic solvents add to the green-

house effect. Some solutions contribute to photochemical ozone formation at ground level, while others contribute to the depletion of the ozone layer in the atmosphere.

Volatile organic compounds with one or more benzene rings are called volatile aromatic compounds and are very stable. The term 'aromatics' refers to benzene, toluene, mixed xylenes, ortho-xylene, para-xylen, meta-xylen (sometimes collectively known as BTX). Benzene is used in the production of styrene, cumene and cyclohexane. Toluene is used primarily in the production of benzene, phenol and toluene diisocyanate.

From the BAT report "The BAT (Best Available Techniques) Reference Document (BREF) entitled 'Surface Treatment Using Organic Solvents (STS)"'[10]
In the case of surface treatments of other metal surfaces, the BAT report refers to:
1. Reduce solvent consumptions and emissions, maximise efficiency of the coating application and minimise energy usage by one or a combination of paint, drier and waste gas treatment techniques. The associated emission values are 0.1 to 0.33 kg VOC/kg solids input. However, this does not apply to installations where the emissions are included in the mass emission calculations for the serial coatings of vehicles.
2. Reduce material consumptions by using high efficiency application techniques.
3. Use other paint systems to replace paints based on halogenated solvents.

At present lacquers are used that contain high levels of solvents. There are also dry lacquers and water based lacquers. The properties necessary for treating heat-resistant surfaces are such that that there are very few feasible alternatives to the current range of lacquers. The product should, for example, be air-drying, easy to repair, scratch resistant, able to both expand and contract with shifts in temperature and be stable in the long term. One of the most widely used products in the industry is Senotherm, especially Senotherm 1666, or similar, which has a very high content of VOCs (Content: 70-75% organic solvent with the remainder being made up of dry solids, VOC = 720 g/l). The alternative product Senotherm 1664 has significantly lower levels of VOCs (44% organic solvents with the remainder being made up of dry solids, VOC = 553 g/l), but it is used only on a limited scale in the industry[11]. Senotherm 1155 is a new product on the market that also has a lower concentration of VOCs (56% organic solvents with the remainder being made up of dry solids, VOC = 612 g/l). It has the advantage of lacking in odour, and of not giving off smoke, when the stove is first lit. This product is also used on a very limited scale. One of the problems with switching from a product with high levels of VOCs to a product with lower VOC content is that it alters the drying time. This has a major impact on production flow. Senotherm are working on water-based alternatives, but the product is not yet fully developed. Danwib has indicated that there are no organic solvents remaining in the lacquer when the user lights the stove for the first time. Nordic Ecolabelling knows of a company that uses powder lacquer with very low levels of VOCs.

The use of products with high VOC content is controlled mainly by two executive orders: VOC Executive Order No. 350 of 29 May 2002, based on EU Directive

[10] The BAT (Best Available Techniques) Reference Document (BREF) entitled 'Surface Treatment Using Organic Solvents", August 2007. ftp://ftp.jrc.es/pub/eippcb/doc/stm_bref_0806.pd
[11] Contact with Danwib as the exclusive representative of Senotherms products in Denmark

13/1999 and VOC product Executive Order No. 1049 of 27 October 2005, based on EU directive 2004/42/EF. VOC Executive Order No. 350 regulates emissions from 20 different types of facilities in which the annual consumption of VOC exceeds the specified thresholds. The Directive stipulates a regulatory minimum, which means that EU member states may impose stricter requirements, for example by legislating for a higher degree of protection for the country's environment than is required by the Directive. The VOC executive order stipulates, in regard metal surface treatments, a maximum use of 5 tonnes of solvent per year. This means that, especially, large producers of stoves are forced to use different methods for recycling/incineration of VOCs to meet legal requirements. The use of VOC-based chemicals is further regulated in national health and safety legislation.

Several methods are used when applying lacquer:

1. The stove is sprayed by hand without the use of local extractors, which means that staff are exposed to health risks and the exterior environment is affected by discharges in hydrocarbons that form ground-level ozone (the spray painter should wear a protective mask). There are presently many surface treatment workshops that operate such an "open system" without local extractors, thus constituting a potential health hazard.
2. The stove is sprayed by hand in a lacquer room, in which emissions are collected by a local extractor, thus protecting personnel from exposure to health risks. There are several surface treatment workshops in which local extractors have been installed.
3. The stove is sprayed by hand in a lacquer room and hydrocarbons are collected by the local extractor and later incinerated. No personnel are exposed but some small emissions of hydrocarbons are released into the environment. Larger producers of stoves use this technology.
4. The stove is sprayed mechanically and hydrocarbons are collected by local exhaust extractors and then incinerated, in which case the energy contained in the hydrocarbons is reused as a source of heating. In this way, energy is saved with only a small cost in terms of the release of fossil carbon dioxide in the atmosphere.
   Few surface treatment workshops which have systems for emissions control and heat recovery.

Nordic Ecolabelling proposes replacing the requirement for aromatic and organic solvents with a requirement regarding enclosed finishing and surface treatment processes e.g. in the closed room with the aim of reducing emissions of organic solvents to 20% of solvent used in manufacture processes or alternatively VOC emissions may be 100 mg/m3 in maximum. In this way personnel can be protected from exposure to health risks when lacquering and emissions are reduced thorough cleaning of VOC emissions.

If it is not possible by application to install a cleaning apparatus the requirement can be fulfilled thorough to sending plan for reduction of VOC emissions. For example to install a cleaning apparatus or change varnishes with surface treatment to products with less of VOC emissions or which are water based. If the manufacturer shows plan for reducing of VOC it must be documented that it is not possible with application to

install cleaning apparatus. It must be documented if consumption of organic solvents with surface treatment for the ecolabelled stoves is at least 500 kg per year.

R6 Metal coating of parts

The requirement in the criteria document:

> *R6 Metal coating of parts*
>
> *Lead, mercury, cadmium, chrome and nickel additives must not be used during the metal coating of parts.*
>
> *Parts may be coated with chrome, nickel or compounds of these if this is justified due to high chemical or mechanical wear or another specific technical requirement. Chrome plating must be based on trivalent chrome.*
>
> *If performed, chrome and nickel plating must be performed using purification, ion exchange, membrane technique or similar process to maximise the reuse of the chemical products. The emissions from coating must be recycled and destroyed. The system must be closed and without a drain.*

Declaration from the manufacturer that the requirement on metal coatings is fulfilled. Specification of need for metal coating and of the purification process. Appendix 3.2 may be used.

Background to the requirement:
(Surface treatment of metal BAT: http://eippcb.jrc.es/reference/stm.html)

The surface coating of metals has an environmental impact (relevance). Substances hazardous to health and environment are used in certain metal coatings, for example chrome plating. The environmental impact of metal coating varies according to the processes and substances used (potential). Nordic Ecolabelling, consequently, places requirements on metal coating (controllability).

Under current criteria metal surfaces may not be coated with chrome, nickel or any of their compounds. Exceptions can be made to this rule, in the case of small parts or surfaces, if justified by high chemical or mechanical wear or other specific technical requirements. In such cases, emissions from the coating must fulfil the requirements of the OSPAR agreement (PARCOM / OSPAR). Any parts surface treated with the above mentioned metals must be reusable/recyclable.

Nordic Ecolabelling proposes that future criteria prohibit the use of lead, mercury, cadmium, chrome and nickel in coating metals, since these substances are classified as hazardous according the requirements set out in R3.

Exceptions can be made to this rule, in the case of parts or surfaces, if justified by high chemical or mechanical wear or other specific technical requirements.
Chrome plating must be based on trivalent chrome. The use of hexavalent chrome in surface treatments is prohibited. Chrome and nickel plating must be performed using purification, ion exchange, membrane technique or similar processes to maximise the reuse of the chemical products. The emissions from coating must be recycled and destroyed. The system must be closed and without a drain.

It is so added the requirement of special types of cleaning apparatus by subcontractors for manufacturer of the ecolabelled stove.

R7 Packaging

The requirement in the criteria document:

> *R7 Packaging*
>
> *It must be possible to recycle or reuse the packaging material. The manufacturer shall provide a description of the packaging and how this is dealt with in the Nordic countries in which the Nordic Ecolabelled stove will be sold.*
>
> *Chlorinated plastics and timber that is treated with wood preservatives/biocides must not be used in packaging.*
>
> *Description of the packaging and its disposal (as provided in the installation manual, see R15).*

Background to the requirement:

This is a new requirement in the criteria. It must be possible to recycle or reuse the packaging material. Packaging shall be disposed of for recycling. Packaging material must be free from halogenated plastics, such as chlorinated plastics, or wood that has been treated with preservatives/biocides. This is in line with the principle of restricting packaging materials, to the extent that Nordic Ecolabelling considers this to be necessary, due to their environmental impact. The requirements are designed for multiple product lines.

R8 Waste

The requirement in the criteria document:

> *R8 Waste*
>
> *The manufacturer shall sort waste at source into the fractions that arise during production, such as wood, glass, plastic and metal. A waste management plan specifying waste fractions, how the waste is managed (for example recycling, landfill or incineration) shall be appended.*
>
> *Waste management plan with waste fractions and waste recipients for the stove manufacturer's operations.*

Background to the requirement:

This is a new requirement in the criteria. Waste minimization and proper waste management are important environmental parameters, for which relevant activities are best carried out by the producer or subcontractor.

Requirements regarding waste management may, to ensure quality assurance, be directed towards the end manufacturer. The manufacturer shall sort waste at source into the fractions that arise during production. A waste management plan must be prepared by the manufacturer of stoves in order to facilitate sorting. Waste fractions and waste recipients must be specified. The requirement does not apply to subcontractors in the present revision.

Supplementary heating system components (Section 1.2)

R9 Solar collector

The requirement in the criteria document:

R9 Solar collector

If the heating system includes a solar collector, this must be type approved according to EN 12 975.

Declaration from the manufacturer of the solar collector, see Appendix 4.

Background to the requirement:
A solar collector delivered together with a stove must be approved according to the appropriate EN standard.

R10 Fuel pellet hopper

The requirement in the criteria document:

R10 Fuel pellet hopper

The manufacturer of a Nordic Ecolabelled pellet stove shall inform the customer of how storage facilities for the recommended fuel should be designed

- *to ensure that the quality of the fuel is not impacted when the fuel pellets are emptied into and stored in the customer's storage hopper.*
- *to ensure that carbon monoxide which eventually emits from storing of pellets does not cause a risk of health or dancer to life.*

📖 *Information must be provided in the instruction manual.*

Background to the requirement:
The manufacturer of a Nordic Ecolabelled pellet stove shall inform the customer of how storage facilities for the recommended fuel should be designed.

Operation of the stove (Section 2)

Air emissions

The following section describes various problems with emissions to air. Polycyclic aromatic hydrocarbons (PAH) is a collective term for several chemical substances that comprise carbon and hydrogen. CO refers to carbon monoxide, OGC the total quantity of organic gaseous carbon and NOx nitrogen oxide and nitrogen dioxide.

The report from Task 3 in the EuP Directive on Solid Fuel Small Combustion Installations, (Lot 15), "Consumer behaviour and local infrastructure"[12] specifies that three conditions are required for complete combustion, often expressed as the 3 Ts:

[12] Consumer behavior and local infrastructure ,Task 3 in the EuP Directive on Solid Fuel Small Combustion Installations, (Lot 15). See:
http://www.ecosolidfuel.org/docs/BIO_EuP_Lot%2015_Task3_v3_200906.pdf (visited 2010.01.12)

temperature, turbulence and time. This relationship is influence by the design of the stove, the use of the correct fuel and the suitable behaviour of the consumer. Suboptimal conditions lead to incomplete combustion and the emission of CO, particles, volatile organic compounds, dioxins and PAH.

The report "Task 4: Technical analysis of existing products", which is the basis for the EuP LOT directive[9], shows in figure on page 60 significant differences in results of tests with and without a dilution tunnel. This difference exists since secondary aerosols are also measured in a dilution tunnel and since in the absence of a dilution tunnel the smoke has a lower linear velocity which increases the distribution and loss of particles.

The Task 4 report also provides a useful description of how the various pollutants form. NOx emissions, for example, are dependent on the quantity of nitrogen in the fuel (which is organically bound in the biomass), the level of excess air and the temperature of combustion. OGC are described as organic carbon compounds in gaseous form, which in many respects are identical to volatile organic compounds (VOC).

In several field tests in Danish residential areas[13,14] flue gas samples have been collected directly from the chimneys of domestic stoves and boilers. These samples were tested for the presence of dioxins, PAH and particulate.

There were great variations in the samples, which depended on the type of burner, fuel and the consumer's firing habits. The relationships are however not fully mapped. There is a tendency that newer stoves produce lower emissions of dioxins and PAH. The picture regarding particulate is however less clear. Samples have not been collected from a sufficient number of stoves to draw clear conclusions as to whether a certain type of stove is better than another. A general conclusion is however that new stoves produce less emission than older such[13].

In general, the results[13,14] demonstrate that a few sources cause the majority of emissions. Among the stoves and boilers investigated in Gundsømagle, two of nine accounted for 61% of the emissions of PAH. This means that emissions can be reduced significantly by targeting the sources that produce the greatest emissions.

The project[13,14] does not chart a clear connection between the emission of dioxins and particles and between dioxins and PAH, which is most likely due to differences in the way these form. There is however a relationship between the emission of PAH and particles. This is since the same conditions, such as poor air supply, produce more PAH and particles but less dioxin.

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[13] From the report "Dioxin, PAH og partikler fra brændeovne" working report from DMU nr. 212.
[14] From the report "Partikler og organiske forbindelser i træfyring" working report from DMU nr. 235
[13] From the report "Dioxin, PAH og partikler fra brændeovne" working report from DMU nr. 212.

[14] From the report "Partikler og organiske forbindelser i træfyring" working report from DMU nr. 235

The report explains that dioxins are formed in a chemical reaction between chlorine and organic compounds. Combustion with generous air supply produces higher temperatures and thus fewer particles and lower level of PAH. But a high combustion temperature also produces more dioxin since chlorine vaporises at these higher temperatures. The temperature in the combustion chamber is not sufficiently high (>950°) that the dioxin decomposes. There is therefore a conflicting relationship between PAH and dioxin if only combustion is considered.

Nordic Ecolabelling does not set any requirements on dioxin. The report[13,14] shows that burning impregnated wood increases the risk of dioxins forming. It is therefore important to observe the Nordic Ecolabel requirements that the instruction manual only recommends the burning of pure wood.

CO is an important parameter regarding combustion. Incomplete combustion produces higher levels of CO. The method of measurement of CO is inexpensive and is therefore used as a check (with limit values) in all types of combustion installations. CO is toxic and thus to be avoided.

PAH forms during poor combustion and some of the compounds are toxic (some even carcinogenic). Several studies have been performed all showing a relationship between PAH and particle emissions. The higher the levels of PAH, the more particulate[15]. Nordic Ecolabelling sets a direct requirement on particle emissions. The risk for PAH can be evaluated from the presence of CO and OGC. Other investigations have previously shown that PAH is formed under similar conditions to CO and OGC. Since PAH is somewhat expensive and time consuming to analyse, the combination of testing for particles, CO and OGC continues to be a good method of assessing the risks to health and the environment. Both CO and OGC levels are indicators of poor combustion. The higher the level of CO the higher the level of PAH.

Poul Bo Larsen at the Danish Ministry of the Environment[16] has made a relative assessment of the problematic components produced by stoves. He has calculated a dilution factor – how much clean air is required to dilute the flue gas from the stove sufficiently so that concentrations are lowered to an "acceptable" level. "Acceptable" here is the background concentration of dioxin and PAH in the general city air and a 0.6% increase in mortality rate for particles. For PAH, one extra death per million inhabitants is also used.

[15] Luftforurening med Partikler – et sundhedsproblem, DMU 2009
[16] Meeting at the Danish Society of Engineers (IDA) of 27 October 2004 regarding particle pollutants from stoves. Lecture by Poul Bo Larsen, Danish Ministry of the Environment.

The assessment shows the following:

- For dioxin, the flue gas must be diluted with 10,000 m^3 air (relative to the background level).
- For PAH, the flue gas must be diluted with 42,000,000 m^3 air (relative to the risk of mortality per 1 million inhabitants) (or 2,000,000 m^3 if a 0.6% increase in mortality is used as an acceptable level).
- For particles, the flue gas must be diluted with 10,000,000 m^3 air (1µg/m^3) for a 0.6% increase in mortality.

The assessment indicates that particles and PAH from stoves have a greater impact on health and the environment than the dioxins produced by stoves. One must however remember that dioxin is assessed against the background level and not an increase in mortality.

The problem with dioxins from stoves is not acute toxicity by inhalation. The greatest problem is that dioxins can concentrate in the food chain. It is therefore not possible to convert air concentrations to mortality rates in the same way as for PAH and particles.

There are roughly 600,000 stoves and boilers in Denmark[13], and the use of fuel has risen considerably. This development has continued in recent years and consumption rose by approximately 70% between 1999 and 2005. 20% of households use wood as a fuel. More than 90% of particle emissions come from wood. The large emission of particles from burning wood can cause major pollution in some residential areas.

Nordic Ecolabelling has therefore concluded that the limits on particles, CO and OGC should not be lowered in the hope of lowering levels of dioxins. Firstly, it is unclear whether such a move would actually reduce levels of dioxins. Studies suggest that old stoves tend to emit both more dioxins and PAH. In addition regarding stoves, dioxins are a lesser problem than particles and PAH.

NOx emissions are primarily produced by cars, power stations and incineration plants. NOx emissions give rise to a number of negative environmental and health effects such as acidification and respiratory problems. They are an important issue since an increase in NOx levels is not desired in the domestic heating sector. The more efficient combustion that is required, the greater is the risk of NOx emissions. The actual Nordic Ecolabelling criteria version 2.2 does not include limit values for NOx. By increasing firing of bio fuels it may occur risk for impact of NOx content in the air outside.NOx values for 8 ex. ecolabelled measured wood stoves and inset stoves are lying between 69-121 mg/Nm^3 The requirement bt hearing was set on 200 mg/Nm^3 for all the types of stoves. Nordic Ecolabel considers that NOx parameter is control parameter for quality of fuel. Wood fuel emits by firing still low NOx emissions. Nordic Ecolabel decided not to set the requirement of NOx by this revision.

Nordic Ecolabelling has not decided to introduce requirements on NOx in this revision.

[13] From the report “Dioxin, PAH og partikler fra brændeovne” working report from DMU nr. 212.

The report "Particulate Emissions from Biomass Combustion in the IEA Countries"[17] from the International Energy Agency presents the results from 17 test institutions in seven countries (including Sweden, Denmark and Norway) regarding residential wood combustion. The results show significant variations in the emissions from hand fed stoves. Also by lighting the top of the fuel rather than the bottom visible smoke can be avoided during the start-up phase and the emissions of particulate matter (PM) reduce by over 50%. PM is a complex mixture of air-borne particles and liquid droplets composed of acids (such as nitrates and sulphates), ammonium, water, black (or "elemental") carbon, organic chemicals, metals, and soil (crustal) material. The burning of pellets has shown that particle emissions can be three times higher for some biomass compared to wood with low bark content. Particle size is the most important parameter regarding particle classification. The American Environmental Protection Agency classifies particles in two groups: coarse particles, $PM_{10-2.5}$, with a particle size of 2.5 to 10 micrometres; and fine particles, $PM_{2.5}$, with a particle size of less than 2.5 micrometres[18]. In addition, there are ultrafine particles, such as the classification PM_1 for particles less than 1 micrometre in diameter. According to the report from IEA, 90% of particles from combustions are ultrafine. Coarse particles are short lived in the air and generally filtered out in the nose and throat while finer particles enter the lungs. One limit with the measurements of particles is that they are considered as a particulate mass. This means that large areas with smaller particles containing toxic substances are not considered. Size, shape, morphology and chemical composition are further parameters that are not considered regarding particle mass. The report provides a useful overview of how the sampling and test method can influence the results, see Figure 1. Swedish data that is presented in the report shows that the use of a dilution tunnel gives results that are 2.5-10 times higher for PM measured in mg of particulate per MJ of heat compared to other methods.

[17] Particulate Emissions from Biomass Combustion in IEA Countries, International Energy Agency, Bioenergy Task 32, Swiss Federal Offfice of Energy (SFOE), Zürich, January 2008.

[18] American Environmental Protectioin Agency, available at: http://epa.gov/NE/airquality/pm-what-is.html (visited 2009.11.30)

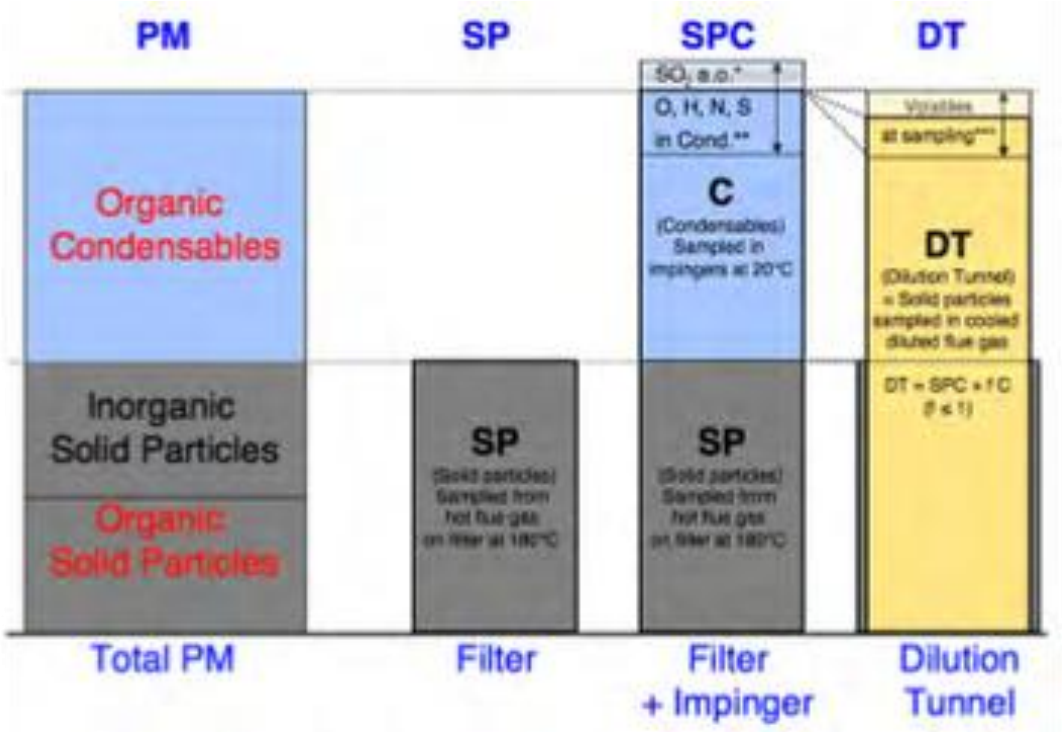

Figure 1. Figure 4.4 from the IEA report "Particulate Emissions from Biomass Combustion in IEA Countries".
Comparison of different sampling methods with total PM in the flue gas. Explanations:

- PM: Total Particulate Matter in flue gas at ambient temperature.
- SP: Filter (Method a) resulting in solid particles SP.
- SPC: Filter + Impinger (Method b) resulting in solid particles and condensables SPC.
- DT: Dilution Tunnel (Method c) resulting in a PM measurement including SPC and most or all C. Hence DT is identical or slightly smaller than SPC + C due to potentially incomplete condensation depending on dilution ratio and sampling temperature (since dilution reduces not only the temperature but also the partial pressure of contaminants).

According to a doctoral thesis from 2008 that investigates the health effects from wood smoke and road traffic[19], both contribute equally to increased concentrations of harmful particles. The results from the investigation shows however that the two sources of emissions can have different effects on health, without the one being more serious than the other. Wood smoke contains large quantities of organic compounds such as polycyclic aromatic hydrocarbons (PAH). The particles in wood smoke also increase the occurrence of allergies in mice[20].

A study of stoves and air quality in residential areas in Sweden shows that a large proportion (44-57%) of particles are 25-606 nm in size[21]. Particles smaller than 10 micrometres and PM_1 constituted 31-83% of the particulate matter. The majority of aerosol particles in the air were small (the ratio PM_1/PM_{10} equal to 0.76).

[19] Bølling, A. K."Pro-inflammatory potential of particles from residential wood smoke and traffic: Importance of physicochemical characteristics", Doctoral theses, University of Oslo, 2008
[20] Samuelsen, M. "Particle size and source; effects on allergy adjuvant activity and innate immunity", Doctoral theses, University of Oslo, 2008
[21] Krecl. P. "Impact of residential wood combustion on urban air quality" Doctoral theses, Stockholm University, 2008

The final report from the project "Ren förbränning av biobränslen i småskaliga värmeanläggningar: partikelmätning och provtagning samt fysikalisk/kemisk och toxikologisk karakterisering (BIOMASS-PM)" (Clean combustion of biomass in small-scale heating installations: particulate measurements and sampling and physical/chemical toxicological characterisation) provides an overview from the participant countries in Sweden, Finland, Germany and Austria[22]. The data from Sweden emphasises that the concentrations and distribution of fine particles are influenced by the combustion conditions and the composition of the ash in the biomass. There are extensive possibilities to reduce particle emissions connected to small-scale combustion in Sweden as well as influence particle composition. But the overview also stresses that the study of particle emissions from new biomass fuels is not comprehensive. The national reports from Finland show that the emissions from small combustion installations produce 25% of the national emissions of $PM_{2.5}$, while road traffic accounts for 19%. PM_1 particles comprise organic material (OM), elemental carbon (EC) and ash. The quantity of OM and EC also increases with particle size. Sauna stoves produce the greatest emissions of OM and EC.

In this revision, Nordic Ecolabel continues its efforts to reduce emissions of particles and PAH (CO and OGC) while also stressing that fuel must only comprise pure wood (and not treated or impregnated wood).

New technology (flue gas purification)
The Danish Ministry of the Environment has financed a project[15] to test various techniques for purifying smoke from stoves and similar appliances. These technologies include particle filters. The project was performed by a consortium comprising Force Technology, The Danish National Environmental Research Institute and the Danish Technological Institute. The project is expected to conclude late 2010.

The project comprises two sections, the first of which is a series of laboratory tests of the latest solutions performed at technological institutions. Tests have included the level of purification of various emissions such as particles, VOC, dioxins and odours.

The second part of the test comprises several technical solutions applied to existing domestic stoves and boilers in Denmark. The performance, appearance and suchlike of the technology are evaluated using a survey distributed to the users and their neighbours. Emissions are measured at selected locations and conduct outdoor air tests in areas where several or all houses in the vicinity of the test station are equipped with measurement instruments.

Five technical solutions have been selected for testing (two types of electric filter mounted in the stove pipe, an electric filter fitted at the top of the chimney, a catalytic converter fitted in the stove pipe and one type of afterburner). A conservative preliminary conclusion of the tests of the five solutions is that their ability to reduce

[22] "Ren förbränning av biobränslen i småskaliga värmeanläggningar: partikelmätning och provtagning samt fysikalisk/kemisk och toxikologisk karakterisering (BIOMASS-PM)" ERA-NET Bioenergy, Final report, Swedish Energy Authority (P 30176-1) October 2008

[15] Luftforurening med Partikler – et sundhedsproblem, DMU 2009

particle emissions is limited[23]. Replacing an old stove with a new one currently produces the greatest reduction in particles and other emissions.

Nordic Ecolabelling is closely monitoring the development of flue gas filters.

New technology for pellet stoves
Bionordic AS[24] has in conjunction with SINTEF developed a new, advanced pellet stove (Jostedalen) that produces very low emissions. It has a rotating pellet feeder that produces even combustion. The stove has an output of 2-6 kW with an efficiency of 93-97% and produces emissions between 1.2-0.4 g/kg. The emissions of CO are lower than 500 mg/m^3.

Requirements have been divided into different types of stoves. It has been divided in the same division in earlier requirements, with an exception.

There are stoves which have been manufactured for temporary firing. In that case the manufacturer informs that the stove may not be fired 24 hours a day. There are also "super stoves" on the market which are suitable for continuous firing and also suit for to be a dominant heat source e.g. for low energy house. These stoves shall be extremely effective and lie on line with requirements of RES directive for relief system of manufactured stoves.

Limit values for emissions to air according to various labelling systems

Table 11 presents the requirements on emissions to air set in version 2 of the criteria for stoves.

Table 11: Emission requirements according to Nordic Ecolabelling requirements, version 2.2

	OGC (mg/m^3 dry gas at 13% O_2)	CO (mg/m^3 dry gas at 13% O_2)	Particles (g/kg fuel)
Slow heat release appliance	**150** (nominal heat output)	**2,000** (nominal heat output)	**1** (nominal heat output) *50 (nominal heat output) mg/m^3 at 13%O_2
Stove Manual feed	**150** nominal heat output	**2,500** nominal heat output	**<5** (3 partial (NS); nominal) **< 10** (for each individual test)
Inset Manual feed	**150** nominal heat output	**2,500** nominal heat output	**<8** (3 partial (NS); nominal) **< 15** (for each individual test)
Stove Automatically fed	**50** (nominal heat output) also $\bar{x}$ (partial 1; partial 2)	**1,000** (nominal heat output)	**< 5** $\bar{x}$ (partial 1; partial 2; nominal) **< 10** (for each individual test)
Sauna stove			
Nominal heat output	**1,000**	**5,000**	**< 8**
Partial heat output*	**1,000**	**5,000**	**< 15** (for each individual test)

*Applies if it is not possible to use a dilution tunnel.

[23] Telephone conversation with Ola Schleicher, Force Technology, May 2009.
[24] Bionordic AS. www.bionordic.no (visited 2010.01.12)

Other limit values

Table 12 presents current limit values for emissions for hand fed stoves.

Table 12: Current limit values for hand fed stoves. The limit values for particle matter in g/kg wood are measured using a dilution tunnel and the limit values in mg/m^3 are measured without dilution tunnel. Only Danish authorities have emission limit for particles expressed in both units.

	Test method	Efficiency	CO	Particles[2]	OGC	NOx
		nominal	nominal	nominal partial heat output	nominal	nominal
CE Class 1	EN13240	> 70%	< 0.3%	-	-	-
CE Class 2	EN13240	> 60%	< 1.0%	-	-	-
CE Class 3	EN13240	> 50%	< 1.0%	-	-	-
DS	DS/EN13240	> 70%	< 0.3%	-	-	-
DS+	DS/EN13240	> 70%	< 0.3%	< 20 g/kg	-	-
DS	DS887	> 70%	< 0.3%	-	-	-
Bek. Nr 1432	NS3058 DIN/EN 13240[1]			< 10 g/kg 75 mg/Nm^3		
NS	NS3058	-	-	< 5 g/kg (catalytic converter) < 10 g/kg (other technology)	-	-
P-mark		70%	0.3% 3750 mg/m^3	100 mg/m^3	200 mg/m^3	-
Umweltzeichen 37 /Austria		80%	700 mg/MJ (1050 mg/Nm^3)	30 mg/MJ (45 mg/Nm^3)	50 mg/MJ (75 mg/Nm^3)	120 mg/MJ (180 mg/Nm^3)
15A Austria (Hand fed stove)	-	> 78%	< 1100 mg/MJ (~ 1650 mg/Nm^3) (~ 0.13%)	< 60 mg/MJ (~90 mg/Nm^3)	< 80 mg/MJ (~120 mg/Nm^3)	< 150 mg/MJ (~225 mg/Nm^3)
BimSch. Stufe 1 (wood stove)		>73%	2000 mg/Nm^3	100 mg/Nm^3	-	-
DIN+	DIN/EN 13240[1]	> 75%	< 1500 mg/Nm^3 (~ 0.12%)	< 75 mg/Nm^3	< 120 mg/Nm^3	< 200 mg/Nm^3
Nordic Ecolabel (vers.2.2)	**DS/EN13240 NS3058/3059 SP1695**	> 73%	**< 0.2% (< 2500** mg/Nm^3)	**< 5 g/kg**	**< 150 mg/Nm^3**	

1. Incl. particle measurement
2. In Austria and Germany, particles are measured directly in the flue gas, while in the Norwegian standard particles are measured in cooled flue gas. Direct comparison between the limit values is therefore not possible.

A similar table should be introduced with values for pellet stoves. The previous background document presented figures for the P-mark, The Blue Angel, the Austrian ecolabel and authorities and German authorities for pellet stoves.

It is not possible to make a direct comparison between the limit values for particulate matter according to the Norwegian NS standard and Nordic Ecolabel or the limit

values presented in the German DIN+ standard and Austrian §15A requirement, since the test methods differ. Above all, the Nordic Ecolabel (in comparison to the Norwegian test method) requires the measurement of cooled gas (after a cooling tunnel) and that the stove is also tested at partial output.

There is an on-going discussion regarding the test method for determining particulate matter. It has been shown in some cases that samples from a dilution tunnel vary in comparison to direct samples of flue gas. Some stoves display inconsistent results in dilution tunnel test but are very efficient and produce low levels of particles measured in mg/m^3. It is proposed that an alternative limit value for particulate matter should be expressed in mg/m^3 of flue gas.

Some laboratories maintain that the best method for measuring particulate matter from stoves is the Norwegian NS standard. The advantages are that particles are measured in the cooled flue gas and at partial loads. Equally, there is disagreement between test laboratories regarding whether the emission limits of the two test methods can be combined. According to the report Task 4 in LOT 15 (page 64), particulate matter is measured using the DIN+ method (without dilution tunnel) since most data on emissions stems from this test method. The report does not however claim that this test method is better than others.

In Norway, testing is performed using a dilution tunnel with the support of national standards on the emission of particles. The correlation between the results with and without dilution tunnel varies depending on the quantity of particulate. The SP Technical Research Institute of Sweden[25] has now tested one stove and one boiler at nominal output to compare test methods. The tests conclude that the methods differ by a factor 2-10 for boilers that have similar particle emissions as Nordic Ecolabelled stoves. Regarding the stove that was tested, the difference was a factor 3-6.

New Danish legislation came into force in 2008. There has been a wish to enable the use of both test methods. Accordingly, two limit values are specified. The test laboratories maintain that the two limit values demonstrate that there is a difference in ambition. The requirement in Denmark was tightened from 20g/kg to 10g/kg particles. The limit value is also specified as a concentration of 75 mg/m^3 (13% O_2).

Technical Committee TC295 is involved in the European standard work on developing a new test method, in which the Nordic laboratories are participating. The standard is being developed based on British, Norwegian, Austrian and German standards. The German standard, VDI 2066, and applicable sections of this standard are suitable for use in accordance with specification TC295 WG5 N 51 E. The standard EN 15 250 for slow heat release appliances does not measure particle emissions. The test method for particles is found in technical specification CEN/TS 15883:2009, Annex A.1.

[25] Partikelmätning vid vedeldning - Jämförelse mellan provtagning i skorsten och spädtunnel (2007) Swedish Testing and Research Institute/Swedish Energy Authority.

Limit values for emissions to air from Nordic Ecolabelled stoves

A stove that is tested must not be fitted by particle filter or catalyst in order to meet requirements R11-R13.

R11 Air emissions

The requirement in the criteria document:

R11 Air emissions

The stove must not exceed the emission limit values for organic gaseous carbon (OGC), carbon monoxide (CO) and particles specified in Table 2.

Table 2. Emission limit values for Nordic Ecolabelled stove tested at 13% O_2 (dry gas). The requirement applies at nominal heat output unless specified otherwise. $\bar{x}$ means a weighted mean value of test results by the given heat outputs within burn rate categories.

	OGC	**CO**	**Particles**
	mg/m^3	mg/m^3	mg/m^3
Hand fed slow heat release appliance	**120**	**1200**	**50**
	mg/m^3	mg/m^3	*g/kg fuel*
Hand fed stove for temporary firing or inset stove	**120**	**1 700**	**4.0**; ($\bar{x}$ for up to 4 heat outputs) **8.0** (for each individual test)
Hand fed stove for continuous firing	**60**	**800**	**3.5**; ($\bar{x}$ for up to 4 heat outputs) **7.0** (for each individual test)
Mechanically fed pellet stove	**60** (nominal heat output) **60** ($\bar{x}$ for partial heat output 1 and 2)	**800**	**3.5**; ($\bar{x}$ for partial heat output1; partial heat output2; nominal heat output) **7.0** (for each individual test)
Hand fed sauna stove	**120**	**1 700**	**100** mg/m^3

The following conditions apply to testing. The test methods are described in Appendix 1.

Hand fed slow heat release appliance.

Test at nominal heat output in accordance with:

- *CEN/TS 15883:2009 for OGC emissions*
- *EN 15250 for CO emissions*
- *CEN/TS 15883:2009, Annex A.1. for particles.*

Hand fed wood stove (for temporary or continuous firing) or inset stove. *Test at nominal heat output for CO and OGC emissions, and at up to four heat outputs within burn rate categories particles in accordance with:*

- *CEN/TS 15883:2009 for OGC emissions*
- *EN 13240 (wood stoves) or EN 13229 (inset stoves) for CO.*
- *NS 3058 and NS 3059 with class 1 and 2 heat outputs for particle tests.*

Mechanically fed pellet stove. *Test at nominal heat output for CO emissions, and at nominal heat output and two different partial heat outputs for OGC emissions and for particles in accordance with:*

- *CEN/TS 15883:2009 with nominal and partial heat outputs defined according to test methods described in appendix 1 for OGC emissions*
- *EN 14785 for CO emissions*
- *NS 3058 and NS 3059 with nominal and partial heat outputs defined according to test methods described in appendix 1 for particle tests.*

Hand fed sauna stove. *Test at nominal heat output for CO, OGC and particle emissions in accordance with:*

- *CEN/TS 15883:2009 for OGC emissions*
- *prEN 15821 for CO emissions*
- *CEN/TS 15883:2009, Annex A.1 for particle emissions.*

Requirements on laboratories, the testing of stoves and the measurement of emissions are described in detail in Appendix 1.
Full test report.

Background to the requirement:
In light of the data for Nordic Ecolabelled stoves (version 2), that the new requirement (version 3) shall specify the same limit values as DIN+ for OGC. The requirement of CO lies on 1700 mg/m^3 for wood stoves for temporary firing and inset stoves which is a bit of easier than the requirement in DIN+ (1500 mg/m^3). The requirement on particle emissions is 4.0 g/kg fuel for wood stoves for temporary firing and inset stoves, which is lower than the DIN+ limit value of 75 mg/m^3. The figure below presents the test results from hand fed wood stoves and inset stoves. The results at the far right are for inset stoves.

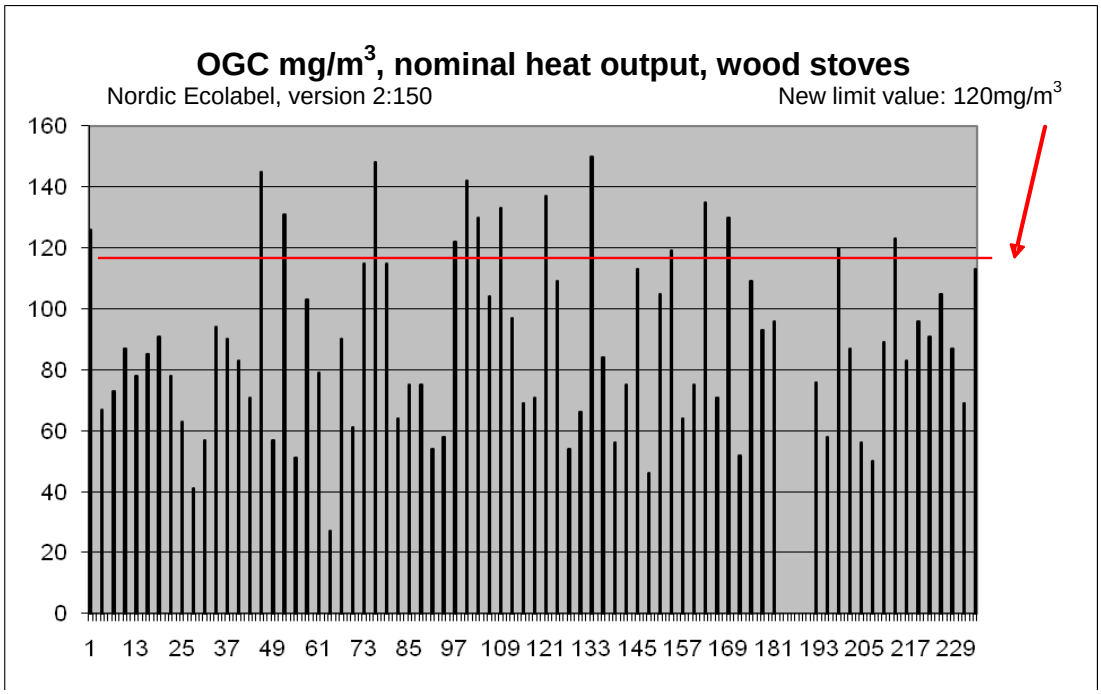

Figure 1 Test results for OGC for hand fed Nordic Ecolabelled wood stoves and inset stoves, weighted values. The Nordic Ecolabel limit value for OGC in version 2 is 150 mg/m^3. The new limit value is 120 mg/m^3.

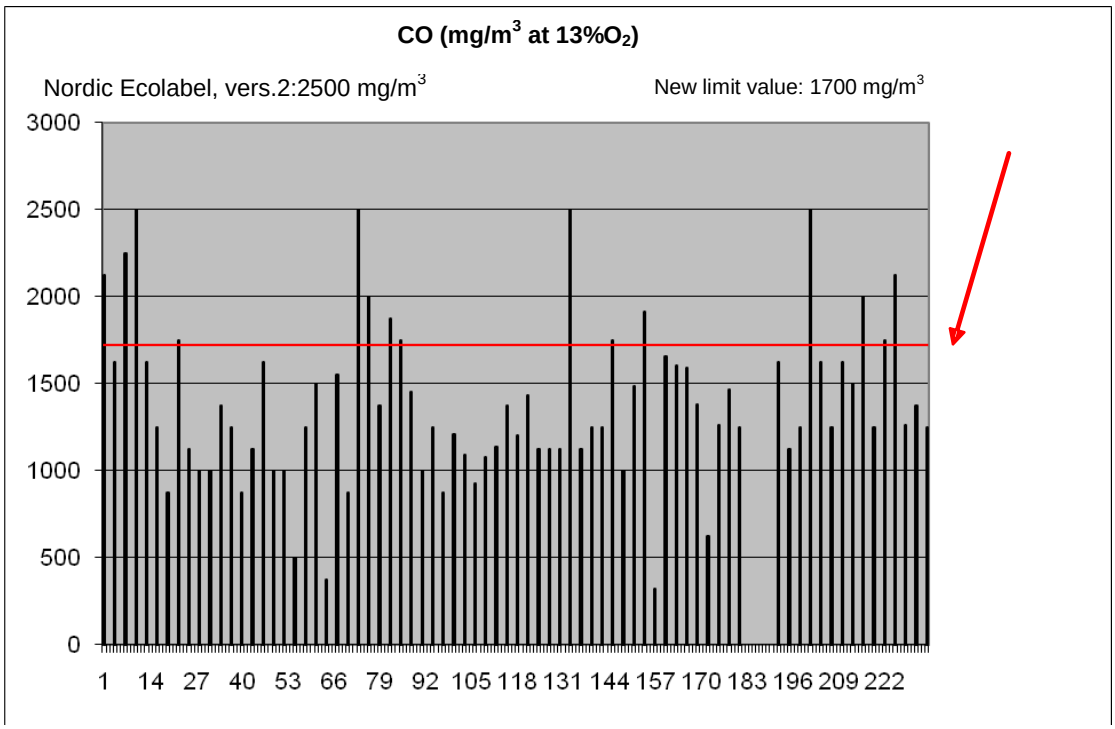

Figure 2: Test results for CO for hand fed Nordic Ecolabelled wood stoves and inset stoves, weighted values. The Nordic Ecolabel limit value for OGC in version 2 is 2500 mg/m^3. The new limit value is 1700 mg/m^3.

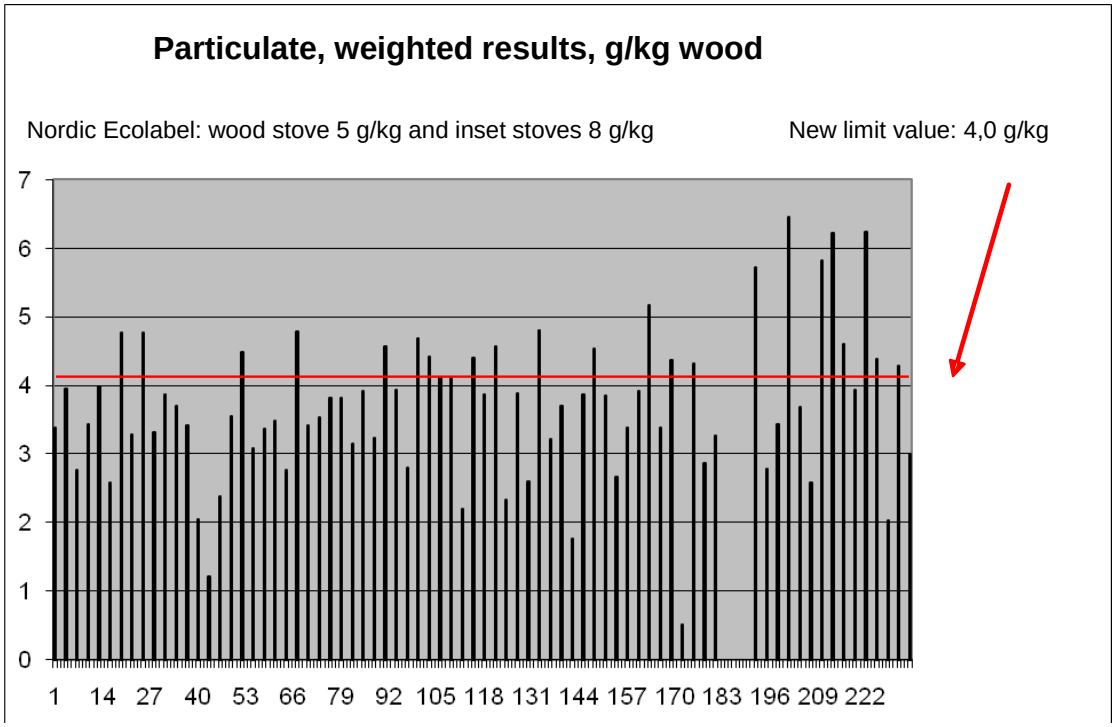

Figure 3: Test results for particles for hand fed Nordic Ecolabelled wood stoves and inset stoves, weighted results. The Nordic Ecolabel limit value regarding particles in version 2 is 5 g/kg for wood stoves and 8 g/kg for inset stoves. The new limit value is 4,0 g/kg for both types of stove.

This requirement on CO 120 mg/m^3, OGC 1700 mg/m^3 is in line with DIN+. The requirement of OGC is some easier than the requirement for DIN+. The requirement on particle emissions is 4.0 g/kg fuel for wood stoves and inset stoves, which is more stringent than DIN+ (75 mg/m^3).

The new requirements mean that 54% (33 of 61) of current Nordic Ecolabelled wood stoves and 47% (7 of 15) of inset stoves fulfil the emission requirements (OGC, CO, particles).

The regulatory requirements in Austria (Art. 15 a-VG) gives values 120 mg/Nm^3 for OGC and 1650 mg/Nm^3 for CO which are about on the same levels as those for Nordic Ecolabel.
The limit values for particles specified by the Austrian ecolabel for hand fed stoves is 60 mg/MJ (equivalent 90 mg/m^3), see Table 5a. This is slightly less stringent than the Nordic Ecolabel requirement of 4,0 g/kg. 45 mg/m^3 is approximately equivalent to 5 g/kg wood. As mentioned previously, it is important to remember that the results of various particle test methods do not correlate and that these values (units) are not directly comparable. Nordic Ecolabelling wishes to set a limit value expressed in g/kg and tighten the limit value.

The German regulatory requirements (BimmSchV Stufe 1) gives limit 2000 mg/Nm^3 for CO who is less stricter than the requirement by Nordic Ecolabel. The requirement of OGC is not included in the regulatory requirement. The German regulatory requirement gives 100 mg/Nm^3 for particles for wood stoves.

The TASK 4 report on LOT 15 (Table 4-33) presents emission values for wood stoves. The average CO value for 7 wood stoves is 2,085 mg/m^3. The average for particle emissions is 82.3 mg/m^3 for 10 stoves. The 18 inset stoves have an average CO value of 2,573 mg/m^3 and average particle value of 46.7 mg/m^3 (Table 4-30). The following emission values are specified for wood stoves in the Base case explanation document to TASK 5 (Table 1): particles 55-75 mg/m^3, CO 1250-1500 mg/m^3, OGC 100 - 120 mg/m^3, NOx < 200 mg/m^3.

For pellet stoves and wood stoves for continuous firing are the new requirements on 60 mg/Nm^3 for OGC, 800 mg/Nm^3 for CO, 3,5/7,0 g/kg for particles. The mechanical fed stoves and wood stoves for continuous firing produce less emissions than other hand fed stoves. Thus it is set the stricter requirement on missions for these stoves than for other stoves.

The Austrian regulatory requirement (Art.15a-VG) gives value about 60 mg/Nm^3 for OGC and 750 mg/Nm^3 for CO which are about on the same level as the Nordic Ecolabel requirement. The Austrian ecolabel specifies a limit value of 60 mg/MJ (equivalent to 90 mg/m^3) for particles which is on higher level than the Nordic Ecolabel requirement.

The German regulatory requirement (BimmSchV. Stufe 1) gives the limit 400 mg/m^3 for CO which is more stringent than Nordic Ecolabel requirement. The requirement on OGC is not included in the regulatory requirement. The limit value is on 50 mg/$m^3$for particles I German regulation, which is comparable with Nordic Ecolabel

requirement on 3,5 kg/kg fuel. The requirement 50 mg/m^3 (about 5 g/kg fuel) is on little higher level than the Nordic Ecolabel requirement.

For slow heat release appliances it is set the new more stringent requirement levels: OGC 120 mg/m^3, CO 1200 mg/ m^3 , particles 50 mg/ m^3. Normal slow heat release appliances have typical emission values on CO about 1900-3750 mg/ m^3 (0,15 %-0,3 %). The new models are able to achieve the value of CO under 1500 mg/m^3 (0,12%) and OGC for some models is under 120 mg/m3 and particles under 75 mg/m^3 (DIN+).

The first new sauna stoves that are on the market meet considerably tougher emission limits than conventional sauna stoves. Accordingly, more stringent emissions requirements are specified for sauna stoves. The emission limits are: OGC 120 mg/m^3, CO 17900 mg/m^3, particles 100 mg/m^3.

There are separate limit values for sauna stoves. These have been tightened. Particle test can be conducted directly from the flue and at nominal output with full air inlet flow only. CEN/TS 2009:2009, Annex A.1 is the test method used for particle tests which is comparable with method VDI 2066. Several test laboratories maintain also that it is difficult to measure particle emissions from sauna stoves using a dilution tunnel since the flue must be sufficiently tall to create the proper through draught. Information on the test methods can be found in Section 14.3 of this document.

The current Nordic Ecolabel criteria (version 2.2) do not specify a limit value for NOx. The increased use of biofuel entails a risk of increased NOx levels in the surrounding environment. Accordingly, Nordic Ecolabelling has decided to introduce limit values for NOx. The NOx values for eight tested Nordic Ecolabelled wood and inset stoves lie in the range 69-121 mg/Nm^3. The requirement in the draft criteria is 200 mg/Nm^3 for all stove types. Nordic Ecolabelling consider that NOx is a control parameter of a quality of afuel. Wood fuel produce with firing a low NOx emissions. Nordic Ecolabelling decided not to set NOX requirement in this revision (version 3).

Efficiency

R12 Efficiency (at nominal heat output)

The requirement in the criteria document:

> *R12 Efficiency*
> *The efficiency of the appliance (η_k) when tested at nominal heat output in accordance with the pertinent EN standard, shall be at least:*
>
> - *83% for hand fed slow heat release appliances, as per EN 15250.*
> - *75% for hand fed wood stoves for temporary firing (EN 13240) and inset stoves (EN 13229).*
> - *85% for mechanically fed pellet stoves as per EN 14785 and for hand fed wood stoves for continuous firing as per EN 13240.*
> - *60% for hand fed sauna stoves as per prEN 15821.*
>
> *Requirements on laboratories, the testing of stoves and the measurement of efficiency are described in detail in Appendix 1.*

Full test report.

Background to the requirement:
The limit value for efficiency was not tightened in the previous version of the criteria. The purpose was to enable a tightening of the limit values for emissions. When a stove using conventional technology produces low levels of emissions (low air flow) its efficiency is also low, and vice versa. Having studied the results of our licensing we have concluded that there are generous possibilities to tighten the limit values.

EuP criteria regarding emissions and the efficiency of various stoves are being developed. The proposed EuP criteria are not included in this revision. The work continues and the current results are considered in coming revision. The report TASK 4 presents the efficiency of wood stoves. The average efficiency of 10 tested wood stoves is 74.9% (Table 4-33) and that of 18 inset stoves 76.0% (Table 4-30).

Since only few hand fed stoves fulfil a requirement of 85% efficiency, Nordic Ecolabel has chosen a lower limit despite the RES directive enabling authorities to provide subsidies to stoves that are more than 85% efficient (see Section 8.1 on the RES directive).

Mechanically fed stoves (pellet stoves) can be made more efficient than hand fed stoves since the fuel is homogenous and feeding optimum. Automatic stoves are often used as the primary heat source in a house and it is therefore essential that their efficiency is high. The project group concluded that for the total efficiency of a pellet stove to equal that of a wood stove, the combustion in a pellet stove must be considerably more efficient than that in hand fed stoves due to the energy required for pellet manufacturing. This supports the higher limit value for pellet stove efficiency.

The Austrian regulations on efficiency is 78 % and German regulations 85 % for pellet stoves. Both the Blue Angel and the Austrian ecolabel set a limit value of 90% for the efficiency of pellet stoves. The Nordic Ecolabel sets a limit of 85% for pellet stoves in criteria version 3. There are several pellet stoves currently on the market that are more than 85% efficient (one ecolabelled stove). The Norwegian Jostedalen pellet stove has an efficiency of 93-97%. According to tests, four out of 10 tested pellet stoves are more than 85% efficient[26]. There are also test results showing that water-jacketed pellets stoves can be more than 85% efficient[27]. The requirement of 85% efficiency for mechanically fed stoves is set to enable a greater number of pellet stoves to fulfil this limit value.

According to current market information, modern slow heat release appliance have an efficiency in the region of 73-78%. It is the special ceramic stove boiler on the market which can achieve efficiency on 88 %. However, some stoves have an efficiency in 80-85%. Slow heat release stoves that are more than 80% efficient use advanced combustion technology. There are also some new types of slow heat release appliances who are able to fulfil the stringent requirement on 83 %. For slow heat release appliances it has been tightened the requirement much from 78 % to 83 %.

[26] Test results for pellet stoves, Swedish Energy Authority, December 2008 and March 2009.
[27] Test av vattenmantalde pelletskaminer, Nr. 10/2002 Råd och Rön.

Hand fed stoves (wood, inset and slow release) are highly dependent on how the user feeds the stove and, in particular, the quality of the fuel. Hand fed stoves are often used as a temporary source of heat. Accordingly, the focus of the criteria is on emissions and a somewhat a bit of lower efficiency is acceptable because these stove types may produce less of environmental impacts than normal stoves on the market.

The limit value for wood stoves has however been tightened from today's 73% to 75%.

Figure 4 shows that only one Nordic Ecolabelled wood stove achieves an efficiency of 85%. Information has also reached the project group that a further stove achieves efficiencies of 85%. These stoves have a special construction and are designed to use for continuous firing. Nordic Ecoleblling considers that it is relevant to set the requirement on the higher level for wood stoves which can be fired continuously. The requirement for these stoves is 85 %.

Based on the test results of ecolabelled wood and inset stoves, the new limit value for efficiency is 75%. This means that 95% of wood stoves (58 of 61 tested) and 80% of inset stoves (12 of 15) fulfil the efficiency requirement of 75%.

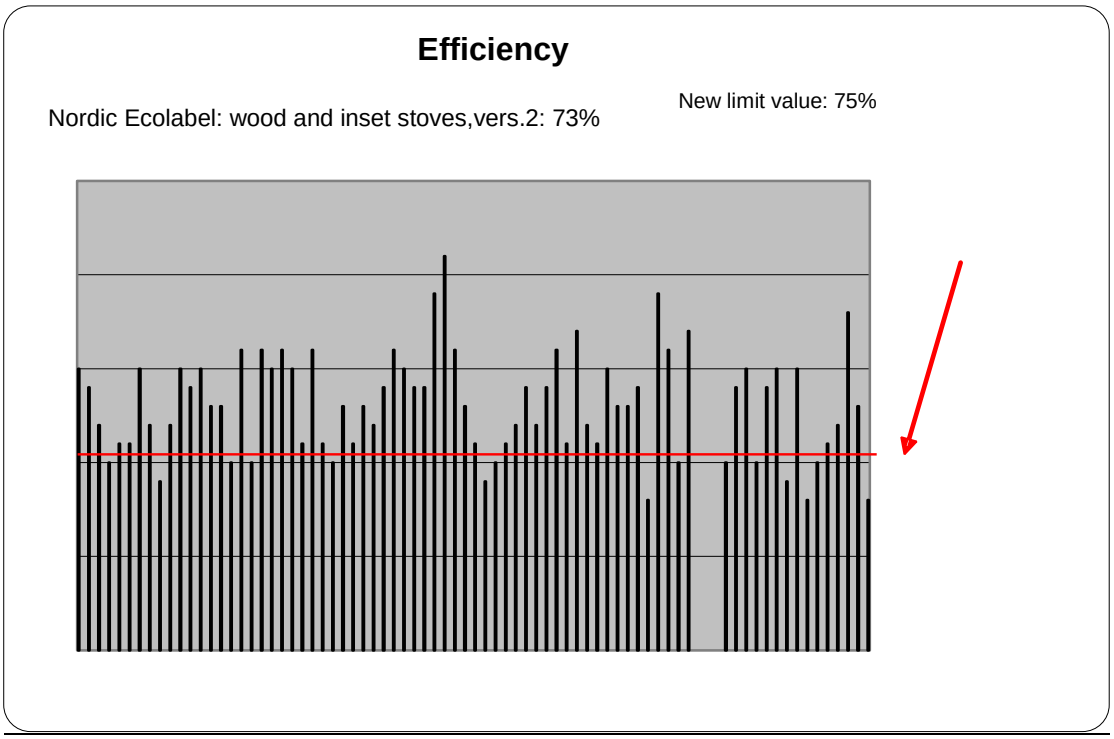

Figure 4. Efficiency test results of Nordic Ecolabelled hand fed wood stoves, weighted values. The limit value of Nordic Ecolabel requirement is in version 2 on efficiency is 73 %. The new limit value is 75 %.

Sauna stoves are not used for heating residential buildings and are therefore not subject to the RES directive. Sauna stoves are fired in such a way as to achieve a high flue gas temperature (400-600°C) so that the stove (stones) becomes sufficiently hot. This reduces the stove's efficiency. The best sauna stoves on the market have an efficiency of 60%, which is in line with the requirement.

In future revision of criteria, it is evaluated if the requirement on efficiency may be raised to 85% for all stove types. According to the RES directive, authorities may then provide subsidies for Nordic Ecolabelled stoves.

Stoves with an efficiency of at least 75/83/85% are assumed to fulfil future EuP criteria.

Efficiency and partial heat outputs

Stoves (excluding water-jacketed and mechanically fed stoves) are often fired at partial heat outputs. Relevant data regarding firing at such outputs has been collected. This issue should be investigated further. It may be suitable to introduce efficiency requirements regarding partial heat outputs. This will be evaluated ahead of the next criteria revision.

Summary of emission and efficiency limit values

Nordic Ecolabelling sets requirement for hand fed stoves regarding the emission of CO, OGC and NOx that are in line with DIN+. The requirement on particles is more stringent that DIN+ requirements. The requirement means that 54% (33 of 61) of wood stoves and 40% (6 of 15) inset stoves that currently carry the Nordic Ecolabel fulfil the emission and efficiency requirements. There are also other stoves that have been tested that fulfil the limit values.

The Nordic Ecolabel emission and efficiency requirements for mechanically fed stoves are more stringent than for hand fed stoves. Two pellet stoves that currently carry the Nordic Ecolabel fulfil the limit values of emissions and efficiency. There are several pellet stoves and wood stoves for continuous firing which fulfil the set requirements on emissions and efficiency.

There are some new models of slow heat release appliances on the market that fulfil the emission and efficiency requirements. New sauna stoves are on the market that may fulfil the revised requirements on emissions and efficiency.

Noise

R13 Noise

The requirement in the criteria document:

> *R13 Noise*
>
> *The noise level from mechanically fed stoves must not exceed 55 d(B)A during normal use measured according to ISO 3743.*
>
> *Requirements on laboratories are described in Appendix 1.*
>
> *Full test report.*

Background to the requirement:

The current noise requirement is 45 dB(A) for pellet stoves. There are only a few pellet stoves on the market that fulfil this requirement. The noise requirement has

been too restrictive. Five out of ten tested pellet stoves fulfil a noise limit value of 55 dB(A)[28]. So that a greater number of pellet stoves fulfil the noise requirement, it is proposed to lower the current limit value to 55 dB(A). The Norwegian Jostedalen pellet stove has a noise level of 38 dB(A).

The noise level of the test pellet stoves is within the range 38-61 dB(A). By way of comparison, air-air heaters produce 40-60 dB(A).

Declaration from the test institute

R14 Declaration on the testing of emissions, efficiency and noise

The requirement in the criteria document:

> *R14 Declaration on the testing of emissions, efficiency and noise.*
> *A laboratory shall certify that the stove is tested in accordance with the specifications in Appendix 1, Section 1.3 for R11-R13.*
> *The laboratory shall be accredited to perform the tests specified according to the Appendix 1, Section 1.2 Test laboratories.*
>
> *Declaration demonstrating the fulfilment of the requirement.*

Background to the requirement:

Applicants must supply sufficient documentation to demonstrate that the stove fulfils Nordic Ecolabel requirements. Ecolabelling requires documentation as to the fulfilment of requirements and a test report.

Not all laboratories provide an official test report but only a description of the test performed, which can be difficult to interpret. It is possible that conditions during testing may differ or that a different test method is used. Under such circumstances, additional tests must be performed. Listed below are the situations in which additional documentation may be necessary.

Situation 1: Nordic Ecolabelling, besides harmonised standards, has chosen to apply a mix of EN, Norwegian and Swedish standards.

When Nordic Ecolabelling started to develop criteria for stoves, the Nordic countries had different legislation with different test methods, different parameters with tests at different heat outputs. Great efforts were expended to align these. One approach would have been to require one method of testing (the EN test method). But Norwegian, Danish and Swedish test methods were all designed to better reflect the actual environmental impact of a stove.

Nordic Ecolabelling has decided to support the use of the Norwegian test method since this specifies particulate matter testing following the cooling of flue gases. This

[28] Test results for pellet stoves, Swedish Energy Authority, December 2008 and March 2009.

better reflects the real-life situation of exposure than the testing of flue gasses in flue. This discussion is now highly topical regarding the standardisation of test methods. It has become apparent that different methods are not comparable. This can make it difficult for administrators at Nordic Ecolabelling to draw clear conclusions form alternative test methods.

Situation 2: Different accredited laboratories using the same test standard get different results.

A further complication is that the results from accredited laboratories in different countries do not correlate. It has been rumoured that some laboratories are "more lenient" than the Nordic laboratories. This difference between results may be the difference between being awarded an ecolabel licence and not. The differences are however less today. Nordic Ecolabelling has received test reports (according to the EN standard) for one and the same stove from laboratories from different countries. The results have varied relatively greatly. This may be explained by the variations between the individual tests and since the test were performed at different times. But the differences should not be significant. Kim Winter from the Norwegian Institute of Technology confirms that test laboratory results differed 10 years ago. The laboratories that are approved to perform tests to the EN standard have been and continue to be aware of this problem. The differences between laboratories are less today according to Kim Winter.

Some manufacturers have proposed that Nordic Ecolabelling should only approve Nordic laboratories. Nordic Ecolabelling believe that this can present a trade barrier.

Situation 3: Some laboratories do not supply a comprehensive test report.

Some laboratories do not supply a comprehensive test reports. This means, for example, that it is not possible to see which heat outputs have been used during testing. We shall in connection with licensing request additional documentation to attain a complete test report.

Situation 4: In case of the use of alternative test methods (see also Section 14.3.2).

In certain cases an alternative test method for particle emissions may be approved if the tested heat outputs can be documented and if the results are sufficiently good that it is highly unlikely that the level of particulate matter should rise dramatically at a defined heat output. Only an accredited laboratory can make such an evaluation. A declaration shall ensure that evaluation is correct.

The laboratory shall certify that the stove is tested according to the requirements specified in Appendix 1.3. Nordic Ecolabelling has the right to require the additional documentation. If it is uncertain by handling of application if the requirements R11-R13 are fulfilled must the laboratory declare that the actual stove fulfils the requirements in R11-R13. For example if it is needed the laboratory must do the technical consideration and approve only if the only test is carried for ground on consideration for several models of stoves.

Customer information

It has become apparent that manufacturers supply different installation manuals in different countries. One reason is that regulatory requirements vary between countries. Another may be poor translation. The installation manual and operating and maintenance instructions must be specified.

Assessment of requirements on the installation manual and operating and maintenance instructions (R15 and R16)

The requirement in the criteria document:

Installation manual (R15)

The stove shall be supplied with an installation manual. The installation manual shall be easy to understand and written in the national language of the Nordic country in which the stove is installed. The manual shall also be found as written in the national language or in English on the internet. The manual shall include the following information and recommendations:

- *Installation of stove and possible particle filter shall be performed as specified by a qualified fitter.*
- *Technical data for the stove (such as material types, dimensions, weight, heat output).*
- *Necessary volume of air for combustion, air inlet flow per m3 per hour.*
- *Distance from combustible materials.*
- *Space required for operation, maintenance and chimney sweeping.*
- *Guidelines for the type of gas flue to which the stove can be connected with regard to flue gas temperature and the dimension including height and location of the gas flue canal/chimney.*
- *Guidelines for the design of a storage vessel for pellets, if such fuel shall be used. How the storage of pellets is designed in order to that a fuel keeps its quality by emptying and storing and that carbon monoxide which is possible emitted from storing does not cause health risk or danger to life.*
- *Ventilation and installation of sauna stoves in a sauna, with regard to the size of the sauna.*
- *How to dispose of packaging in the Nordic countries where a stove is sold.*

Copy of the installation manual that is supplied with the stove to fitter and customers.

Operating and maintenance instructions (R16)

Operating and maintenance instructions shall be supplied with each supplied stove.

The instructions shall be easy to understand and written in the national language of the Nordic country in which the stove is sold. The instructions shall also be found as written in the national language or in English on the internet. The instructions shall contain the following information:

- *Information on classification of stove for temporary firing or for continuous firing.*
- *How different fuels (types, grades) influence emissions.*
- *Suitable fuels for the stove and information that fossil fuels should not be used. That Nordic Ecolabelled pellets should be used in pellet stoves.*
- *Recommendations for the handling and storage of wood, pellets and other possible solid biofuels. How the storage of pellets is designed in order to that a fuel keeps its quality by emptying and storing and for that carbon monoxide which is possible emitted from storing does not cause health risk or danger to life.*
- *How to light a fire.*
- *Directions on laying the fire and maximum wood length.*
- *Adjustment of air inlet. How by what kind of measures it is secured the required air inlet of air for combustion for a stove.*
- *How a low air supply can result in poor combustion, high emissions and low efficiency.*
- *Instructions on cleaning, inspection and maintenance of stove and possible particle filter.*
- *Instructions describing the recommended maintenance.*
- *Content of guarantee and period of validity in years shall be given. Guarantee shall meet the requirement in R2.*

Copy of the operation and maintenance instructions that are supplied with the stove to fitters and customers.

Background to the requirement:
Some of the specified requirements are to be documented in the installation manual. This requirement is primarily to guarantee that the stove is installed and used in the correct manner to minimise environmental impact. Even if a stove achieves excellent test results in laboratory tests, it may perform significantly less well if installed incorrectly.

Requirements regarding qualified fitting: Ideally, all Nordic Ecolabelled stoves should be installed by a qualified fitter. It is however not possible to impose this requirement on the open market. Instead, Nordic Ecolabelling required that the manufacturer provides contact details to qualified fitters.

It has become apparent during the review of applications that manufacturers have found it difficult to fulfil this requirement. This has probably delayed the registration of stoves in so much as manufacturers have had to contact neighbouring countries to contact fitters. We believe that our requirements have influenced the number of licences in Sweden. It is likely that there are now a greater number of qualified fitters for Nordic Ecolabelled stoves.

The requirement is in line with the proposal for a Commission directive on the promotion of the use the use of energy from renewable sources. 2008/0016(COD), Article 13.
Conclusion: No change required in this revision.

Requirement on information regarding the handling and storage of fuel: The information provided by the manufacturer has in some cases been substandard but has been quickly rectified. This requirement is most important for pellet stoves.
Conclusion: Retain the requirement.

Requirement on the description of the gas flue:
Data has in some cases been submitted without issue.

The design of the gas flue is important, especially as the efficiency requirements are tightened. Supply air for circulation is another important factor. In airtight, energy-efficient houses, modifications may be required to increase the supply of air.

If the correct information has been submitted, it may mean that the market for stoves is reduced since they simply are not suitable for certain houses with their existing gas flue. It is vital that the customer is provided with this information. Chimney-sweeps have reported that they sometimes find themselves in the difficult situation that the stove and the gas flue they are inspecting are incompatible. There is therefore a wish to require that the manufacturer provides clear information as to the air flow demanded by the stove. This is influenced by the dimensions of the gas flue and the supply flow.

Conclusion: The requirement of information regarding the gas flue in the installation manual was considered and compared to the EN standard for stoves.

Fuel
It is vital to provide information as to how different fuels (types and grades) influence heat output and emissions, and to provide recommendations regarding suitable fuel. For example, it shall be stated that fossil fuels must not be used.
Conclusion: Supplementary information on the fuel shall be provided.

Other technical data and user information: This has been of varying quality and in some cases entirely incorrect. Nordic Ecolabelling has in such cases helped manufactures to improve the standard of their manuals. It is important that the installation manuals are clear and correct to ensure the quality of the Nordic Ecolabelled product.

Conclusion: We clarify the requirements on installation manuals (R15) and consumer information (R16) to ensure their high standard.

Manufacturer's requirements on resellers and fitters (Section 4)

R17 Qualification requirements

The requirement in the criteria document:

R17 Qualification requirements
If the stove has a water jacket and a supplementary solar collector, the reseller must recommend a qualified fitter.

Example of the written information supplied to resellers and fitters.

Background to the requirement:
No changes.

R18 Design and sizing of the heating system

The requirement in the criteria document:

R18 Design and sizing of the heating system
If the stove has a water jacket and the heating system has a supplementary solar collector, the heat system of water jacketed stove/solar collector must be correctly designed and sized.

Example of the written information supplied to resellers and fitters.

Background to the requirement:
Specification of heat system was realized.

R19 Other information

The requirement in the criteria document:

R19 Other information
The manufacturer shall inform resellers that:

- *The stove should be installed by a qualified fitter.*
- *That the user must have access to the installation manual and operating and care instructions.*

Example of the written information supplied to resellers and fitters.

Background to the requirement:
An example of the written information shall be submitted to the reseller.
Minor amendment to the requirement text.

Quality and regulatory requirements (Section 5)

R20 Laws and regulations (regulatory requirements)

The requirement in the criteria document:

> *R20 Laws and regulations*
> *The licensee must ensure that local applicable laws and regulations in force are observed at facilities at which the Nordic Ecolabelled stove is manufactured. For example, local regulations and provisions regarding health and safety, the working environment, environmental legislation (including REACH) and plant-specific conditions and concessions, must be followed in the country where stove is manufactured.*
>
> *Declaration from the licensee that the requirement is met, and details of the regulatory authority. See Appendix 2.*

Background to the requirement:
Local regulatory requirements must always be followed, irrespective of where the manufacturer its suppliers are located. Regulatory requirements include the REACH system. The requirement text now includes that health and safety shall comply with requirement. The requirement text has been specified in the criteria version 3.

R21 Licence administrators

The requirement in the criteria document:

> *R21 Licence administrators*
>
> *The manufacturer and the licensee if it is the other one than manufacturer shall appoint an individual responsible for ensuring the fulfilment of Nordic Ecolabel requirements, and a contact person for communications with Nordic Ecolabelling.*
>
> *Organisational structure showing the above areas of responsibility.*

Background to the requirement:
The company shall appoint an individual responsible for ensuring the fulfilment of Nordic Ecolabel requirements, and a contact person for communications with Nordic Ecolabelling. This requirement is common to all Nordic Ecolabel products. No changes have been made since the previous revision.

R22 Documentation

The requirement in the criteria document:

R22 Documentation
The licensee must keep the following documents during the licence period. The licensee must be able to present these documents during the application process and follow-up inspections:

- *Copy of the entire application.*
- *Facts/basic data (including test reports, documents from suppliers and suchlike).*
- *Results from inspections of the production of the ecolabelled product.*
- *Returns and complaints.*

Checked on site by licnsee/manufacturer.

Background to the requirement:
The requirement on quality assurance specifies that documentation regarding the application shall be kept by the applicant. The section on documentation has been moved from Section 1.2 in version 2.2 since the previous heading was somewhat long and has now been changed to "Documentation".

R23 Stove quality

The requirement in the criteria document:

R23 Stove quality
The licensee must ensure that the quality of manufacturing of the Nordic Ecolabelled stove is maintained throughout the validity period of the licence.

Nordic Ecolabelling maintains the right to request documentation of the annual quality inspection of manufacturing if the laboratory has performed such a test.

Requirements regarding the quality of materials are found under R2.

Procedures for collating and, where necessary, dealing with claims and complaints regarding the quality of the Nordic Ecolabelled stove. Documentation regarding quality control during manufacture if requested by Nordic Ecolabelling.

Background to the requirement:
When a manufacturer holds a licence for the manufacture of Nordic Ecolabelled stoves, they must guarantee that requirements are fulfilled for the entire licence period. In this revision it has been added that Nordic Ecolabelling maintains the right to request documentation regarding quality control during manufacture if the test laboratory has performed such a test. Such checks can for example regard the organisation, documentation, purchasing procedures, inspection plan, production (incl. checking that labelled products fulfil the requirements), the procurement of components for labelled products and corrective actions. Quality regarding materials is covered by R2.

R24, R25 and R26 Changes, non-conformities and traceability

The requirement in the criteria document:

R24 Planned changes

Planned changes to manufacturing controlled by Nordic Ecolabel requirements must be reported in writing to Nordic Ecolabelling and the licensee (if other than the product manufacturer).

Procedures detailing how planned changes are handled.

R25 Unplanned non-conformities

Unplanned non-conformities in manufacturing related to areas controlled by Nordic Ecolabel requirements must be reported in writing to Nordic Ecolabelling and the licensee (if other than the product manufacturer) with keeping records.

Procedures detailing how unplanned non-conformities are handled.

R26 Traceability

The licensee/manufacturer must have a traceability system for the production of the Nordic Ecolabelled stove.

Description of/procedures for the fulfilment of the requirement.

Background to the requirement:
Requirement R24, Planned changes, R25 Unplanned nonconformities, and R26 Traceability are all general requirements included in all Nordic Ecolabel criteria. These requirements have not been changed from previous versions.

R27 Take-back system

The requirement in the criteria document:

R27 Take-back system
Applicable national regulations, legislation and/or agreements within the sector regarding the recycling systems for products and packaging shall be met in the Nordic countries in which the Nordic Ecolabelled stove is marketed.

Statement from the applicant regarding adherence to existing recycling/take-back agreements.

Background to the requirement:
Previous requirement. No changes.

R 28 Marketing

The requirement in the criteria document:

A Nordic Ecolabelled stove may be marketed using the Swan label so long as the associated licence is valid.

The label must be positioned so that there is no doubt as to what the label refers and so that it is clear that the stove is ecolabelled.

More information on marketing can be found in "Regulations for Nordic Ecolabelling" of 12 December 2001 or later version.

✉ *The filled appendix 5.*

Background to the requirement:
The Nordic Ecolabel, the Swan, is a very well-known and well-reputed trademark in the Nordic region. A Nordic Ecolabelled stove may be marketed using the Nordic Ecolabel so long as the associated licence is valid.

The general marketing requirements must be fulfilled. No changes to the requirement.

Testing (Appendix 1 in the criteria document)

Testing

The requirement in the criteria document:
The stove must be tested to determine the flue gas emissions regarding carbon monoxide, hydrocarbons expressed as organic gaseous carbon (OGC), particles and efficiency. Testing is based on the European standards. But testing shall also be performed at the heat outputs specified by the Norwegian standard (NS).

Mechanically fed stoves must also be tested for noise.

The test laboratory shall produce a comprehensive test report that contains information on the following.

1. Selected test method.
2. Results from all tests.
3. A clear definition of the stoves.
4. Confirmation that the test has been performed in accordance with the method specified, except where stated otherwise.
5. Specification of the test fuel.
6. That the laboratory fulfils the specified requirements and can demonstrate that testing is performed in an impartial, competent manner.

Sample products shall be chosen at random from the factory's warehouse or from the open market.

Nordic Ecolabelling maintains the right to request additional documents regarding the fulfilment of requirements and test reports.

Background to the requirement:

A comprehensive test report shall be submitted with the application. The accredited laboratory shall submit test results that demonstrate that the stove fulfils Nordic Ecolabel requirements regarding emissions, efficiency and noise (if applicable).

Conclusion: The laboratory shall produce a comprehensive test report that demonstrates fulfilment of emission, efficiency and noise requirements.
Nordic Ecolabelling maintains the right to demand comprehensive test results.

Test laboratory

The requirement in the criteria document:

Flue gas tests shall be performed by an accredited laboratory that fulfils the general requirements of EN ISO/IEC 17 025. An alternative laboratory may perform testing if the laboratory has applied for accreditation according to an applicable test method but has not yet been granted approval or because it does not exist accreditation for technical specification or a proposal of the a standard. The laboratory must be able to show that it is independent and qualified.

If the country of origin lacks an accredited laboratory, the laboratory may be chosen following approval from Nordic Ecolabelling.

Noise can be tested by the manufacturer of the appliance if the manufacturer has been assessed by a notified body in accordance with Directive 2002/14/EC relating to noise emission.

Background to the requirement:
The analysis laboratory used shall fulfil the general requirements of standard EN ISO/IEC 17025. An accredited laboratory shall perform the tests.

In countries that lack an accredited laboratory, a competent independent body may perform tests in the same way as in the current criteria. Finland does not have an accredited laboratory. VTT has official approval to perform tests for the CE label. Conclusion: No changes to the criteria.

Test methods

Applicable test methods

The requirement in the criteria document:

Testing of hand fed stoves

Slow heat release appliances shall be tested at nominal heat output only. CO and efficiency tests shall comply with EN 15 250 and OGC test shall comply with CEN/TS 15883, with the following modifications. Particle tests shall comply with applicable sections of CEN/TS 15883:2009, Annex A.1.

Wood stoves for temporary or continuous firing: CO and efficiency tests shall comply with EN 13 240 and OGC test shall comply with CEN/TS 15883, with the following modifications. Particle emissions from wood stoves shall be tested at up to four heat outputs (within burn rate categories) according to NS3058 and NS3059.

Inset stoves: CO and efficiency tests shall comply with EN 13 229 and OGC test shall comply with CEN/TS 15883, with the following modifications. Particle emissions from inset stoves shall be tested at up to four heat outputs (within burn rate categories) according to NS 3058 and NS 3059.

Sauna stoves: CO and efficiency tests shall comply with EN 15 821 and OGC test shall comply with CEN/TS 15883. Particle emissions from sauna stoves shall be tested at nominal heat output according to CEN/TS 15883:2009, Annex A.1.

Test assembly

Slow heat release appliances and sauna stoves

Stoves are tested for CO, OGC and particles at nominal heat output connected to an extraction system according to the instructions in the standard in question.

Stoves and inset stoves

Nominal heat output tests for CO and OGC shall be performed with the stove connected to an extraction system according to the instructions in the standard in question. The rest of the extraction system shall be designed as a dilution tunnel as described in NS 3058-2, Section 4.2.

Testing for particles at different heat outputs (within burn rate categories) shall be conducted with the stove connected to a chimney as described in NS 3058-1, Section 3.1, and the rest of the extraction system shall act as a dilution tunnel as described in NS 3058-2, Section 4.2.

Fireplaces with water tanks must also be connected to a water system that can ensure the flow temperature is maintained at 80 ± 5±C.

Fuel

Hand fed stoves shall at nominal output be fired on the fuel specified in each standard.

At different heat outputs (within burn rate categories) the test fuel and fill quantity must comply with NS 3058-1, Section 4.3.

Procedure

During particle testing, pre-firing (stove ageing) in accordance with NS 3058-1, Section 6.1 may be excluded, if the partial heat output tests are not part of a complete type approval in accordance with Norwegian NS 3058 and NS 3059.

Nominal output tests of hand fed stoves shall comply with EN standards. The measurement of the total hydrocarbon content (THC) shall comply with CEN/TS 15883.

Different heat output tests (within burn rate categories) for particles of hand fed stoves shall comply with EN 3058-2, Section 6.2 and 6.3. Testing shall be conducted at normal pressure with outputs equivalent to class 1 and 2 different heat outputs.

Measurements

The following measurements must be taken during testing at nominal heat output:

- CO, CO_2 or O_2 and flue gas temperature measured in accordance with the specific EN standard.
- Room temperature measured according to the specific EN standard.
- Total hydrocarbon content (THC) measured according to CEN/TS 15883, as a basis for determining OGC.
- Particle emissions for hand fed stoves and inset stoves measured in accordance with NS 3058-2. The ignition phase is not included in the measurements.

- Flue gas pressure and temperature measured according to the specific standard.
- Particle emissions from slow heat release appliances shall be measured according to CEN/TS 15883:2009, Annex A.1.
- Efficiency measured according to the specific EN standard.

For different heat outputs the following shall be measured:

- Flue gas temperature in accordance with NS 3058-1 Section 4.1.2.
- Particle emissions for hand fed stoves and inset stoves measured in accordance with NS 3058-2. The ignition phase is not included in the measurements.
- Flue gas pressure measured in accordance with NS 3058-1, Section 3.8.

Calculations

OGC calculations shall follow CEN/TS 15883 and be based on an average total hydrocarbon content (THC) measured at nominal heat output for stoves for temporary and continuous firing and inset stoves.

Particle emissions for hand fed stoves and inset stoves shall be calculated according to NS 3059, Section 4. The emission level shall be calculated for each individual heat output range and as a weighted mean value of all tests.

Particle emissions from slow heat release appliances shall be calculated according to CEN/TS 15883 2009, Annex A.1.

Testing of mechanically fed stoves

Pellet stoves: CO and efficiency tests shall comply with EN 14 785 and OGC and NOx test shall comply with CEN/TS 15883, with the following modifications. Partial heat output tests are performed without thermostatic control. OGC and particle emissions from pellet stoves shall be tested at nominal heat output and at two partial heat outputs (within different burn rate categories) according to NS 3058 and NS 3059 with partial heat outputs defined according to test methods described under in the chapter “Procedure”. Stoves shall also be tested for noise according to ISO 3743.

Test assembly

Nominal heat output tests shall be performed with the stove connected to an extraction system according to the instructions in the standard. The rest of the extraction system shall be designed as a dilution tunnel as described in NS 3058-2 Section 4.2.

Testing at partial heat output shall be conducted with the stove connected to a chimney as described in NS 3058-1, Section 3.1, and the rest of the extraction system shall act as a dilution tunnel as described in NS 3058-2, Section 4.2.

Mechanically fed stoves with built-in smoke extraction or other mechanical installations in the air and/or smoke ducts may be connected to a chimney according to the manufacturer’s instructions.

Stoves with water tanks must also be connected to a water system that can ensure the flow temperature is maintained at 80 ± 5°C.

Noise emissions shall be measured during combustion at a power output of 3-5 kW. Testing shall comply with ISO 3743.

Fuel

Pellets complying with the specifications of EN 14 785 shall be used for testing. The specifications allow a variable grade of pure wood raw material. If testing uses a fuel of a lesser grade but that nonetheless fulfils the standard, this shall be specified. In this case, the customer must be encouraged to purchase fuel of such a grade.

In exceptional cases, following approval from Nordic Ecolabelling, fuel grades other than pure wood raw material may be used, such as straw pellets or other biomaterial. This must be stated clearly. In this case, the customer must be encouraged to purchase fuel of such a grade. Peat is not considered to be a biofuel.

Procedure

Partial heat output testing shall be conducted over 2 x 4 hours (4 hours for each output level). Testing shall be performed at ≤ 2 kW and 3-5 kW. Testing shall take place at normal pressure, unless otherwise stated by the manufacturer or if the stove is designed to operate with a smoke extractor or other mechanical installations in the air and/or smoke ducts. In both tests, measurement begins after half an hour once the stove output has stabilised.

Measurements

The following measurements must be taken during testing at nominal heat output:

- CO, CO_2 or O_2 and flue gas temperature measured in accordance with EN 14 785.
- Room temperature measured according to EN 14 785.
- Total hydrocarbon content (THC) measured according to CEN/TS 15883 to determine OGC.
- Particles measured in accordance with NS 3058-2. The ignition phase is not included in the measurements.
- Flue gas pressure measured according to EN 14 785.
- Efficiency measured according to the specific EN 14 785.
- Noise.

For partial heat outputs the following shall be measured:

- Flue gas temperature in accordance with NS 3058-1 Section 4.1.2.
- Particle emissions in accordance with NS 3058-2. The ignition phase is not included in the measurements.
- Total hydrocarbon content (THC) measured according to CEN/TS 15883 to determine OGC.
- Flue gas pressure measured in accordance with NS 3058-1, Section 3.8.

Noise emissions shall be measured during combustion at a power output of 3-5 kW. Testing shall comply with ISO 3743.

Calculations

OGC calculations shall be made in accordance with CEN/TS 15883 based on the measured THC at nominal heat output and two partial heat outputs. A weighted mean value is calculated for partial heat outputs.

Particle emissions shall be calculated according to NS 3059, Section 4. The emission level shall be calculated for each individual heat output range and as a weighted mean value of all tests.

Background to the requirement:

Test methods

The test methods have been reviewed and are up to date. New methods for OGC (CEN/TS 15883) have been introduced for all stove types, and for CO and efficiency (prEN 15821) for sauna stoves. Regarding OGC (THC), test methods SP1695 may not be used.

Previous test methods regarding CO and efficiency shall be used. Slow heat release stoves shall be tested to EN 15250, hand fed wood stoves to EN 13240, inset stoves to EN 13229, and mechanically fed appliances (pellet stoves) to EN 14785. Particle emissions shall be tested in accordance with NS 3085 and NS 3059 for stoves fired at nominal and partial heat outputs.

The testing of particle emissions from slow heat release stoves and sauna stoves are fired at nominal heat output and may be performed in the gas flue using methods CEN/TS 15883:2009, Annex A.1.

Conclusion: Current test methods were included in the criteria.

Testing of particle emissions from slow heat release stoves and sauna stoves at nominal heat output

There are difficulties with using a dilution tunnel to test particle emissions from slow heat release stoves and sauna stoves. The chimney has to be sufficiently tall to provide the right air flow. In some cases it is unfeasible to construct such a flue to further connect a dilution tunnel. The Norwegian test method is based on natural draught, unlike the EN standard. It is therefore suitable for slow heat release appliances to be tested using CEN/TS 15883:2009, Annex A.1 (the German/Austrian method) which is used for testing particle concentrations in the hot flue gases in the chimney. The EN standard for slow heat release appliances does not measure particle emissions.

A limit value for particle emissions from slow heat release stoves was therefore set during the evaluation of the criteria (12/2008). Our ambition is that in this revision to tighten the limit value for slow heat release stoves (requirement: 50 mg/m^3).

The revised requirement applies to particle emissions from sauna stoves. The sauna stoves in question are only fired at nominal heat output (full inlet air flow) and can be tested using the German method which is given on the technical specification CEN/TS 15883:2009, Annex A.1.

Conclusion: Slow heat release appliances shall be tested with flue gas sampled from the gas flue using test method CEN/TS 15883:2009, Annex A1. Sauna stoves are fired at nominal heat output and shall also be tested at nominal heat output with full inlet air flow according to this method.

Alternative test methods

The requirement in the criteria document:
Nordic Ecolabelling may approve products for licensing based on test results from testing methods other than those mentioned above if the test method in question is assessed as equivalent by an independent, competent body.

Background to the requirement:
It is possible to use alternative test methods provided that the accredited laboratory describes the basis for its evaluation. The following information shall be included:

- Details of the measurement method used.
- At least the results of particles measured in the dilution tunnel/gas flue, CO or OGC. Stoves (excl. slow heat release appliances) shall be tested at nominal and partial heat outputs, unless they are only for use at nominal heat output.
- Justification as to why the fireplace in question is deemed to have satisfied the requirements in the criteria document. This justification must include comparative reasoning regarding the combustion cycle.

Since several working groups are currently revising the standards for testing stoves, the issue of uniformity between test methods has been discussed during the revision. It has been difficult to find a relationship between particle tests of hot flue gases and cold gases in a dilution tunnel. It is not possible to "translate" a limit value in mg particles/m^3 gas to g particles/kg fuel. The limit values are strictly tied to the specific test method. Danish legislation has solved this issue by specifying two limit values.

Conclusion: Alternative test methods may be used under certain conditions, according to the laboratory's assessment.

Design of the Nordic Ecolabel

During the revision, it was considered whether it would be possible to use a subtext with the Nordic Ecolabel logotype, the Swan, stating that the efficiency of wood stove, slow heat release appliance or pellet stove exceeds 85% (as per the RES directive). This subtext, which would specify a higher efficiency than that required in the criteria document, could however cause confusion. How efficient is a Nordic Ecolabelled stove? To avoid misunderstanding, it has been decided that the Nordic Ecolabel logo should not include this subtext.

The manufacturer is able to present this information to customers in some other form if the stove fulfils the higher level of efficiency (>85%) and fulfils the RES directive requirements on support schemes. The ecolabelled pellet stoves and wood stoves for continuous firing meet the requirement 85 %.

Changes from the previous criteria version

The new criteria introduce the following changes:

- New, tightened limit values for emissions and efficiency.
- Adjusted noise requirements.
- New material requirements.
- New quality requirements.
- Updated test methods.
- Clarification of customer information.

New criteria

Ahead of coming revisions, the following requirements will be evaluated:

- More stringent requirements on emissions and efficiency.
- Material/production requirements including the requirement on surface treatment.
- Whether it is possible to require that other solid biofuels do not have negative health effects.
- Whether stoves fired on liquid biofuel can be included in the product group with relevant requirements for such.
- The recycling of stoves.

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APPENDIX 1

Requirements that have been discussed but not introduced in this version of the criteria

Material and production requirements

Metal
1.1 Cast iron and steel products (Ref. BAT report: http://eippcb.jrc.es/reference/i&s.html)

1.1.1 Percentage recycled iron and steel raw material
Metal production has a high local environmental impact. Metal production produces emissions and consumes large quantities of energy. In general, using recycled metals reduces energy consumption and emissions. In principle, the manufacture of a stove can choose its supplier of metal but it can be difficult for small stove manufacturers to acquire information regarding metal production.

Iron and steel manufacturers use roughly 20% recycled material in their metal production (large-scale, ore-based production). The production processes and availability of scrap metal varies, which influences the proportion of iron and steel that is used. Metal and scrap metal are valuable materials and there is a history of recycling. The licensee has limited potential to influence developments in this area, which makes it unnecessary to set requirements regarding recycled material.

Manufacturers of cast iron fireplaces use 100% recycled iron. For example, according to Danish licensees all cast iron in their products comprises scrap iron. Therefore it is unnecessary to set requirements in this area.

One conclusion is that the Nordic Ecolabel does not have sufficient potential to influence the development (and relevance) of the use of recycled metal (scrap metal) since all scrap metal is already used. There are no potential environmental benefits regarding cast iron fireplaces since the cast iron already comprises 100% scrap metal.
It is difficult to control energy consumption during metal production. There are no differences between the products with regard to design for recycling (reduced potential for environmental improvements). The following points (Working environment at production facilities, energy consumption/recovery in production, purification of process water) will be taken into consideration in the next revision (approx. 2011-2012). Greater resources are required for an investigation of metal production before relevant requirements can be set regarding this points.

1.1.2 Working environment at production facilities

In future revisions it should be possible to set requirements regarding dust, organic chlorine compounds, SO_2, NOx, heavy metals and similar in metal production and require waste gas dedusting. There are ventilation systems and purification technologies intended for this purpose. Metals can be recovered from the filter dust and can be recycled rather than disposed of as waste.

Current limit values for emissions to air:
Dust < 10 mg/Nm^3 (for steel production BAT < 5 mg/Nm^3 for new facilities and < 15 mg/Nm^3 for existing plants.)
NOx < 350 mg/Nm^3

It is also vital to prevent leaks such as from old furnace doors and covers used in the smelting process and when the molten iron is poured into moulds. Such leaks are a detriment to the working environment and pose an unnecessary load to the possible waste gas dedusting system. This area may be subject to a requirement in the future.

Foundry sand can contain furfuryl alcohol, which is carcinogenic. It should be investigated whether it is possible to phase-out the use of this substance so that Nordic Ecolabelling can prohibit the use of dangerous substances in future revisions.

1.1.3 Energy consumption/recovering in production

In future revisions, it should be evaluated whether excess heat from smelting furnaces and production premises can be recovered and used at the facility (e.g. scrap preheating) or even as an external source of heat.

1.1.4 Purification of process water

If the production process uses rinsing water, this will contain some substances that must be removed on-site before the water is released into the municipal waste water system. Purified rinsing water can also be reused to reduce the total water consumption. Proposed relevant parameters for emission limits for future revisions:
NH_3 < 20 mg/l
COD > 90%
Sulphide < 0.1 mg/l
PAH < 0.05 mg/l
CN < 0.1 mg/l
Phenols < 0.5 mg/l
$NH_4 + NO_3 + NO_2$ < 30 mgN/l
Suspended solids < 40 mg/l

1.1.5 Surface treatment of iron and steel
(BAT: http://eippcb.jrc.es/reference/stm.html)

Substances used for the surface treatment of metals
The surface treatment of metal parts requires baths with degreasing and rinsing water, often in several stages. Various drying processes are used before the metal is ready for surface treatment. BAT uses 3-20 litres of water/m^2 metal surface/stage. The purification and reuse of the process water, acid baths and metal sediments. It should also be required that cutting fluid is as far as possible removed physically before the metal is put in the degreasing bath to reduce the consumption of chemicals and prolong the interval for changing the bath fluid.

According to the BAT report, alternatives to the following substances can be used:

- EDTA
- PFOS
- Chrome
- Cyanide

The use of Nordic Ecolabelled cutting fluid (lubricant) should be promoted. Such fluids are covered by the Nordic Ecolabel requirements for lubricants.

Conclusion: Regarding metal surface treatment agents, the decision was taken not to set requirements prohibiting the use of substances that are included in the REACH/ECHA or RoHS Directive. Instead, applicable regulatory requirements connected to the REACH/ECHA and RoHS directive must be followed in the production of the stove.

1.2 Stone production

It may in future revisions be appropriate to set requirements on the quarrying of stone. At current, there are EU Flower criteria for hard floor coverings (stone and tiles). It should however be evaluated whether requirements should be introduced regarding stone production (incl. tiles) in future revisions.

Conclusion: The requirement shall be evaluated ahead of the next revision and include an investigation of the primary production of stone products.

1.3 Glass manufacturing

Glass manufacturing (BAT: http://eippcb.jrc.es/reference/gls.html)

1.3.1 Composition

Borosilicate glass is the most commonly used material in stove doors. It contains 70-80 % SiO_2, 7-15 % B_2O_3, 4-8 % Na_2O or K_2O and 2-7 % Al_2O_3. NB! Boron has serious health and environmental properties. Lead hydrogen arsenate and triethyl arsenate are used in the glass. There are no alternative substances that can be used. There are only two manufacturers in the world: Schott Glas (Germany) and Keraglass (France).

The manufacturing of some special glass uses lead, arsenic, fluorine and other substances that Nordic Ecolabelling should prohibit in future criteria.

Limited substances are specified in the RoHS directive and REACH/ECHA candidate list, Annex 1 (http://echa.europa.eu/chem_data/candidate_list_en.asp). The requirement does not apply to glass as it is not possible or very difficult for stove manufacturers to gain information regarding suppliers. This also means that there no requirements regarding other raw materials that are used in insulation.

Conclusion:

It was decided not to prohibit substances that are limited by the REACH/ECHA or RoHS directives from use in glass or insulating material (or all other materials that make up the stove, see above). Instead, this requirement shall apply to the manufacture of the stove itself.

The following requirements – working environment and emissions to air, the use of recycled glass from stove doors, energy recovery, and waste water – shall be evaluated prior to the next revision of the criteria. Significant resources are required to investigate glass manufacturing, such as the aforementioned items and the BAT/BREF reports, before it is possible to set relevant requirements in this area.

1.3.2 Working environments and emissions to air

According to the BAT report, ventilation and dedusting systems can be installed that reduce the dust from glass production to <5 mg/m^3. This will be taken into consideration in future revisions.

1.3.3 Use of recycled glass from stove doors

According to the BAT report, it would be beneficial to have standardised glass types to enable recycling in the future. This type of recycled glass is currently not available on the market. Accordingly, the area is not applicable for ecolabelling.

1.3.4 Energy recovery

Glass manufacturing consumes significant amounts of energy for the melting and moulding of glass. It is hoped that future criteria will be used to stimulate the recovery of energy from processing.

1.3.5 Waste water

Glass is processed and rinsed before being sent to the market. Processing generates unwanted waste water and glass particles. These may also contain lead, arsenic and fluorine, if these substances have been used in the manufacturing process.

1.4 Plastics

The current requirements on plastics (version 2.2 of the criteria) concern labelling and their content of heavy metals, phthalates and halogenated flame retardants. Since only small plastic parts are used in stoves, Nordic Ecolabelling proposes that these requirements on plastics are omitted.

Conclusion: The requirement on plastics has been omitted from the criteria since only small plastic parts are used in stoves. Small parts have limited environmental impact compared to the other constituent materials of the stove. It is also difficult, or impossible, for the stove manufacturer to attain details regarding such small parts from their suppliers.