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**SINTEF NBL as**

Address: NO-7465 Trondheim, Norway  
Location: Tillerbruvegen 202

Telephone: +47 73 59 10 78  
Fax: +47 73 59 10 44  
E-mail: nbl@nbl.sintef.no  
Internet: nbl.sintef.no

Enterprise No.: NO 982 930 057 MVA

# SINTEF REPORT

TITLE

**Ethanol-fuelled, flue-less fireplaces. An evaluation.**

AUTHOR(S)

Karolina Storesund, Thai T. Mai, Christian Sesseng

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**ABSTRACT**

Fireplaces fuelled with ethanol have lately become a trendy design element in Norwegian homes and public buildings, and the number of such units is increasing. Being a new type of product the safety regulations are still unspecific and a number of accidents have been reported.

This report has been aimed at identifying and suggest measures to be taken in order to prevent accidents to occur in the future.

Tests were conducted, mainly with respect to temperature development, on 4 ethanol-fuelled fireplaces, which are available on the Norwegian market from different price segments. Their instruction manuals were evaluated in order to get a notion of the quality level of current documentation.

Finally, recommendations for properties to be tested and suitable contents of the documentations, as well as suggestions to further work are presented.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	Fire	Brann
GROUP 2	Safety	Sikkerhet
SELECTED BY AUTHOR	Fireplace	Ildsted
	Ethanol	Etanol

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### Acronyms used in this report

Acronym	Name in original language	Name in English	Country
BE	Statens bygningstekniske etat	The National Office of Building Technology and Administration	Norway
DSB	Direktoratet for samfunnssikkerhet og beredskap	The Directorate for Civil Protection and Emergency Planning	Norway
FNO	Finansnæringens fellesorganisasjon	Finance Norway	Norway
MSB	Myndigheten för Samhällsskydd och Beredskap	The Civil Contingencies Agency	Sweden
SIK	Sikkerhedsstyrelsen	The Danish Safety Technology Authority	Denmark
SP	Sveriges Tekniska Forskningsinstitut (earlier: Statens Provningsanstalt)	The Technical Research Institute of Sweden	Sweden
TUKES	Turvatekniikan Keskus	The Safety Technology Authority	Finland

### Word list – related to ethanol-fuelled, flue-less fireplaces

A number of different words are used to describe the ethanol-fuelled fireplaces. Here, a number of them are represented, in both English, Norwegian and Swedish:

English	Norwegian	Swedish
Bio-fireplace	Bioetanolpeis	Alkoholeldad spis
Decorative fireplace	Biopeis	Biobrasa
Design fireplace	Bordpeis	Biospis
Flueless fireplace	Dekorasjonspeis	Skorstenlös kamin
Instant fireplace	Designildsted	Trivselbrasa
Light fireplace	Etanolpeis	Väggbrasa
	Peis uten pipe	
	Peis uten skorstein	
	Pyntepeis	

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## **Summary, conclusions and recommendations**

This report presents a study of the regulation of ethanol-fuelled fireplaces in Norway, Sweden and Denmark. There exists no specific regulation of such products in Norway, whereas in Sweden, there is a certification arrangement for ethanol-fuelled fireplaces.

Statistics and accidents from the three countries have also been examined. It is shown that the statistics are insufficient and that there exist no specific system for reporting accidents in relation to ethanol-fuelled fireplaces. Measures should be taken to improve the reporting of accidents related to such products.

Tests were conducted on four different fireplaces, mainly with respect to temperature development both on the external surfaces and inside the wall where they were mounted. The tests show that temperatures behind the wall rised to about 40 to 70 °C. In addition to testing the fireplaces, their user manuals were examined. It is shown that there is a great variation in the amount information between the user manuals.

This report recommends that a certification system, similar to the one in Sweden, is established in Norway in order to prevent dangerous products from entering the marked.

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## **1 Introduction**

### **1.1 Background**

Fireplaces fuelled with ethanol have lately become a trendy design element in Norwegian homes and public buildings, and the number of such units is increasing. It is marketed as being environmentally friendly, affordable and easy to install. Because of the type of fuel it does not require a flue to remove the combustion gases; the product from burning pure ethanol is carbon dioxide and water. However, in the media there have been reported accidents with exploding ethanol and burning fireplaces falling down from walls. There is no detailed regulation specifically aimed at such products on the Norwegian market today, although both the Norwegian Directorate for Civil Protection (DSB) and The National Office of Building Technology and Administration (BE) have issued guidelines and recommendations concerned with their safety.

This has lead DSB to initiate an investigation of how the safety of this group of products should be controlled and regulated.

#### **1.1.1 Suppliers and the extent/scope of the ethanol-fuelled fireplaces on the Norwegian market**

Ethanol-fuelled fireplaces were introduced to the Norwegian market approximately 2005/2006, mainly as a decorative interior design element, but also as a small heating element. As it is a relatively new product group it is quite difficult to collect data on the total amounts of sold items on the Norwegian market. Indicating sales figures are collected from a few of the main importers/producers, but the accuracy of these figures are quite rough, so it is chosen not to represent these in this report.

### **1.2 Objectives**

The main objective with this project has been to collect available information that may form a foundation for determining the need for further regulations aimed at ethanol-fuelled, flue-less fireplaces.

To achieve this investigations have been undertaken to uncover the cause and number of occurred accidents.

A test- and evaluation procedure has also been developed, that would be suitable for controlling that products sold on the Norwegian market are marketed in accordance with national regulations.

Testing and evaluation of products currently on the market along with revising their documentation was also performed according to the developed test procedures.

### **1.3 Methods**

A survey of available literature and information has been conducted in order to determine existing laws and regulations concerning ethanol-fuelled fireplaces and similar products.

To be able to describe the extent of accidents occurring with relation to ethanol-fuelled fireplaces, a selection of statistics databases have been surveyed.

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By searching on the internet along with advice from DSB different suppliers of ethanol-fuelled fireplaces were identified. Sales venues, e.g. Jula, Biltema, Europris, Varmeforum and Obs-Bygg, were also visited in order to locate different types of fireplaces.

A selection of different user manuals and installation instructions has been examined in order to get a notion on the quality level of the information to the users.

A few relevant test methods have been reviewed with the objective to, along with our own experiences, and with Norwegian regulations in mind, try to recommend a test and approval procedure for ethanol-fuelled flue-less fireplaces.

4 different fireplaces have been tested with the intention of evaluate both the test method as well as the product in question.



## 2 Ethanol-fuelled fireplaces

### 2.1 General

As mentioned in the introduction, decorative, ethanol-fuelled fireplaces have gained increasingly popularity in Norway. In addition to modern designs, the fireplaces have other seemingly advantages. Manufacturers claim that ethanol-fuelled fireplaces are cleaner and cheaper than traditional wood-fired fireplaces. They are even easier to install, and the installation does not require any inspection from the authorities. It is known that combustion of pure ethanol forms carbon dioxide and vaporized water, which exists naturally in indoor environments. Consequently, it is stated that a flue is not required to remove the combustion gases.

Ethanol-fuelled fireplaces can mainly be divided into two subcategories; wall-mounted and free-standing. The wall-mounted fireplaces are delivered with some sort of fixing for easy mounting to the wall. Also, fireplaces to be placed on the floor are also considered wall-mounted as long as the fireplace is fixed to the wall. Examples of wall-mounted ethanol-fuelled fireplaces are shown in Figure 2-1 and Figure 2-2 below.



**Figure 2-1** “New York Empire”, a bestseller with Decoflame /1/.



**Figure 2-2** “Cupola” by Vauni /1/.

Compared to wall-mounted fireplaces, free-standing fireplaces need no mounting or fixing at all, except from the assembly of the product. There is a large number of different models of free-standing ethanol-fuelled fireplaces. There are both small ones intended for placing on tables, and larger ones intended for placing on the floor. What often distinguish the free-standing models is that they are moveable or portable. Some are fitted with wheels, and some have handles. Some examples of free-standing fireplaces are presented in Figure 2-3 to Figure 2-7 below.



**Figure 2-3** “DCIN1” designed by Martin Zbären /2/.



**Figure 2-4** “Athen” from Biopeis /1/.



**Figure 2-5** “Rollfire” from Conmoto /1/.

The volume of the Rollfire fuel tank is 0,825 L, which is a considerable amount of combustible liquid to place free-standing on the floor /3/.



**Figure 2-6** “Travelmate” by Conmoto. /4/



**Figure 2-7** “Dots” by Conmoto. /5/

## 2.2 The fuel

The ethanol intended as fuel for fireplaces, is produced by fermenting starch products like sugar cane, potatoes etc. It is therefore considered a renewable energy source, hence the name “bio” ethanol. Pure ethanol contains 96 vol% ethanol and 4 vol% water. This is because ethanol is hygroscopic and absorbs water from the air. Pure ethanol is necessary for chemical processes in research and industrial work, cleaning and other technical purposes, etc. Pure ethanol is poisonous so in order to prohibit the abuse of ethanol and for processes where the purity is not detrimental, various compounds has been added to the ethanol to make it undrinkable. The name for such product is *denatured ethanol* or *alcohol*. The most commonly used additives in denatured ethanol are isopropanol and denatonium, to make the ethanol undrinkable. /6/ Different manufacturers of P-marked fireplaces recommend or require different brands of ethanol fuel. A selection of some brands available on the marked is listed below.

Table 2-1 Ethanol fuel recommended/required of P-marked fireplace suppliers /7/

Name	Supplier	Additional information in the manual concerning the fuel
“Denatured alcohol”	Any	reference to <a href="http://www.ecosmartfire.com">www.ecosmartfire.com</a> for examples of brands in different countries (e.g. rødsprit in Scandinavia)
“Bioethanol”	Any	N/A
“Kemetyl Karneval”	Kemetyl AB	“or exactly equivalent fuel”
“Real Flame Jel”	Jensen Metal Products Inc. (?)	“or other fuel approved by Real Flame”,
“Fireplace ethanol for firing indoors”	Any	N/A
“Fire of Sweden Fireplace fuel”		N/A
“Fireplace fuel for flue-less fireplaces”	Any	“denatured alcohol (rødsprit) must not be used”
“ignoRa Bio fuel”	ignRa	Also called “bio alcohol”
“Karneval fireplace fuel”,	Kemetyl (?)	“never denatured alcohol”
“Fireplace fuel approved by the Swedish National Food Administration (Livsmedelsverket), with an energy value of 20.000 kJ/l, e.g. “Flame spisbränsle””	Flame spisbränsle from RGE AB	N/A
“FANOLA®”	FANOLA®	N/A
“Denatured alcohol”		Recommends “Kemetyl Karneval”
“Biltema Röd Etanol with article number 36-1545 and 36-1546”	Biltema	N/A
“OK Q8 Röd etanol”	OK Q8	N/A
“NITOR”	NITOR	N/A
“AC Röd etanol” with article number 203224”	NITOR	N/A

### 2.3 Emissions and indoor air quality

When pure ethanol burns, it produces carbon dioxide and water. Since ethanol intended as fuel for fireplaces contains compounds that make it undrinkable it may also produce by-products additional to carbon dioxide and water vapour during combustion. SINTEF has tested several fireplaces fired with propane /8/. Such fireplaces may be flue-less so that the emissions are sent to the room. An earlier study on flue-less gas-fuelled fireplaces showed that concentrations of emissions exceeded the accepted reference values that the Norwegian Institute of Public Health has stated /9/. The fireplaces also produced extra fine particles in addition to the emitted gases that were emitted to the room. However, the study concluded that high concentrations of particles are accepted during short exposure times. It should also be pointed out that ethanol and propane have different calorific value and will burn differently and therefore the amount of by-products also varies. More information is needed about the emissions made by ethanol-fuelled fireplaces before making any further conclusions.

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## 3 Regulations

### 3.1 Norway

The Norwegian authorities have recently agreed upon how to govern the product group of ethanol-fuelled fireplaces. Wall mounted, or otherwise fixed fireplaces are to be considered a construction product and will therefore fall under the responsibility of The National Office of Building Technology and Administration (BE). Fireplaces and “lamps” that are free-standing will be surveyed by DSB /10/.

The requirements for documentation of construction products are given by Section 77 of the Planning and Building Act /11/ and Chapter 5 of TEK, the regulation for requirements on constructions and construction products /12/. The requirements regarding safety, health, environment and fitness for use will be ensured through TEK §5-19. The producer and his representative (e.g. importer) are responsible for documenting the properties of the product.

BE issued a press release on 3 December 2009 where it is informed that ethanol-fuelled fireplaces, in order to be allowed to be marketed in Norway, must have an initial technical approval from an accredited laboratory /13/. Furthermore it is informed about marking of the fireplaces (product name, designation of type, fuel type, producer name, country of origin, name and address of the importer) and what information that minimum must be included in the user manuals (materials that the fireplace is intended to be mounted on/to, distance to combustible material, installation instructions, required ventilation of the room where the fireplaces is to be installed in, fuel type, refuelling instructions, ignition instructions, extinguishing instructions, cleaning and maintenance instructions). BE has chosen to accept SP method 4160 (see 5.1) until there exists a harmonised standard /14/. The equivalent information is available from DSB /15/.

The objective of the Product Control Act /16/ is to ensure that products or services are safe and will not lead to any injury, and to prevent environmental disorder. Producers and importers of the products are responsible of gathering enough information so that safety and the environment are ensured and protected. They are also responsible for providing the consumers of the products with adequate and relevant information on how to safely use the product. This information must be clear, easily accessible and suited for the needs of the consumer.

The Fire and Explosion Safety Act states that products which handle dangerous substances and goods must have such a performance that there will not be any danger of fire, explosion or any other accident. Installations shall be done in a safe and professional manner /17/.

The Internal Control Act requires that hazards and potential problems are assessed and that there are plans for minimizing these. There shall be routines in place to uncover, correct and prevent any breach on the regulations regarding safety, health, environment and fitness for use. This shall be documented in writing/18/.

The Regulation for inflammable products requires that the vessel or device used for handling inflammable products shall be designed in such a manner so as they are expedient and safe and there must never be a risk of fire, explosion or accident. They must be produced in a suitable material and be resistant to the substance it is intended for as well as ambient conditions. Installations shall be performed in a safe and professional manner /19/.

### 3.2 Sweden

SWEDAC – the Swedish Board for Accreditation and Conformity Assessment is the authority in Sweden that coordinates the overall market surveillance in the country. MSB (Myndigheten för Samhällsskydd och Beredskap), the Swedish Civil Contingencies Agency, is the authority responsible for market surveillance of products where fire- or explosion hazards are relevant, or that involves any properties that may be comprised under the Flammables and Explosive Act (1988:868) or the Transport of Dangerous Goods Act (2006:263). Decorative fireplaces without flues belong to this group of products /20/.

The responsibility for the safety of use of a product lies with the producer or the importer. The market surveillance means that the authorities check that the goods sold on the market fulfil the specified requirements, and that they do not present any risk to life, health or the environment. The goods shall also be marked and controlled according to regulations. The authority shall take measures towards those producers or importers whose products do not fulfil current product regulations. Hence, the supervision is associated with the product in question and not whether it is correctly used. The implementation of market control is regulated by the regulation (2005:893) on market surveillance of products as well as in the EU Directive on general product safety (2001/95/EC) /21/. The authority also depends upon tips from the public and competitors on the market in question /20,22/.

The regulations in Sweden state that the products shall be safe to use, that they shall be type tested and type approved /23/. The certification system of the P-mark (see 5.1) of the fireplaces is, however, voluntary. It is just one of the possible ways to demonstrate the safety of the product.

The P-mark certification rule for ethanol-fuelled fireplaces refers to *Lag 1994:847 om tekniska egenskapskrav på byggnadsverk m.m. (BVL) §2*, (Code 1994:847 on requirements on technical properties of constructional work etc. (BVL) Section 2.). The BVL Section 2 handles requirements e.g. safety in case of fire, safety during use with respect to hygiene, health and environment, safety during use, fitness for intended use etc. /24/.

Sections 5:41 (Protection against the outbreak of fire; General), 5:421 (Heat producing appliances; General) and 5:437 (Cleaning and inspection) of the Building Regulations (BBR) are applicable. For example, these sections state the requirements on distance to combustible material, and they state that “Gases shall not escape from heat producing appliances and burners” and “The heat-producing appliance shall be supplied with a sufficient amount of air for combustion” /25/.

### 3.3 Denmark

The products on the Danish market are regulated by the Product Safety Act. The Danish Safety Technology Authority is responsible for controlling that the products satisfy the requirements described in the Product Safety Act, with the main focus on tasks related to fire and explosions. The decorative fireplaces without flues belong to this group of products.

The Danish Safety Technology Authority has initiated a study in order to introduce a European regulation for the product group of ethanol-fuelled fireplaces. /26/

### 3.4 Finland

TUKES, The Safety Technology Authority in Finland is responsible for the market surveillance of ethanol-fuelled fireplaces. This has, until recently, been the responsibility of the Consumer

Agency, which has, in cooperation with the City of Helsinki Rescue Department, worked out a guideline for flue-less fireplaces. This guideline refers to product safety regulations. In brief: the use of such products must not pose any hazard to consumer health or property. Finnish authorities require the information on use and installation concerning the product to be written in both Finnish and Swedish. It is the manufacturers, importers and retailers of these products that are responsible for ensuring that use is safe and that appropriate documentation is available and that warning labels are provided /27/.

## **4 Incidents and information survey**

### **4.1 Norway**

#### **4.1.1 DSB– The Directorate for Civil Protection and Emergency Planning**

DSB collects statistics on fire incidents reported by fire departments and police. There is no specific code or checkbox in the report forms for fires where flue-less ethanol-fuelled fireplaces were the source of fire, but there is a field where it is possible for the police or fire brigade to give special remarks to the fire. A search in this field in the database on fires related to “ethanol”, “bioethanol” or “decorative fireplace”, during a period of time between 2000 and 2010 turned up with only one incident that can be directly related to an ethanol fireplace. The incident took place in September 2009, where a fire spread during lighting of the fireplace to a nearby sofa and coffee table. The fire fighters quickly extinguished the fire upon arrival /28/. It is, however, possible that more accidents have occurred, that is not turning up in a search on particular words. There are several different names related to this type of product. Also, this statistics would only show incidents that have been reported to the fire department or the police. It would not show any incidents that has not involved the police or the fire department.

#### **4.1.2 FNO – Finance Norway**

Another source of statistics is the database of the insurance companies, which is kept by FNO – Finance Norway, the trade organisation for banks, insurance companies and other financial institutions in Norway. Their database would reveal any reported accidents that would have been reported in Norway as an insurance issue. FNO did, however, not have any data of any fires related to particular types of fireplaces /29/.

#### **4.1.3 The Norwegian Consumer Council (Forbrukerrådet)**

The Norwegian Consumer Council can report on one complaint related to ethanol-fuelled fireplaces. The customer was complaining on alcohol odours during use of the fireplace /30/. The Consumer Council concludes that the product is a wall-mounted type, there does not exist a installation instruction, the fuel is principally ordered from the fireplace supplier (3 boxes of it is also included upon purchase of the fireplace), and that this means that there does not seem to be any shortcomings with the installation itself. From this it is concluded that the fuel is the cause of the problems, but that it is difficult for the Consumer Council to evaluate whether there are any faults with the fuel without a statement from an expert. The consumer is advised to contact the local fire department or chimney sweeper service for further investigations /31/.

### **4.2 Sweden**

#### **4.2.1 MSB – The Civil Contingencies Agency**

MSB does not have statistics on accidents or incidents related to ethanol-fuelled fireplaces. The reason is that this would require an extensive free-text search in the reports of the police and fire



departments. One great difficulty lies in the fact that many names prevail for this type of product. Therefore MSB relies on incidents being reported directly to them. Since 2005 they have received 4 such reports. None of them has led to any person being injured and the fire has been put out before causing any great damage to the room and without having to call the fire service. One of these four incidents occurred before the P-marking was in place. It was a wall-mounted model that fell to the floor while burning. Two of the other incidents occurred after the P-marking was implemented, and they were related to using the wrong type of fuel. The last incident was reported to MSB only recently, and has not yet been evaluated /32/.

#### **4.2.2 SP – The Technical Research Institute of Sweden**

The P-marking in Sweden was introduced fairly early. The first flue-less ethanol-fuelled fireplaces arrived on the Swedish market about 2005, and the P-mark was available in 2007. Thereby a system for checking the safety of the ethanol-fired fireplaces was already available, when the product concept was starting to spread commercially in Sweden. Therefore it may be difficult to evaluate the effect of the regulation on the number of accidents occurring /33/.

Today almost 130 different models from 15 different suppliers of ethanol-fuelled fireplaces have been P-marked in Sweden. 9 of these models require the installation to be controlled by a chimney sweeper or fire expert, because they are designed to be installed within a construction such as an existing fireplace.

#### **4.3 Denmark**

We do not have accurate statistics from Denmark. However from media, we know of at least 3 incidents (see 4.4.1).

#### **4.4 Media**

Decorative ethanol-fuelled fireplaces have from time to time figured in media. Below are some examples of articles which either recommend or warn against the use of such fireplaces.

##### **4.4.1 Accidents and warnings**

Two women were seriously injured on December 18th 2009 in Oslo, when a fireplace exploded. Two other people were also sent to the hospital. The cause of the explosion was most probably that the fireplace was refuelled while still hot, according to the task manager from the fire department /34/.

A flat in Oslo caught fire when the heated screws piercing a gypsum wall ignited the wooden joists behind it (the article in question presents little information about the incident) /35/.

Three Danish accidents are often cited in the media. In one case a young woman was injured when a burning fireplace fell down from the wall and landed on top of her back. In the other two cases people were injured by large flames while refuelling a hot fireplace /36/.

The cause of the accident where the fireplace fell down from the wall was that it was fixed to the wall with screws and plastic plugs. When the screws were heated the plastic plugs melted and the fireplace fell down, pouring burning ethanol on the affected woman /37,38, 39, 40/.

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#### **4.4.2 Trend-setting articles**

The ethanol-fuelled fireplace seems to be an increasingly more common interior element in Norwegian homes and public buildings (hotels, restaurants etc.). There are many interior articles in magazines, news papers as well as on the internet. In some of them there have been examples of somewhat misleading information, giving the reader a sense that these products are very safe, healthy, environmentally friendly and that they are very easy to install.

It is common to state that during combustion the only product is carbon dioxide and water vapour. This may be true, but it is rarely mentioned the importance of ventilation in order to ensure a healthy oxygen level /41, 42/.

There are, however, examples of articles which inform about the hazards of ethanol-fuelled fireplaces, e.g. the importance of ventilation, correct installation and emissions from impure fuel /43/.

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## **5 Test methods and product analysis**

### **5.1 SITAC certification and the test method SP 4160**

#### **5.1.1 SP Certifying/SITAC certification rule 034**

Certification rule 034 considers technical information for ethanol-fuelled fireplaces without flues. The rules describe design requirements, functional requirements, requirements on product description and what type of documentation and marking is required in relation with the fireplace in order to achieve the P-mark. The test method referred to in the certification rule is SP 4160 /44/. (See Appendix A for the complete method, and the following section for a summary).

#### **5.1.2 SP 4160 – Test method for ethanol-fuelled fireplaces**

This is a summary of SP-METHOD 4160, for more details the reader is referred to the method. (See Appendix A)

##### **Scope of the method**

The method considers safety-, emission- and operating characteristics of ethanol-fuelled fireplaces without flues. In addition, the manual of the fireplace is revised to assure that it complies with the certification criteria defined in Certification rule 034 section 4.3 (SP Certifying/SITAC).

##### **Control of the design**

Before the fireplace is lit, the design of the fireplace is studied.

The stability of a fireplace intended to stand on the floor is assured by filling the fuel container to 4/5 of the container's height. The fireplace is then tilted with an angle of 30° and it is assured that no fuel is spilled and that the fireplace does not tip over. However, if it is suspected that the fireplace is vulnerable to jolts, a jolt test is to be performed. For wall-mounted fireplaces, the fireplace shall be mounted on the wall as described in the producer's manual and strained with a weight of 60 kg for 10 minutes.

##### **The test**

The fireplace is mounted or placed as intended by the producer. The test shall proceed for 60 minutes after the fireplace has reached a stable temperature or for as long as the fuel lasts. The fireplace shall obtain and maintain a stable, soot-free flame within the two first minutes after ignition.

##### **Measurements**

The test method defines different measurements to be taken during the test (the reader is referred to the method for details). Temperatures, both on the surface of the fireplace and on the adjacent walls shall be measured. In addition, the concentration of both CO and CO<sub>2</sub> shall be registered. The fuel shall be weighed both before and after the test in order to determine the fuel flow and fuel density.

### **5.1.3 NS-EN 1:1998/A1:2007 Flued oil stove with vaporizing burners /45/**

The standard considers safety- emission- and operating characteristics of flued oil stoves with one or more vaporizing burners. The stoves have either a draught regulator or a combustion air limiter and a normal heating capacity of maximum 15 kW.

The standard focuses mostly on oil stove specific aspects which cannot be related to ethanol-fuelled fireplaces. The few exceptions are temperature requirements and installation procedures. Therefore, this standard has not been emphasized in these tests.

### **5.1.4 NF 427 – Ethanol operated household appliances /46/**

This is a French test standard which is somewhat more complex than SP 4160. The most apparent difference between the two test methods is NF 427's demand of safety devices.

#### **Scope of the method**

The method considers safety-, emission- and operating characteristics of ethanol-fuelled fireplaces without flues. In addition, the manual of the fireplace is revised to assure that it complies with the certification criteria defined.

#### **Control of the design**

The design of the fireplace shall assure that normal use and maintenance will not result in deformation or damage. If there are any fragile or vulnerable parts, these should be protected. The fireplace shall also withstand the normal operating temperatures, corrosive combustion products and inflammation of fuel leakage.

The product shall be equipped with an igniter which shall prevent lighting of the fireplace if the temperature is above a certain limit.

The fireplace shall also be equipped with an emergency stop device, allowing the user to extinguish the flame if an undesirable situation occurs.

Another criterion is that there shall be an anti-jolt device installed, which shall react when the side of the fireplace is lifted and dropped. There shall also be a device reacting when the fireplace is being tilted.

Finally, there shall also be a CO detector activating the extinguishing system if the CO concentration becomes too high.

#### **The test setup**

The fireplace is mounted or placed in a black-painted corner with thermocouples embedded in the wall. The fireplace should be tested with maximum effect.

#### **Measurements**

The test method defines different measurements to be taken during the test (the reader is referred to the method for details). Temperatures, both on the surface of the fireplace and on the adjacent walls shall be measured. In addition, fuel flow and the concentration of both CO and CO<sub>2</sub> for combustion in both open and closed rooms shall be determined.

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## 5.2 Product analysis

### 5.2.1 Criteria for evaluating installation instructions and user manuals

According to Norwegian authorities (i.e. BE and DSB), the following information is the minimum requirement in the documentation following the fireplace /13, 15/:

- Which types of walls or materials the fireplace is intended to be installed on.
- The minimum required distance to combustible material.
- How to install the fireplace.
- Required type of ventilation of the room where the fireplace is to be installed in.
- Minimum room size and volume.
- Specified fuel, along with refuelling instructions.
- Ignition instructions.
- Instructions for putting out the fire.
- Instruction for cleaning and maintenance.

All information as well as warnings shall be written in Norwegian.

It is also advised that grown-ups shall be present, at all times, in a room where an ethanol-fuelled fireplace is ignited.

According to the Finnish authorities' guidance the additional requirements also apply /27/:

- The installation documentation must include accurate and detailed instructions on how to choose a safe and appropriate location for the fireplace.
- The installation documentation must include instructions as well as graphical illustrations of the steps to ensure safe installation (this is particularly important with wall-mounted fireplaces).
- A wall protector of sufficient size and material must be placed behind the fireplace unless the wall itself is made of a non-combustible material (also applies to free-standing fireplaces). The Finnish guidance document does not define "non-combustible" in terms of construction products classification. DSB points out /47/ that many people believe that "mounted on a wall of non-combustible material" also includes gypsum boards, and states that test results must show that that type of installation is possible or, alternatively, the fireplace shall be installed using distance pieces or a wall protector. However, gypsum boards are often multilayered with a gypsum core with paper on both sides. The core of gypsum is classified as non-combustible, but the entire product, including the paper backings, has a lower reaction-to-fire class e.g. A2-s1, d0 /48/.
- Only appropriate fuel may be used with flueless fireplaces. Information must include detailed instructions on the storage and use of fuel (both in the user's manual and on the vessel used for storing fuel).
- Information must include a mention of the restriction that a maximum of 25 litres of flammable fuel may be stored in a home at any given time. (This number is 5 litres in Norway /49/)
- The fire should be put out with an appropriate extinguishing device.
- Aside from fuel, no combustible materials must be put in the fireplace. Equipment for putting out incipient fires, such as a fire blanket or fire extinguisher, should be kept near the fireplace.
  - It is recommended that the room should be thoroughly ventilated after use of the fireplace.

The Danish Safety Technology Authority gives advice that is very similar to the above mentioned /50/. They also specify why ventilation is so important; that carbon monoxide may be formed in small spaces, in addition to carbon dioxide and water, and that this is both toxic and dangerous.

### **5.2.2 Test criteria for this project**

Two test methods were examined; the Swedish SP-method 4160 and the French NF 427. The French method was found to be too complex for the products existing on the Norwegian marked today, whereas the Swedish method was more suitable. Therefore, the test method used in this project is based on SP-method 4160.

In the long term, one should aim at establishing a harmonized European standard. Harmonized standards make it easier for manufacturers to design and produce fireplaces which conform to the regulation in the countries the standard embraces.

As mentioned, the test method used in this project is based on SP-method 4160. However, some modifications to the test setup were made, upon agreement with DSB. This was based upon the economic framework of the project. The deviations are remarked below.

The test method express that wall-mounted fireplaces should be mounted to the wall as described in the manual and strained with a weight of 60 kg for 10 minutes without being previously lit. During these test the focus was to investigate the behaviour of the fireplace while being lit, consequently, this point was omitted. (However it is important to ensure that the fastening system is sturdy enough so that the fireplace does not fall down from the wall due to weaknesses.)

According to the test method, the flame's sensitivity to draught should be tested by exposing the flame to 2 m/s draught for 10 seconds. However, this was not done in this test series.

The test method states that the wall to mount the fireplace upon should be painted black. This was not done and it is not believed to be essential to the results of these tests.

When testing wall-mounted fireplaces, an extra measurement was made. Since gypsum boards are vulnerable to calcining, the temperature on a fastening screw piercing the gypsum boards and the underlying wooden board was measured.

### **5.2.3 Criteria for evaluating test reports**

As stated in the preceding section, the SP-method 4160 was deemed suitable for the products on the Norwegian marked today, therefore it is suggested by SINTEF NBL that the requirements for test reports should be adopted from the Swedish method.

The test report shall contain<sup>1</sup>:

- Name and address of the test laboratory, together with the address of the test site (if it is not the same as the address of the laboratory).
- A unique identification of the test report and of each page, as well as the total number of pages in the report.
- Name and address of the client/sponsor.
- Description and identification of the test specimen.
- List of product documents.

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<sup>1</sup> These are standard criteria in CEN- and ISO-reports

- The date of arrival of the test specimen and date of the test.
- Reference to this method.
- Test results as described below.
- Information of measuring uncertainty.
- Signature of the persons responsible for the testing together with the date of the report.
- Statement that the test report is valid only for the tested item.

The test results shall present:

- The results of the examination described in section 3.
- The results of the test described in section 4.

Regarding the power- and emission measurements, the following should be presented:

- Duration of the test.
- Type of fuel.
- Consumed fuel.
- Produced power.
- Mean value of CO concentration in the combustion chamber.
- Mean value of CO<sub>2</sub> concentration. in the combustion chamber

#### 5.2.4 Potential hazards

##### Calcining

Gypsum boards are available in different qualities based on composition and performance. The chemical formula of gypsum (calcium sulfate dihydrate) is  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ . Gypsum boards normally contains both crystal bound water and moisture in form of free water. Different gypsum board products may have different material properties depending on factors like paper quality and paper thickness, density of the gypsum core, addition of e.g. reinforcement fibres to the gypsum core, and thickness of the final board /51/.

One of the requirements according to the Swedish P-mark certification is that for all open fireplaces which are intended to be mounted on a plasterboard wall, it should be taken into account that gypsum starts to calcine at 45-50 °C. /52/.

Water is released from the gypsum at temperatures between 100 and 120 °C. The dehydration is an endothermic process called calcining, and significant energy is required to evaporate free water and release the crystal bound water. Complete dehydration does not occur until the temperature reaches about 700 °C /53/. The strength of gypsum board at elevated temperatures may be regarded as very small /54/.

However, Norwegian manufacturers of gypsum boards stress that the dehydration process can occur at lower temperatures, and that products based on gypsum boards should not be long-term exposed to temperatures above 50 °C. Such long term exposure could lead to loss of strength /55,56/.

Therefore, elements such as electric radiators must be fastened to the substructure or nailing strips and not to the gypsum boards /57/.

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### **Ignition of ethanol vapours**

Many models are designed with loose containers placed in holders within the fireplace. Danish studies /58/ have shown that fuel spills within the holder may evaporate, heat up and deflagrate.

### **Refuelling**

Refuelling an ethanol fireplace while it is still hot is very risky. The ethanol may vaporise quickly, ignite and cause an explosion. There are reported incidents where refuelling of a hot fireplace has caused injury to persons. In fact, this seems to be one of the most common user errors.

### **Free-standing fireplaces**

The free-standing floor models pose a potential risk by the fact that they are moveable. It is possible that the fireplace may be placed too close to combustible material and consequently causes a fire.

It is also possible that people, not used to the current placement, will trip over the fireplace, tip it and the result is burning ethanol pouring out on the floor and on people.

There have been design examples where the fireplace may even be mistaken for a stool, which may lead to people actually tries to sit on the fireplace.

### **Faulty installations of wall-mounted fireplaces**

There have already been incidents reported where plastic installations have melted by the heat from the fireplace, causing it to fall from the wall while still burning.

Another risk that needs to be eliminated is the risk of fixing screws conducting heat into the wooden joists behind e.g. plasterboard walls. The mounting instruction may state that the fireplace must be installed on a non-combustible material, but the laymen may not consider the risk of fire in the substructure.

Mounting a fireplace to a wall with electric cables in close vicinity may lead to undesirable situations. Studies show that the elasticity agent in the cable insulation vaporizes when exposed to long-term temperatures around 71-77°C. If the cables are placed behind the wall, the vaporized gases are trapped, and if the concentrations and temperature becomes high enough, the gases may ignite. Also, light arcs may arise in cables exposed to long-term temperatures as low as 71°C /59/.

### **Hot surfaces**

Areas of potential skin contact may cause burn injuries.

### **Combustion gases**

Many retailers market the flue-less ethanol fireplace as a completely clean product without any form of emissions. In some places it has been described as equivalent of two candles. Some (not Norwegian) retailers on the web states that the flue-less ethanol fireplaces are so emission free, that there is no need for ventilation at all. Not much research has been done on the area of the emissions from the ethanol fireplaces. However, it is clear that in order to burn, it will consume oxygen. The products of complete combustion of ethanol are carbon dioxide and water. At first glance, these are harmless substances which are also produced by respiration. However, in large amounts, carbon dioxide is not healthy, and leads to hyperventilation. Even water may pose a threat, in that it increases the humidity in the area where the fireplace is located. Too much



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humidity can increase the growth of mould fungus, and actually pose a real threat to people with allergies and asthma.

### **Emissions from the non-combusted fuel**

There have been complaints of headaches, nausea and bad smells from the ethanol-fuel. According to the material data sheets of the ethanol-fuels it is stated that headaches and nausea may result from inhaling fumes from the fuels. Therefore a valid question would be, is it unhealthy to keep fuel in the burner cups, either as residues or a full cup?

### **Children and pets**

There are many design examples on fireplaces that are not suitable in locations where there are children or pets around. Children may get too close to the flame, they may touch hot surfaces, try to climb a free-standing model, try to ignite a fireplace without any supervision etc.

## 6 Testing

### 6.1 Products tested

Four fireplaces were selected for testing; all of them intended for wall-mounting. Three of the four fireplaces (“Type A”, “Type B” and “Type C”) were developed (designed, but not necessarily produced) in Norway. These three fireplaces were delivered by two different suppliers. Type A and Type B lies in the price range of approximately NOK 10.000-15.000, Type C would cost approximately NOK 5.000. The fourth fireplace, Type D, was purchased by SINTEF NBL for the project, it was an inexpensive model that cost less than NOK 800. The fireplaces are shown in Figure 6-1.



Type A



Type B



Type C



Type D

**Figure 6-1** The four test objects during test.

The three products supplied directly from the suppliers were fitted with a double layer of steel plates in the rear, which form an air gap. One may assume that this air gap is intended for insulating purposes and hence that these products offer enhanced safety with cooler surfaces towards the wall it is intended to be mounted on. The fireplace that was purchased by SINTEF NBL was of a relatively simpler design and had only a single layer of steel plate in the rear. The test results are presented in Table 6-1.

The intention was originally to also test ethanol gel fuel, but none of the fireplaces that was included in the test were intended for gel fuel so this part was excluded.

## **6.2 Comments to the test setup**

In order to simulate installation failure Tests 1 and 2 were conducted without using the mounting brackets included with the fireplace.

The intention of Tests 3, 4, 5 and 6 was to investigate the effect of the air gap resulting from using the mounting brackets. Different types of wall material, gypsum boards and ply-wood boards, were also used. The intention with Tests 8, 9 and 10 was to simulate a fuel spillage into the holder of the fuel containers and try to force a deflagration. 10 % of the poured ethanol was used as spillage fuel. See Appendix H.

### 6.3 Test results

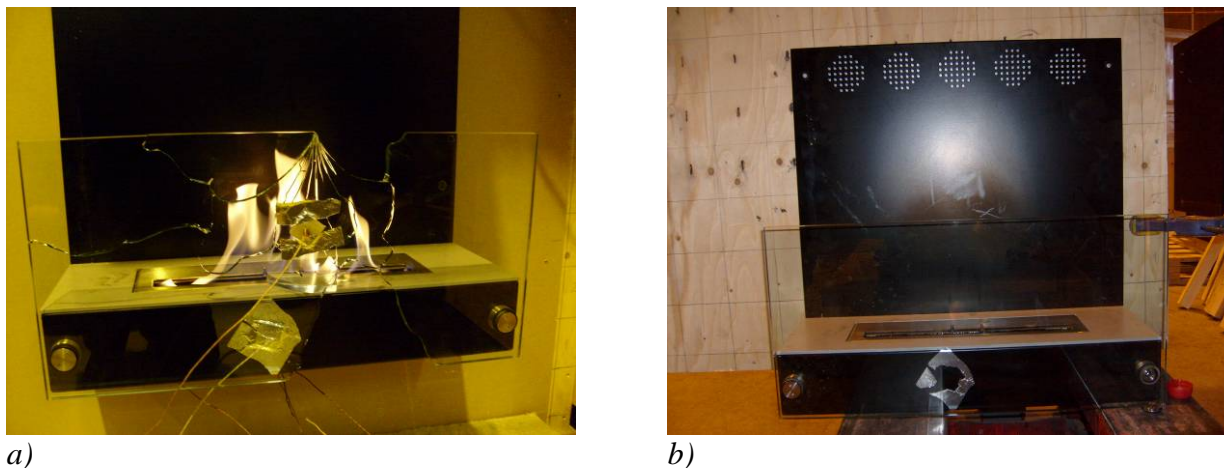
**Table 6-1** Fireplace tested under different test conditions

Test no.	Type of fireplace	Test setup	Amount of fuel	Duration	Heat output <sup>*)</sup>	Ambient temp.	Temp. behind the wall	Temp. on the mounting bracket	Temp. on the mounting screw	CO/CO <sub>2</sub>
[-]	[-]	[-]	[L]	[hh:mm]	[W]	[°C]	[°C]	[°C]	[°C]	[%]
1	A	Mounted on wall of gypsum board, without mounting bracket	1.0	01:25	4148	22.7	61.1	-	41.2	-
2	A	Mounted on wall of gypsum board, without mounting bracket	2.5	03:30	4198	23.6	73.9	-	52.6	-
3	A	Mounted on wall of gypsum board, using mounting bracket	2.5	03:05	4765	21.3	40.3	82.2	-	0.0001/0.57
4	B	Mounted on wall of gypsum board, using mounting bracket	2.5	03:50	3833	21.6	53.1	68.1	-	0.0008/0.62
5	B	Mounted on wooden wall using mounting bracket	2.5	03:35	4100	21.5	56.4	71.2	-	0.0008/0.62
6	C	Mounted on wooden wall using mounting bracket	1.3	01:50	4167	21.6	70.1	81.8	76.5	0.0005/0.56
7	D	Mounted on wall of gypsum board, using mounting bracket	0.4 x 3	01:23	5098	-	53.7	90.8/60.2	91.5	-
8	C	Explosion test	1.3	01:51	-	-	-	-	-	-
9	D	Explosion test	0.4 x 3	01:18	-	-	-	-	-	-
10	D	Explosion test	0.4 x 3	-	-	-	-	-	-	-
11	A	Repeat test 3 without temperature measurement.	2.5	03:40	-	-	-	-	-	-

<sup>\*)</sup> The heat output is calculated according to the SP-method 4160 (Appendix A).

#### 6.4 Product evaluation

When mounting the fireplaces directly on the wall as in Tests 1 and 2, without using the intended mounting brackets, there will be no air gap between the fireplace and the wall. The temperature measured behind the wall reached 74 °C despite the fact that it was fitted with a double layer of steel plates. During Test 1, the glass cracked and pieces fell down the floor. Figure 6-2 shows a piece of glass on the burner. The glass pieces fell randomly and may cause splashing of heated bio ethanol if the pieces land on the liquid surface. In worst case, it can lead to fire incidences. A new glass front was replaced and a new test (test 11) was carried out.



**Figure 6-2** a) The front glass cracked during a test (test 3). b) A new glass front was replaced, and a new test was carried out (test 11).

Test 3, 4 and 5 show that the temperature behind the wall reached approximately 50 °C when the fireplace was placed on a mounting bracket. Test 6, on the other hand, reached 70 °C. It seems the air gap of only 9 mm supplied by the mounting bracket for models A and B is preventing build-up of heat in the wall. Model C in Test 6 had a larger distance (18 mm) between the rear of the fireplace and the wall it was mounted on. However in this case the temperature was higher on the wall. This is probably due to the construction of the double steel plates. Types A and B are supplied with a sort of grating that will lead out the heat between the two steel plates. Type C does not offer this, hence the hot air between the two steel plates is trapped. The maximum temperature measured on the mounting bracket was 82 °C for the entire test period, which means that the temperature on the mounting screws cannot be higher than 82 °C.

Test 7, which was the test on Type D with a single steel plate in the rear. This was also an example of a fireplace where the fastening screws were exposed to the heat of the flames, within the fireplace chamber. Because of the single steel plate in the rear the fireplace did not have a built-in air gap but instead had four distance pieces that offered a 50 mm distance between the rear of the fireplace and the wall it was mounted on. The air gap did prevent the heat build-up on the wall, it reached approximately 50 °C, however the distance pieces became very hot (91 °C) which would have been conducted into the wall. One of the four distance pieces is shown in Figure 6-3 and Figure 6-4.

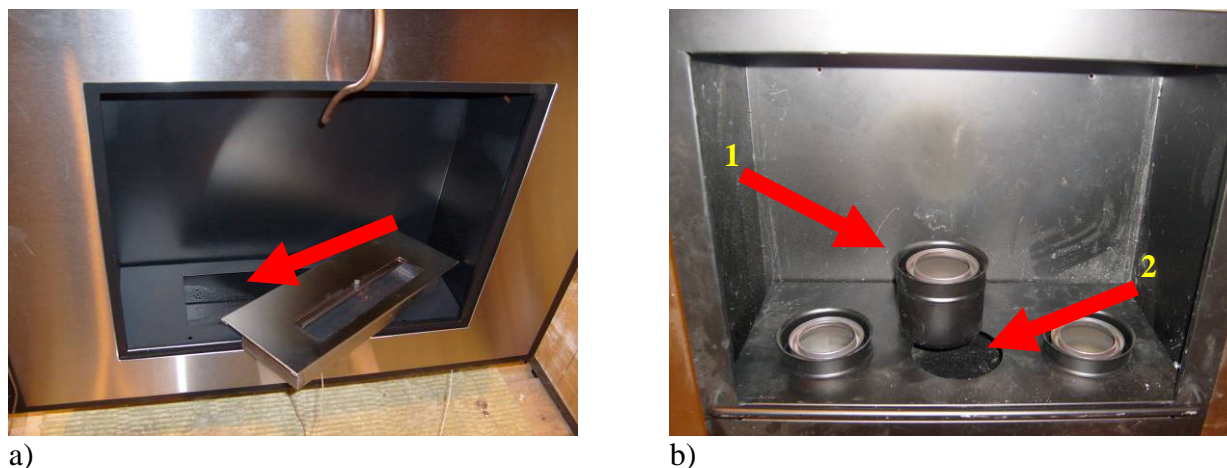


**Figure 6-3** The temperature was measured in both ends of the distance piece. The distance pieces were installed with screws from the inside of the burning chamber.



**Figure 6-4** A hole was drilled on the head of the screw so that the temperature was measured 20 mm further inside the screw. The temperature was measured to be 92 °C.

The selected fireplaces for the deflagration/explosion tests are shown in Figure 6-5 . The fireplaces of type A and B are delivered from one producer. Their designs are of the same basic construction. This type of fireplace does not have a type of fuel container holder that would make it suitable for the “explosion test”, therefore it was only Types C and D that were tested in this manner.



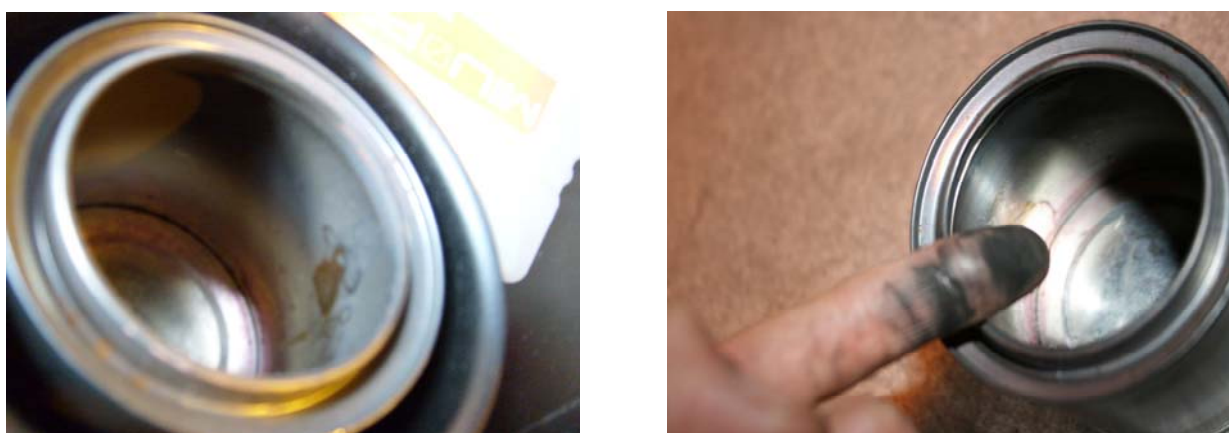
**Figure 6-5** The red arrows show where the spillage fuel was filled. The fuel container **a)** belongs to the fireplace of type C, while fuel container **b)** belongs to the fireplace of type D.

After the completion of the tests, no explosion was recorded. The holder of the fuel container shown in Figure 6-5a) was not tight and this caused the fuel to seep out. After approximately 30 minutes, the fuel-container holder was empty. Any fuel left in the holder might well have vaporized through the gap.

The gap between the fuel containers and its holders as seen in Figure 6-5b) were large enough to ventilate the vaporized ethanol away, in stead of it building up inside the holder and eventually explode. An attempt to generate an explosion by filling the compartment under the spill container with ethanol (0.5 L) failed. The compartment under the spill container is shown in Figure 6-5b), arrow no. 2.

CO and CO<sub>2</sub> were measured for Types A, B and C. The values are low compared to the reference values stated by the Norwegian Institute of Public Health /60/ However the results are not conclusive because the test setup with the fume hood was not according to SP-method 4160.

After the tests, the containers were visual examined and there were found trace of soot on the wall of the containers. An example is shown on Figure 6-6.



**Figure 6-6** An example of soot on the burner.

#### 6.4.1 Quality of the presented documentation (e.g. user manuals instructions)

**Table 6-2** Summary of the information presented in the user manuals for the tested fireplaces

	<b>Criteria</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
1	– All information as well as warnings shall be written in Norwegian.	X	X	X	-*
2	– Which types of walls or materials the fireplace is intended to be installed on.	X*	X*	-	X
3	– The minimum required distance to combustible material.	X	X	X	-
4	– How to fit or install the fireplace.	X	X	-*	X*
5	– Required type of ventilation of the room where the fireplace is to be fitted.	X*	X*	X*	-
6	– Minimum room size and volume.	X	X	-	-
7	– Specified fuel, along with refuelling instructions.	X*	X*	X*	X*
8	– Ignition instructions.	X	X	X	-
9	– Instructions for putting out the fire.	X	X	X	-
10	– Instruction for cleaning and maintenance.	X	X	X	-
11	– The installation documentation must include accurate and detailed instructions on how to choose a safe and appropriate location for the fireplace.	X*	X*	-	-
12	– The installation documentation must include instructions as well as graphical illustrations of the steps to ensure safe installation (this is particularly important with wall-mounted fireplaces).	X	X	-*	-*
13	– A wall protector of sufficient size and material must be placed behind the fireplace unless the wall itself is made of a non-combustible material (also applies to free-standing fireplaces).	-*	-*	-	X*
14	– Only appropriate fuel may be used with flueless fireplaces. Information must include detailed instructions on the storage and use of fuel (both in the user's manual and on the vessel used for storing fuel).	X*	X*	X*	X*
15	– Information must include a mention of the restriction that a maximum of 10 litres of flammable fuel may be stored in a home at any given time.	-	-	-	-
16	– The fire should be put out with an appropriate extinguishing device.	X	X	X	X*
17	– Aside from fuel, no combustible materials must be put in the fireplace. Equipment for putting out incipient fires, such as a fire blanket or fire extinguisher, should be kept near the fireplace.	X	X	-	-
18	– It is recommended that the room should be thoroughly ventilated after use of the fireplace.	X*	X*	X*	-
19	– It is advised that grown-ups shall be present, at all times, in a room where an ethanol-fuelled fireplace is ignited.	X	X	-	-

\*) *Remarks made below.*



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As table Table 6-2 shows, there is a varying quality of the user manuals of the tested fireplaces. Whereas the manuals of fireplace A and B (they had the same user manual) have a mention of most of the criteria, the manual of fireplace D is insufficient. Comments to the table are presented below.

### **Fireplace A and B**

It is specified that the fireplace must be mounted on a flat, non-combustible wall. A more specific type of wall or appropriate location is not given.

When refuelling the fuel container, it is advised to wait for at least 15 minutes after the flame was put out, and only approved fuel should be used.

As for criterion 5 and 18, the manual states that the room where the fireplace is installed should have sufficient ventilation. What type of ventilation is, however, not specified.

A wall protector of sufficient size is not included, but the fireplace should only be mounted on a non-combustible wall.

### **Fireplace C**

It is mentioned, in the manual, how to install the fireplace. However, the instruction is insufficient and there are no graphics showing how this should be done.

As for fireplace A and B, the manual states that fireplace C should be installed in well-ventilated rooms. In addition, it explains the need for ventilation with the fact that the flame will consume the oxygen in the room.

When refuelling the fuel container, it is advised to wait for 15 minutes after the flame was put out. It is also instructed that the fuel container should be filled maximum 2/3 of the total capacity. Furthermore, it is stipulated that only a specified fuel is to be used. It is not mentioned how to store the fuel.

### **Fireplace D**

The manual of the last fireplace is in Danish. This manual stands out from the others since it mainly contains sketches (only five lines of written instructions). The sketches may seem, to some, difficult to read.

There are no written installation instructions, the user have to rely on the sketches in order to assembly and mount the fireplace correctly.

It is not specified how to refuel the fireplace, but it is stated that only 95% ethanol should be used.

There are no wall protector of sufficient size and material included, only four fixing screws making a gap between the fireplace and the wall.

An extinguisher device is included, but it is not mentioned in the instructions.

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## 7 Discussion

### Statistics

It is seen from the statistics search-results that the statistics on accidents related to ethanol-fuelled, flue-less fireplaces, are not substantial. It does not mean that accidents do not occur, but they do not seem to be reported as related to ethanol fireplaces. We have seen that many different names are used for this type of products, in Norwegian and English, as well as Swedish. This makes it difficult and time consuming to search and collect the needed information. It would therefore be desirable that measures be taken in order to improve the statistics. One such measure could be to add a special field devoted to ethanol-fuelled fire-places in the fire incident report form used by the police and the fire department. The same would apply for the insurance companies' statistics. It would be of interest to be aware also of those incidents that do not involve police or fire departments, but still are related to problems with ethanol-fuelled fireplaces.

### Regulations

The regulations in Norway are very similar to those of other European countries. There is still no harmonised test standard for this type of products, so there are general product safety and construction regulations, as well as fire and explosions acts that apply. It is the responsibility of the importer/producer to document that the product, during its intended use, poses no danger to safety, health or environment. A harmonised test standard would facilitate both for the producers and importers to respect regulations, as well as for the authorities to survey the market.

The product design of ethanol-fuelled fireplaces is very versatile. There are examples of wall-mounted models, anchored free-standing floor-models, portable floor models, table-top models etc. There is also a large price span on them, which is probably due to the fact that some of them are very simple in its construction and therefore inexpensive to produce. Because of this large span of different models and varying quality and safety levels we believe that it is important to issue a set of specific requirements that all of the products, be it wall-mounted or portable floor models, must conform to in order to be allowed on the market.

### Documentation

From examining the manuals of the four tested fireplaces it is clear the information included varies greatly. From stating almost all of the criteria defined in section 5.2.1 to lacking close to all necessary information.

There was no information on the regulations on storing flammable liquids in any of the manuals. Perhaps the manufacturers of the fireplaces are not aware of this prohibition, or perhaps they do not regard it as their responsibility to inform the users about it.

Other pieces of information that in some cases has been found to be lacking are missing information about which type of wall the fireplace is intended for, minimum size of the room it can be installed in, safe usage, and informative graphical sketches. Vital information about how to extinguish liquid fires is also lacking in some instances.

The varying content of the different manuals suggests that there are, to date, a number of instruction manuals that lack large portions of the information required by the authorities, and this situation must obviously be amended.

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## **Fuel**

For safety issues, the authorities, in their guidance documents, advise that the type of fuel that is intended for a particular fireplace shall be stated. In the user manuals this statement is sometimes specified to a certain brand of fuel, and in some cases even with an article number. This is safe as long as the consumer can source that particular product. A fair question is then what the consumer should do if he cannot find the specific fuel as required in the user manual. Perhaps it changes names over time, production ceases or the fireplace is imported directly by the consumer and the fuel is not available in Norway. Another risk is that the consumer finds the branded fuel too expensive and therefore chooses to disregard the requirements in the instruction manual and buys a less expensive ethanol-based fluid. For reason of avoiding confusion, it may be wise to require a generic fuel-type and recommend the brand names of the supplier's choice. In addition it is suggested that further investigations are conducted on the consequences of using another type of fuel than what is suggested/required by the supplier.

## **Hazards**

From section 5.2.4 it is seen that ethanol-fuelled fireplaces represent several potential hazards. For instance, fireplaces designed without consideration to the rising temperatures on the wall may cause damage to the fixing (plastic materials used will melt), to the wall (calcining) which both may cause the fireplace to fall down, and to electric cables which may cause short circuits and fire.

Also, ignition, refueling and extinguishing of the fireplace may cause damage and injuries if caution is not taken. Therefore, in order to minimize these risks, it is advised that such products should be tested and verified by an appropriate instance before being introduced to the market. Ideally demands should be made upon the technical design of the fireplaces so that for example accidents with fuel are automatically avoided.

## **Tests**

The performed tests show the importance of creating effective heat insulation between the wall and the fireplace. In the cases of the tested products this is achieved mainly by creating air gaps by using different types of spacers between the wall and the fireplace, and also by creating a relatively thin layer of air between two steel plates in the rear of the fireplace. By allowing for ventilation of this thin layer the insulation is made even more effective.

The tests also show the potential of heat being conducted into the wall via the mounting system. Having mounted the fireplace incorrectly on a wall containing combustible material may lead to fire.

Although the tests in this report did not include testing the fastening system for a 60 kg load previously to the fireplace being lit, it is still an important property to test. It is of essence that the fastening system is sturdy enough so that the fireplace does not fall down from the wall due to weakness.

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## 8 Conclusions and recommendations

### Improving data collection

The existing statistics on this area is too poor to be able to conclude if the ethanol-fuelled fireplaces are dangerous products or not. We see however, several potential hazards with these products that would be beneficial to attend to (and new products accompanied with new types of hazards will probably turn up also). In order better monitor any incidents involving these types of fireplaces we see some potential of improvements with both the authorities and the insurance companies in gathering statistics on the issue.

### Market surveillance

We think it may appropriate that one authority is responsible for the surveillance of the complete product group of both wall-mounted and free-standing ethanol-fuelled fireplaces. It is important to uphold the competence within the authorities, and the multitude of different product types makes it possible that some variants may otherwise fall between two stools.

### General knowledge

The knowledge about safety and hazards concerning ethanol-fuelled fireplaces seems to be lacking among many interest groups, e.g. consumers, producers, importers and media.

### Approval system

We recommend that a similar approval system including testing and marking of ethanol-fuelled fireplaces is introduced in Norway.

The following should be tested and/or evaluated:

- Convective heat; fireplace-surface to wall temperature
- Radiant heat; mounting system through wall temperature. The temperature of the screws must not exceed 25 K above room temperature where the fireplace may be installed on a gypsum board wall.
- Emissions (CO, CO<sub>2</sub>, particles and possibly NO<sub>x</sub>)
- Efficiency, consumed fuel and produced power
- Sturdiness of the fireplace (tilting, mounting system, etc depending on the type of model)
- Instruction manual, (installation, safety precautions, safe usage etc.)

### Fuel

There should be stricter requirements on how to specify correct fuel type, in order to avoid people making mistakes.

It has been shown that refuelling has already caused several accidents. Therefore suppliers should be required show that there is a foolproof system of refuelling, where the fireplace cannot be refuelled before it is completely safe to do so. Also, it must be made impossible to accidentally spill fuel in closed compartments where fumes may be ignited and cause explosions.

### Emissions into the room

Since there is very little information on what is actually emitted, both from the unlit fuel and during combustion under different conditions (room size, ventilation quality, relative humidity etc.) we recommend that this is further investigated.

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## Appendix A – SP-method 4160

### Test method for ethanol fueled fireplaces without chimney

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Authors: Henrik Persson  
Lennart Gustavsson  
English translation: Christian Sesseng (SINTEF NBL as)

#### 1. Scope

This method concerns testing of open, ethanol fueled (the fuel can be ethanol gel) fireplaces without chimneys. The effect of the fireplace can be at most 4000 W. The method tests the safety-, emission- and operational characteristics of the fireplace.

#### 2. General conditions

##### 2.1 The basis for the test

The following material should be available in advance of the test:

- One specimen of the fireplace, included parts which can affect emission-, safety- and operating characteristics.
- All manuals and drawings.
- The intended fuel for the fireplace.

##### 2.1.1 Review of the operating manual

Manual and installation instructions are reviewed in order to assure that they comply with the criteria in Certifieringsregel 034 section 4.3. The consistency between the tested product and its manuals should be examined. Especially, it should be assured that the proposed methods for verification of the security are documented and possible to perform as intended.

##### 2.1.2 Test fuel

The fuel, which shall be a commercial type, is provided by the manufacturer (importer). The fuel's calorific value shall be determined if the manufacturer does not have a documented analysis of the fuel.



### 3. Examination of the design

#### 3.1 Stability

For fireplaces intended to be placed on the floor, the fuel container is filled to 4/5 of the container's height. The fireplace is then tilted to an angle of 30°. Make certain no fuel is spilled, nor that the container tips over. If it is suspected that the fireplace is vulnerable to horizontal jolts, a jolt test should be performed (selected sections of SS EN 12600). The side of the fireplace should be aligned with the suspended weight. A counter weight is placed on the opposite side of the fireplace. The 10 kg weight is lifted to an angle of 45° before it is dropped into the side of the fireplace. The test is repeated twice.

For wall mounted fireplaces, the fireplace should be mounted as described in the installation instructions and strained with a 60 kg weight for 10 minutes.

#### 3.2 Fuel containers

- The volume of the fuel container is determined.
- It is assured that the design of the container prevents fuel leakage and the container from tipping.
- It is assured that the container is vented.
- It is assured that the container and sealings' materials are not affected by the fuel.
- It is assured that the container and sealings withstand normal stress during handling and that all parts are strong and solid enough to keep all sealings intact.
- It is assured that the collecting tank beneath the fuel container does not leak. This can be verified by filling the tank with water.

#### 3.3 Surface temperatures

The surface temperature of the fireplace is measured with thermocouples.

Surface temperature on the surrounding walls and floor is measured in a test corner, according to ETF-QD De3.

### 4. Safety test

#### 4.1 Maximum effect

The fireplace is placed upon a scale and maximum fuel consumption is determined. The test shall continue for 60 minutes after the fireplace has gained thermal stability, or for as long as it takes to consume a full fuel container. The maximum input power is calculated as follows:

$$P = \frac{B \cdot H_i}{\rho \cdot 3.6}$$

where

P = input power [W]

B = fuel flow [kg/h]  
H<sub>i</sub> = lower heating value [kJ/l]  
ρ = fuel density [kg/l]

#### **4.2 Adjusting the flame**

It is assured that the flame is stable and soot free within two minutes after ignition.

#### **4.3 Non-sensitivity to draught**

An anemometer, aligned with the top of the fuel container, is used together with a fan to obtain an alternating air flow, alternating between 2 m/s for 10 seconds and 10 seconds cut-off. The outlet diameter of the fan shall be at least 120 mm. The puff should be directed horizontally towards the fuel container. This should be done for 5 cycles. This procedure should be repeated every 45° in a horizontal plane around the fireplace.

#### **4.4 Carbon monoxide concentration**

The fuel container is placed underneath an exhaustor hood (according to ETF-QD annex Cc8) and carbon monoxide- and carbon dioxide concentrations are measured. The distance between the hood and the fuel container's upper edge shall be 0.15 m. The measurements shall be taken at maximum power and, where appropriate, also at partial load.

### **5. Measurements**

#### **5.1 Surface temperatures**

The surface temperature is measured during the test according to ETF Instruktion 0002 and 0003 in SP-method 1682.

#### **5.2 Ambient temperature**

The ambient temperature is measured continuously during the test according to ETF Instruktion 0006 in SP-method 1682.

#### **5.3 Fuel flow**

The test specimen is placed upon a calibrated scale. The fuel flow is determined by reading the scale at the start of the test and after a period of time (the period is determined by a chronometer but should last for at least 30 minutes).

#### **5.4 CO concentration**

The CO concentration is logged continuously according to SP-method 1693.

### 5.5 CO<sub>2</sub> concentration

The CO<sub>2</sub> concentration is logged continuously according to SP-method 1693.

### 5.6 Caloric value

If the caloric value is not given by the producer of the fuel, it should be determined according to ASTM D 4809.

### 5.7 Fuel density

The density of the fuel is given by its producer. However, it could be verified by utilizing a graduated tube and a scale.

## 6. Report

The test report shall contain

- Name and address of the test laboratory, together with the address of the test site (if it is not the same as the address of the laboratory).
- A unique identification of the test report and of each page, as well as the total number of pages in the report.
- Name and address of the client/sponsor.
- Description and identification of the test specimen.
- List of product documents.
- The date of arrival of the test specimen and date of the test.
- Reference to this method.
- Test results as described below.
- Information of measuring uncertainty.
- Signature of the persons responsible for the testing together with the date of the report.
- Statement that the test report is valid only for the tested item.

The test results shall present

- The results of the examination described in section 3.
- The results of the test described in section 4.

Regarding the power- and emission measurements, the following should be presented

- Duration of the test.
- Consumed fuel.
- Applied power.
- Mean value of the CO concentration.
- Mean value of the CO<sub>2</sub> concentration.

## **Appendix B – Certification rule 034**

# **P-marking of construction products**

**Certification rule 034**

**-Decorative, ethanol-fuelled fireplaces without chimneys**



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## Preface

Certification rules describe the criteria for certification of construction products by SP Certifiering/SITAC. The criteria are defined by product-specific and general rules (Certification rule 000 – General).

The certification rules are based on existing standards, but they can be revised, e.g. in order to adjust them to European or international standards. Revising may also be necessary if new regulations are introduced or as a consequence of experiences made from the certification rules. If clarification or supplements are necessary, the rules are revised and republished at SP's and SITAC's websites.

Certification rule 034, which considers ethanol fueled fireplaces without chimneys, is established by the unit manager for SP Certification and VDn for SITAC.

2006-xx-xx

Lennart Månsson  
Unit manager SP Certification

Peter Bengtson  
VD SITAC

SP Certification  
Postbox 857  
501 15 Borås  
Sweden

Tel. +46 33 16 50 00  
Fax. +46 33 16 56 10

[www.sp.se](http://www.sp.se)

SITAC  
Postbox 553  
371 23 Karlskrona  
Sweden

Tel. +46 455 33 63 00  
Fax. +46 455 20 688

P-marking of construction products – Certification rule 34 – Decorative fireplaces without chimneys  
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## General

This certification rule considers technical information for ethanol fueled fireplaces without flues. For general information, the reader is referred to certification rule 000.

### 1. Intended use

The certification rule considers decorative fireplaces without chimneys, fueled with ethanol intended for comfort heating.

### 2. Applicable requirements

#### 3.1 Applicable requirements stated in law "Lag 1994:847 om tekniska egenskapskrav på byggnadsverk m.m. (BVL) §2"

Requirements stated in BVL	Applicable
1. Load bearing capacity, stability and durability	
2. Safety in case of fire	X
3. Protection considering hygiene, health and environment	X
4. Safety in use	X
5. Noise protection	
6. Energy conservation and thermal insulation	

#### 3.2 Applicable requirements stated in the regulations of the Swedish National Board of Housing, Building and Planning

Requirements in BVL	BBR	
2	5:41	Protection against the occurrence of fire
4	5:421	Fireplace
4	5:437	Cleaning and inspection
3	----	----

### 3. Technical requirements

#### 4.1 Examination of decorative fireplaces without chimneys

Testing and examination as described below should be performed. If there are any reasons to perform another test program, it should be approved by SP Certification/SITAC.

##### 4.1.1 Design requirements

Table 1 Design requirements

Characteristic	Method	Requirement
General		<p>The design of the fireplace should assure:</p> <ul style="list-style-type: none"> <li>-adequate safety with respect to fire, explosion and accidents.</li> <li>-that opening the fireplace door does not represent any unacceptable risk for injury at contact.</li> <li>-that the fireplace has at least three walls (excluding the bottom).</li> <li>-that opening the fireplace door does not represent any risk for nuisance such as smell, noise or fuel leakage.</li> <li>-that the bottom of the fireplace is tight (not glued) or equipped with a collecting tank.</li> <li>-that a good combustion level is maintained.</li> <li>-that the open fireplace can be lit and extinguished without interference.</li> <li>-that the fireplace inset is rigidly mounted to a framework, if such is intended to be a part of the installation.</li> <li>-that, for wall-mounted fireplaces, it is taken into account that plasterboard walls start to calcine at 45 - 50°C.</li> </ul>
Material and strength		<p>The fireplace should be made of a material which at the highest operating temperature sustains its shape and its ability to withstand thermal, mechanical and chemical strains (included corrosion).</p> <p>Examples of critical objects:</p> <ul style="list-style-type: none"> <li>• Wall fixings</li> <li>• Hatches</li> </ul>
Stability	SP-method 4160	<p>The design of the fireplace should allow the fuel container to be filled 4/5 of the container's height and tilted 30° without the container tipping or any fuel being spilled. The test is defined in SP-method 4160.</p> <p>For wall-mounted fireplaces, a fixing assuring safe suspension should be provided. This is tested according to SP-method 4160.</p>

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		<p>If the fireplace is intended to stand on the floor against a wall, a fixing anchoring the fireplace to the wall should be provided.</p> <p>If the stability of the fireplace is considered insufficient, a jolt test should be performed.</p>
Fuel containers	SP-method 4160	<p>The fuel containers for ethanol fueled fireplaces should meet the following criteria:</p> <ul style="list-style-type: none"> <li>- maximum volume of the container is 5 dm<sup>3</sup>.</li> <li>- troughs should be made of a rustproof material.</li> <li>- troughs and sealing should not be affected by the content.</li> <li>- troughs and sealings should withstand normal stress during handling and be fixed in a manner preventing them from tipping.</li> </ul>
Temperatures	SP-method 4160	<p>The fireplace should be designed so that the temperatures given below, for the respective measuring points, are not exceeded when the fuel giving the highest temperatures are used. When the ambient temperature is 20 °C, the surface temperatures for the sides of the fireplace must not exceed 90 °C. The surface temperatures of the sides are measured at those areas which may be touched unintentionally. If the fireplace is equipped with fire grates or similar objects to protect against contact with hot surfaces, the temperature limits applies for these objects.</p> <p>The design of the fireplace shall prevent the temperature on the adjacent walls or other flammable objects from exceeding 85 °C, since the open fireplace is placed as close to the wall as possible.</p> <p>If the fireplace has a framework of combustible material the temperature measurement shall be conducted inside the framework.</p> <p>Any possible spacers between the installation and combustible buildings components shall be integrated in the construction of the fireplace.</p>

### 4.1.2 Functional requirements

#### 4.1.2.1 Safety requirements

Characteristic	Method	Requirement																		
Maximum effect	SP-method 4160	<p>Maximum allowed effect is 4000 W. If the intended fuel is ethanol, liquid or solid, the 4000 W maximum effect counts for all the fuel containers placed within the fireplace.</p> <p>The fireplace can only be installed in areas of a minimum room volume (or floor area) which is governed by the maximum allowed effect. The relationship between effect and volume/area is given in the table below:</p> <table border="1"> <thead> <tr> <th>Maximum effect [W]</th> <th>Minimum room volume [m<sup>3</sup>]</th> <th>Minimum floor area [m<sup>2</sup>]</th> </tr> </thead> <tbody> <tr> <td>2000</td> <td>32</td> <td>13</td> </tr> <tr> <td>2500</td> <td>40</td> <td>17</td> </tr> <tr> <td>3000</td> <td>48</td> <td>20</td> </tr> <tr> <td>3500</td> <td>56</td> <td>23</td> </tr> <tr> <td>4000</td> <td>63</td> <td>26</td> </tr> </tbody> </table>	Maximum effect [W]	Minimum room volume [m <sup>3</sup> ]	Minimum floor area [m <sup>2</sup> ]	2000	32	13	2500	40	17	3000	48	20	3500	56	23	4000	63	26
Maximum effect [W]	Minimum room volume [m <sup>3</sup> ]	Minimum floor area [m <sup>2</sup> ]																		
2000	32	13																		
2500	40	17																		
3000	48	20																		
3500	56	23																		
4000	63	26																		
Adjusting the flame	SP-method 4160	A stable, soot free flame shall be obtained within the two first minutes after the ignition of an initially cold fireplace.																		
Insensitivity to draught	SP-method 4160	The flames from the fuel containers must not go out or cause dangerous situations as a consequence of the 2 m/s air draught, described in SP-method 4160 .																		
Emissions	SP-method 4160	The ratio of CO/CO <sub>2</sub> of the exhaust must not exceed 0.002. Also, the CO-concentration cannot exceed 35 ppm during the test described in SP-method 4160 at nominal effect (according to requirements from the The Swedish Work Environment Authority)																		

### 4.2 Product description

The product description shall include name, intended use, dimensions and material specification.

### 4.3 Related documents

The related documents should contain necessary information so as to planning, installation and use of the product can be done correctly.

The following documentation, in addition to requirements described in Certification rule 000, should be accounted for and examined:

P-marking of construction products – Certification rule 34 – Decorative fireplaces without chimneys  
October 2006 ©

### Manual

The manual should contain a product description, installation instructions and operating and maintenance instructions in Swedish. It should also contain a table of contents with page references together with a front page containing the product name, the latest revising date, edition number and the certification number (supplied by SP).

The product description should contain the following information:

- Type designation.
- That the fireplace can only be used in rooms where the ambient temperature normally does not exceed normal room temperature.
- That combustible objects must not be placed on top of or in the near vicinity of the fireplace, in order to avoid them from being subjected to high temperatures.
- The minimum room volume / floor area which is required for the room where the fireplace is to be installed.
- That the fireplace cannot be used in inflammable and potentially explosive rooms (EN 60079-10 and SRVFS 2004:7).
- Minimum distance between the fireplace and flammable objects.
- That the fireplace can only be used in rooms with good ventilation.
- Wall mounting instruction, where applicable.

The installation instructions should contain the following information:

- What fuel qualities the fireplace is intended for.
- That only the intended fuel should be used.
- That the fireplace should be extinguished and cool before refueling.
- How refueling is performed.
- How adjustments, ignition and extinguishing of the fireplace is performed.
- That the fireplace should not be ignited while it is warm.
- How, and how often inspection and cleaning should be performed.
- Troubleshooting.
- That the fuel should not be preheated.
- That only intended objects, such as ceramic logs, should be placed in the area of fire.

## **4. Marking**

The marking of the product and of its packing should present the following information:

- Type designation.
- Certification number.
- Year of production.
- Serial number or equivalent.
- Maximum effect.
- Maximum fuel consumption.
- Manufacturer.
- Importer (if imported).
- The minimum room volume / floor area which is required for the room where the fireplace is to be installed.

P-marking of construction products – Certification rule 34 – Decorative fireplaces without chimneys  
October 2006 ©

## 5. Extra

The following warnings should be included:

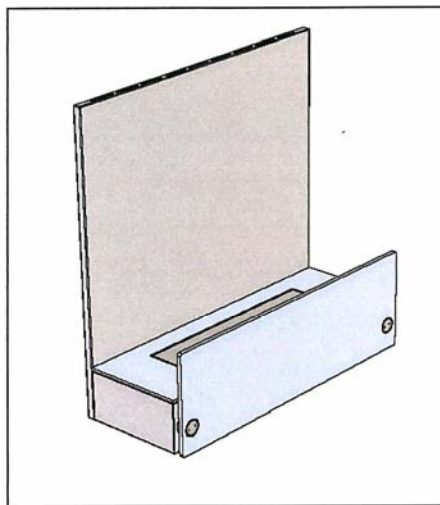
- WARNING! Dangerous concentrations of exhaust may arise, good ventilation must be provided.
- WARNING! High surface temperatures may arise.
- DO NOT COVER
- ONLY INTENDED FUEL SHALL BE USED.

---

## Appendix C – User manual fireplace A

### Monteringsanvisning for





Biopaiser for veggmontering

Les anvisning nøye før montering og bruk



Takk for at du valgte en av våre [blurred] modeller. [blurred] er designet, utviklet og produsert i Norge. Våre peiser skal være et designmessig tilskudd til rommet samt gi god varme. Peisene er plasseringsvennlig og enkle i bruk. Peisen er konstruert for å fyres med bioetanol og trenger derfor ikke tilkobles pipe. Det må kun brukes bioetanol som brensel (oljebasert produkter som parafin, rødsprit etc vil sote).

**Tekniske data:**

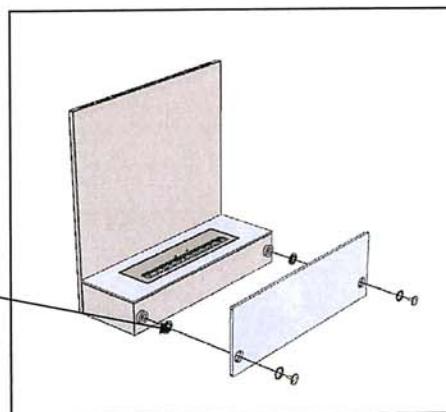
- Brenner i syrefast rustfritt stål.
- Herdet 8mm glass.
- Brennkammer i pulverlakkert stål.
- Tankvolum: 3 liter (anbefalt bruk 2,5 liter).
- Regulerbar og slukkbare flamme.
- Effekt med maksimal flamme 2,5 – 3 KWH.
- Reguleringspak ligger vedlagt.
- Skruer for gips, tre og betong ligger vedlagt.

**Viktige sjekkpunkter:**

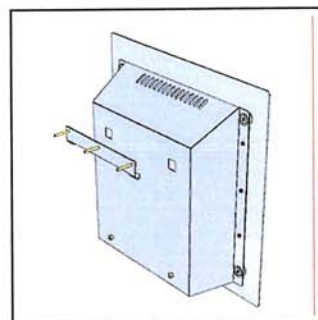
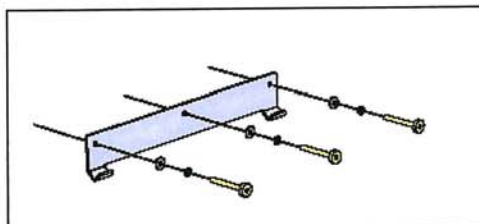
- Peisen kan brukes utendørs. Vær varsom med å brenne i sterk vind.
- For innendørs bruk bør rommet ha en størrelse på minimum 13m<sup>2</sup> eller rominnhold på 32 m<sup>3</sup>.
- Peisen må monteres på en solid rett vegg av ikke brennbart materiale.

**Monteringsanvisning peis:**

1. Fjern emballasje.
2. Legg peisen på et stødig bord med ryggen ned
3. Legg på medfølgende foring på distanseknott.
4. Legg på glassfront.
5. Skru festknottene med medfølgende verktøy.

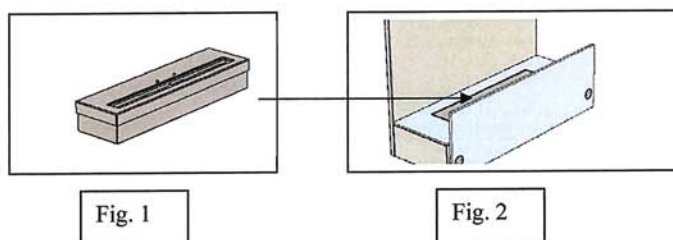

**Monteringsanvisning veggfeste:**

1. Finn ønsket høyde og lag hull til en skrue. Alle peiser kommer med godkjente skruer for gips, tre og betong.
2. Skru inn den første skruen.
3. Bruk vater til å sørge for at veggfestet er i horisontal posisjon.
4. Merk de andre skruehullene med en blyant.
5. Lag hull og fest de 2 siste skruene slik at veggfestet er godt tildratt.
6. Løft peise opp og plasser fest peisen på veggfestets holdekroker.
7. Se til at peisen henger beint og stødig og at klarering på baksida mot vegg er like stor langs hele peisen.



**Montering av brennkammer:**

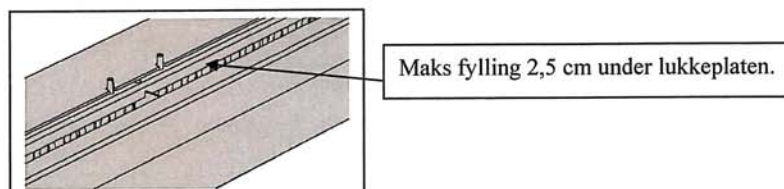
Består av brenner (Fig.1) og brennkammer i peis (Fig.2).



1. Plasser brenner i peisens brennkammer (Fig.1 + Fig.2).
2. Åpning av brenner skal vende ut mot rommet, slik at lukkeren skyves fremover.

**Sikkerhet og bruk:**

- All omgang med ild krever aktsomhet og forsiktighet. Ikke forlat åpen ild, og ikke la barn være alene med åpen ild uten tilsyn.
  - Det skal være minimum 1 meters klaring til løse tekstiler som gardiner etc.
1. Hell ønsket mengde bioetanol i brenner. Maks 2,5 liter eller ca 2 cm under lukkeplaten.



2. Tenn på med lang lighter eller fyrstikk. Det tar noen minutter fra opptenning til flammen når full størrelse. Blås aldri inn i flammen.
3. Regulerig av flamme skjer ved å skyve eller dra lukker frem og tilbake med vedlagte reguleringspak.
4. Slukking skjer ved å skyve eller dra lukker helt igjen. **VIKTIG! Påse at flamme er skikkelig slukket. Skyv lukker opp og se at det ikke er restflammer. Etter at man har forsikret seg om at flammen er slukket, sett lukkeren i lukket posisjon.**



5. Ved bruk av pyntestener og keramiske kubber skal disse plasseres slik at de ikke kommer i kontakt med flammene.
6. Sørg for tilstrekkelig lufting i rommer som peise befinner seg i.
7. Fyll **aldri** bioetanol rett etter at flammen er slukket. Vent minimum 15 minutter.
8. Peisen må aldri dekkes til.
9. Ikke oppbevar biobrensel innenfor 1 meter fra peisen.
10. Bruk aldri vann til å slukke brennende bioetanol. Bruk brannsløkkingsapparat eller kvelningsteppe.
11. Bruk aldri annet brennstoff enn godkjent bioetanol.
12. Dersom man søler bioetanol må dette tørkes opp før man fyrer på. Fjern brenner og brønn og tørk i peisens brennkammer. Tørk opp bioetanol som er kommet på gulv før man fyrer opp.

**Vedlikehold og rengjøring:**

Biopeisen trenger ikke spesielt vedlikehold utover vanlig rengjøring. Peis bør tørkes støv av jevnlig. Brenner bør rengjøres jevnlig ved å tørke med fuktig klut for å fjerne partikler og støv. Brennkammer bør tørkes med fuktig klut ved behov.

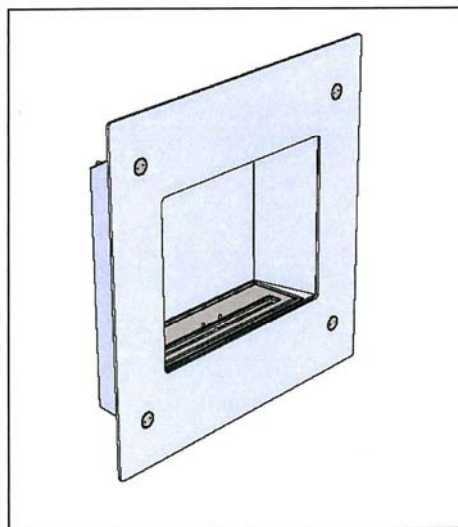
**Importør/ Produsent:**

---

## Appendix D – User manual fireplace B

### Monteringsanvisning for





Biopeiser for veggmontering

Les anvisning nøye før montering og bruk

Takk for at du valgte en av våre ■■■ modeller. ■■■ er designet, utviklet og produsert i Norge. Våre peiser skal være et designmessig tilskudd til rommet samt gi god varme. Peisene er plasseringsvennlig og enkle i bruk. Peisen er konstruert for å fyres med bioetanol og trenger derfor ikke tilkobles pipe. Det må kun brukes bioetanol som brensel (oljebasert produkter som parafin, rødsprit etc vil sote).

**Tekniske data:**

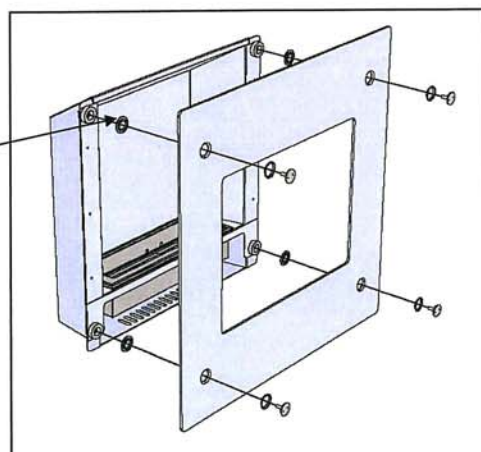
- Brenner i syrefast rustfritt stål.
- Aluminium frontplater.
- Brennkammer i pulverlakkert stål.
- Tankvolum: 3 liter (anbefalt bruk 2,5 liter).
- Regulerbar og slukkbare flamme.
- Effekt med maksimal flamme 2,5 – 3 KWH.
- Reguleringsspak ligger vedlagt.
- Skruer for gips, tre og betong ligger vedlagt.

**Viktige sjekkpunkter:**

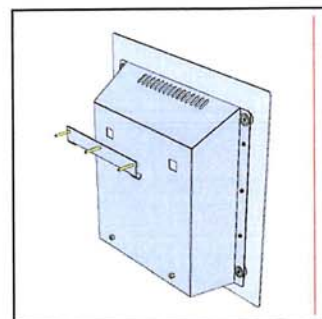
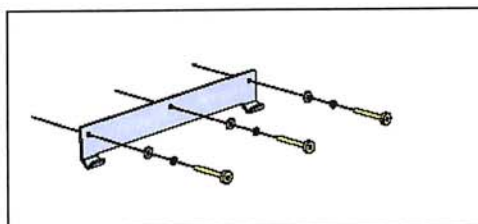
- Peisen kan brukes utendørs. Vær varsom med å brenne i sterk vind.
- For innendørs bruk bør rommet ha en størrelse på minimum 13m<sup>2</sup> eller rominnhold på 32 m<sup>3</sup>.
- Peisen må monteres på en solid rett vegg av ikke brennbart materiale.

**Monteringsanvisning peis:**

1. Fjern emballasje.
2. Legg peisen på et stødig bord med ryggen ned
3. Legg på medfølgende foring på distanseknott.
4. Legg på front.
5. Skru festknotter med medfølgende verktøy.


**Monteringsanvisning veggfeste:**

1. Finn ønsket høyde og lag hull til en skrue. Alle peiser kommer med godkjente skrue for gips, tre og betong.
2. Skru inn den første skruen.
3. Bruk vater til å sørge for at veggfestet er i horisontal posisjon.
4. Merk de andre skruehullene med en blyant.
5. Lag hull og fest de 2 siste skruene slik at veggfestet er godt tildratt.
6. Løft peise opp og plasser fest peisen på veggfestets holdekroker.
7. Se til at peisen henger beint og stødig og at klarering på baksida mot vegg er like stor langs hele peisen.



**Montering av brennkammer:**

Består av brenner (Fig.1), brønn (Fig.2), og brennkammer i peis (Fig.3).

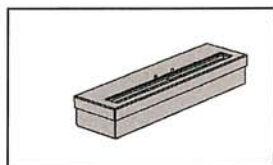


Fig. 1

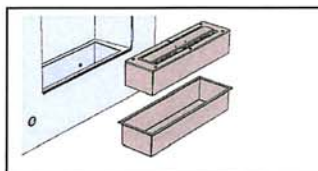


Fig. 2

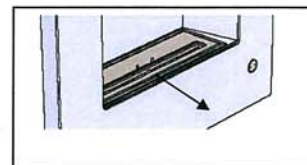
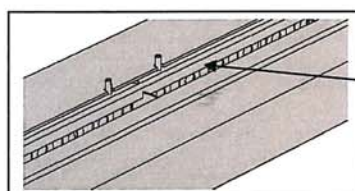


Fig. 3

1. Plasser brenner i brønn (Fig.1 + Fig.2)
2. Plasser brenner og brønn i peisens brennkammer (Fig.3)
3. Åpning av brenner skal vende ut mot rommet, slik at lukkeren skyves fremover.

**Sikkerhet og bruk:**

- All omgang med ild krever aktsomhet og forsiktighet. Ikke forlat åpen ild, og ikke la barn være alene med åpen ild uten tilsyn.
  - Det skal være minimum 1 meters klaring til løse tekstiler som gardiner etc.
1. Hell ønsket mengde bioetanol i brenner. Maks 2,5 liter eller ca 2 cm under lukkeplaten.



Maks fylling 2,5 cm under lukkeplaten.

2. Tenn på med lang lighter eller fyrstikk. Det tar noen minutter fra opptenning til flammen når full størrelse. Blås aldri inn i flammen.
3. Regulerig av flamme skjer ved å skyve eller dra lukker frem og tilbake med vedlagte reguleringspak.

4. Slukking skjer ved å skyve eller dra lukker helt igjen. **VIKTIG! Se til at flammen er skikkelig slukket. Skyv lukker opp og se at det ikke er restflammer. Etter at man har forsikret seg om at flammen er slukket, sett lukkeren i lukket posisjon.**
5. Ved bruk av pyntestener og keramiske kubber skal disse plasseres slik at de ikke kommer i kontakt med flammene.
6. Sørg for tilstrekkelig lufting i rommet som peisen befinner seg i.
7. Fyll **aldri** bioetanol rett etter at flammen er slukket. Vent minimum 15 minutter.
8. Peisen må aldri dekkes til.
9. Ikke oppbevar biobrensel innenfor 1 meter fra peisen.
10. Bruk aldri vann til å slukke brennende bioetanol. Bruk brannslukkingsapparat eller kvelningsteppe.
11. Bruk aldri annet brennstoff enn godkjent bioetanol.
12. Dersom man søler bioetanol må dette tørkes opp før man fyrer på. Fjern brenner og brønn og tørk i peisens brennkammer. Tørk opp bioetanol som er kommet på gulv før man fyrer opp.

**Vedlikehold og rengjøring:**

Biopeisen trenger ikke spesielt vedlikehold utover vanlig rengjøring. Peis bør tørkes støv av jevnlig. Brenner bør rengjøres jevnlig ved å tørke med fuktig klut for å fjerne partikler og støv. Brennkammer bør tørkes med fuktig klut ved behov.

**Appendix E – User manual fireplace C**




 leveres i seks forskjellige design og krever ingen pipe eller mur for å installeres. Peisen monteres raskt og enkelt på vegg med medfølgende festebraketter.

#### Montering:

Fjern emballasjen og se at alle deler følger med. Monter festebrakettene waterrett på veggen med skruer og plugg. Medfølgende plugg er beregnet for betong. Sørg for å bruke plugg som er beregnet for underlaget peisen monteres på. Sett videre inn brennkammeret og eventuell rist. Det skal være en sikkerhetsdistanse på 60 cm mellom gulvet og peisåpningen. Møbler eller annet brennbart materiale skal ikke plasseres nærmere enn 100 cm. Det anbefales også at peisen plasseres minst 2 meter fra vinduer og gardiner.


#### Optenning:

Fyll brennkammeret/ koppene med maksimum 2/3  brennveske. Søl må tørkes vekk og vaskes med vann for å forhindre antenning rundt brennkammeret! Søl med brennveske kan også gjøre metallet matt. Sett brennvesken på god avstand før du antenner ildstedet. Flammene vil brenne svakere i begynnelsen og bruker ca 15 minutter på å nå optimal temperatur og høyde.

**NB! Etterfyll aldri brennveske så lenge peisen brenner.**

Brennkammeret skal avkjøles i 15 minutter før ny brennveske etterfylles.

#### Slukking:

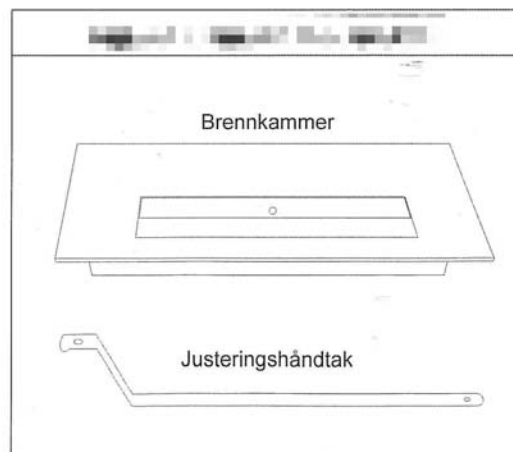
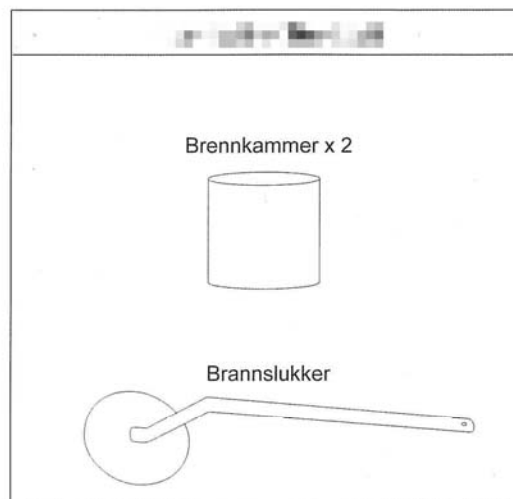
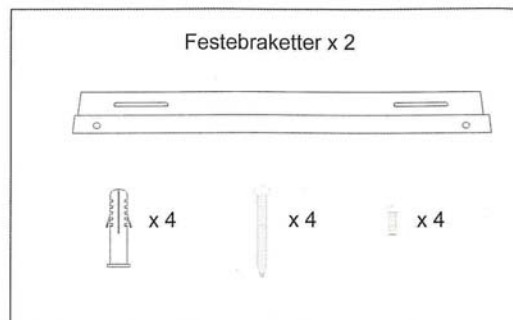
Hell aldri vann på flammene. La brennvesken brenne helt ut hvis mulig. Ønskes det å slukke før brennkammeret er tomt kan luken dras over brennkammeret. Vent i ca 10-15 minutter for å la flammene slukne helt.  har runde brennkamre. Her brukes medfølgende brannslukker for å kvele flammene. Gjenværende brennveske skal avkjøles i 30 minutter før den fjernes.

#### Vedlikehold:

Brennkammeret må rengjøres jevnlig. Bruk varmt vann og oppvaskmiddel. Merker på peisen fjernes best med en klut og varmt såpevann. Advarsel: Ikke bruk kjemikalier, stål-ull, skrubb eller liknende da dette kan skade overflaten og gi riper.

#### Sikkerhetsregler:

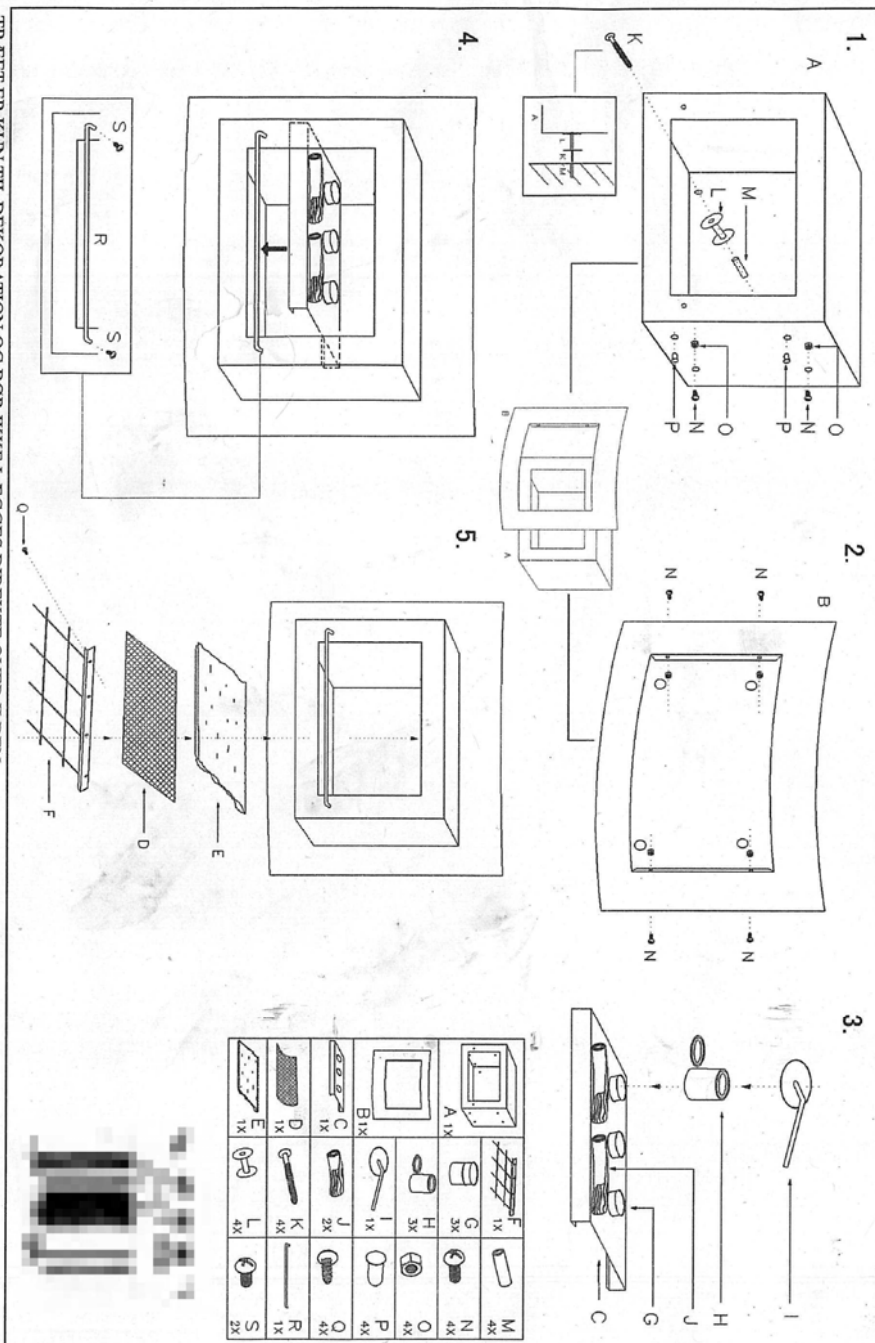
- NordBio peiser må kun benyttes på godt ventilerte steder da flammene vil bruke oksygen fra rommet.
- NordBio peiser har åpne flammer og skal aldri forlates uten tilsyn.
- NordBio peiser er kun for innendørs bruk.
- Ikke blås eller hell veske på flammene.
- Unngå trekk i rommet der peisen er tent.
- Oppbevar brennvesken utilgjengelig for barn og dyr.





**Appendix F – User manual fireplace D**

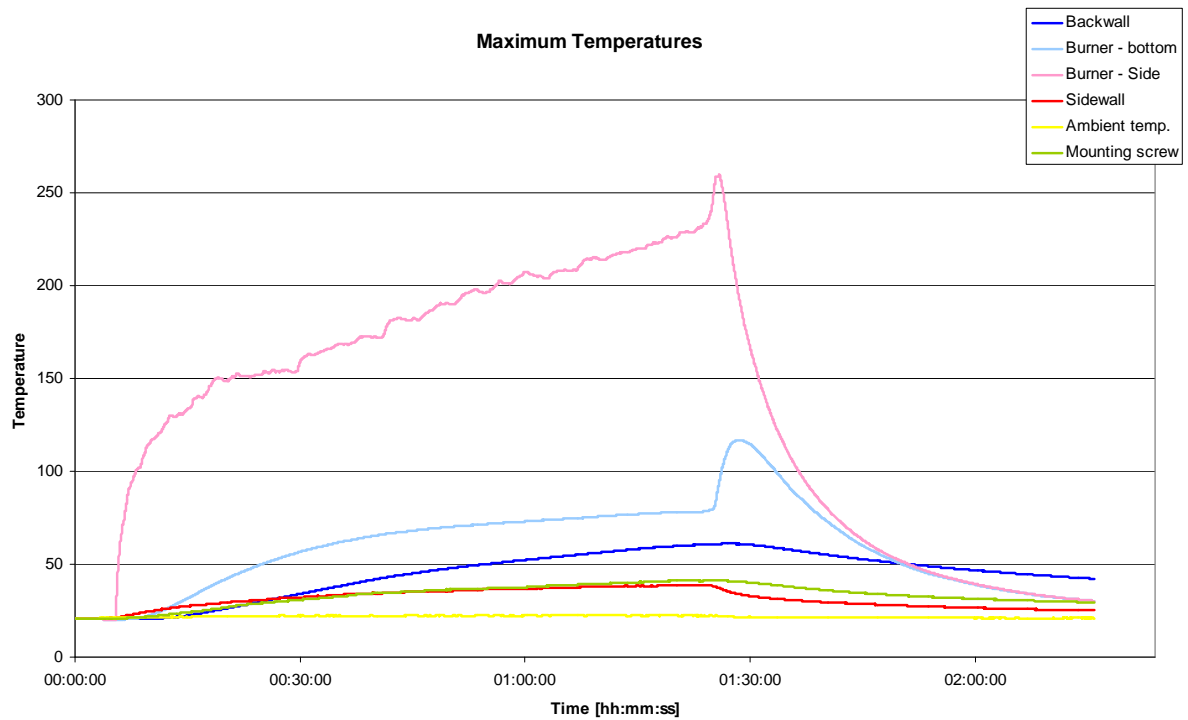
**Samlevejledning**



TRÆFET ER KUN TIL DEKORATION OG BØR IKKE LÆGGES DIREKTE OVER LIDEN PEISEN MÅ KUN MONTERES PÅ EN IKKE BRÆNDBAR VÆG BRUG KUN 95% ETHANOL. BRUG ALDRIG LAMPEOLIE ELLER LIGNENDE BRÆNDBARE VÆSKER. FYLD KUN BEHOLDEREN 75% - SE MÆRKNINGEN PÅ BEHOLDEREN. BEMÆRK! DE MEDFØLGENDE SKRUE OG PUGS KAN IKKE VÆRDES I ALLE TYPER VÆGGE, BRUG ANDRE SKRUE SÅREMT DE IKKE PASSER.

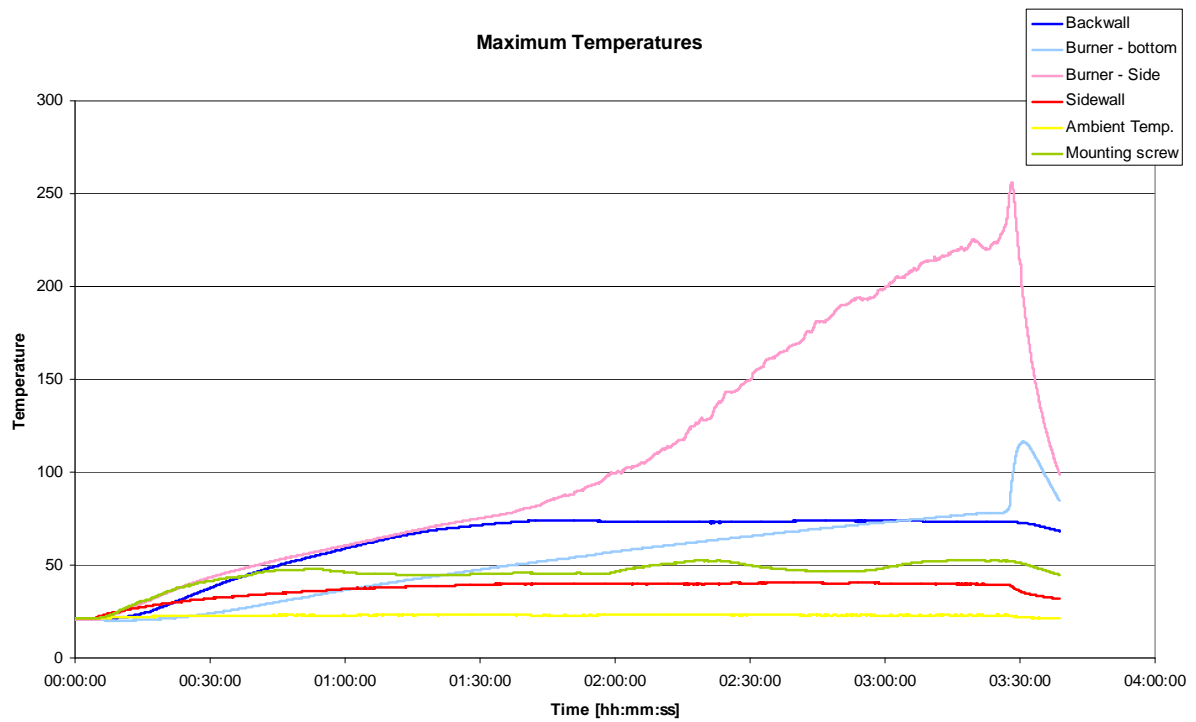
## Appendix G – Test results

### Test 1



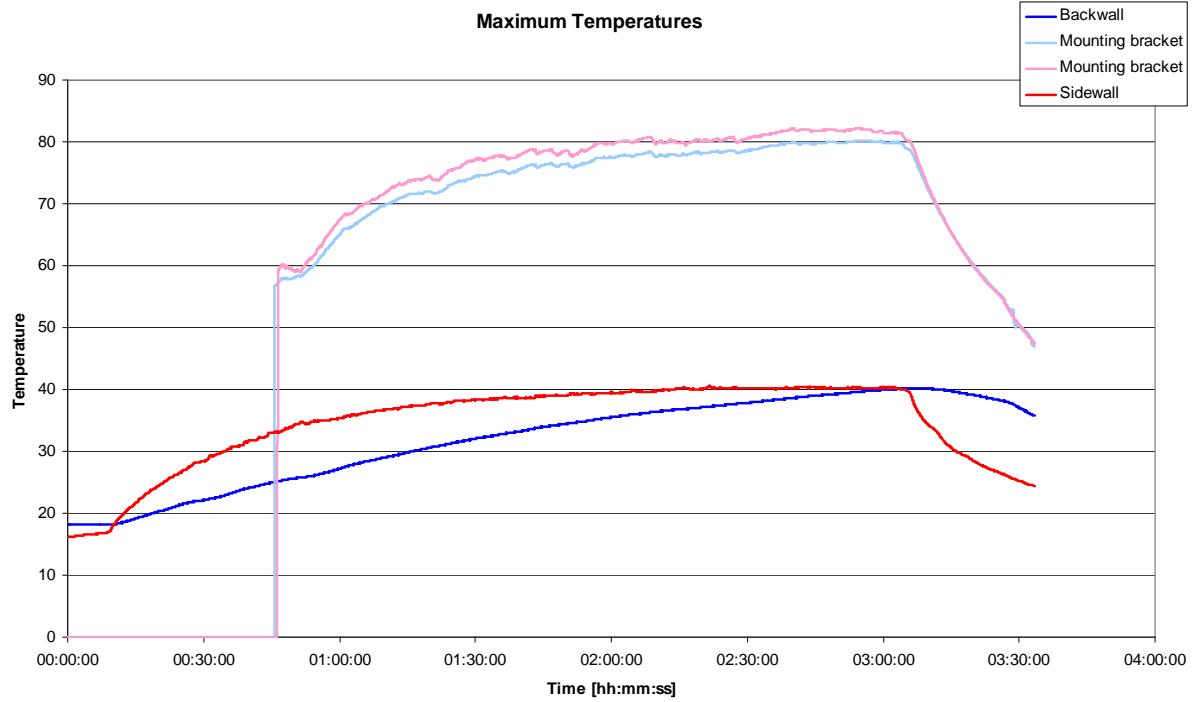
Test results [°C]	
Back wall	61,1
Side wall	38,7
Mounting screw	41,2
Ambient temp.	22,7

## Test 2



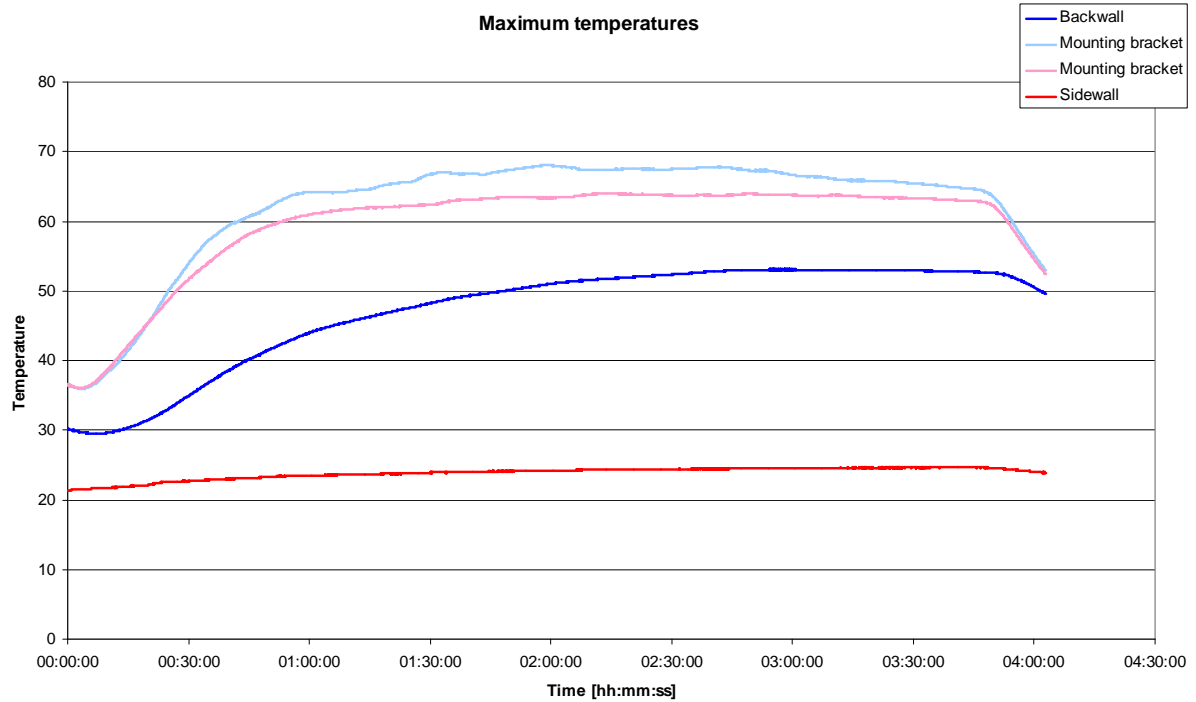
Test results [°C]	
Back wall	73,9
Side wall	40,6
Mounting screw	52,6
Ambient Temp.	23,6

## Test 3



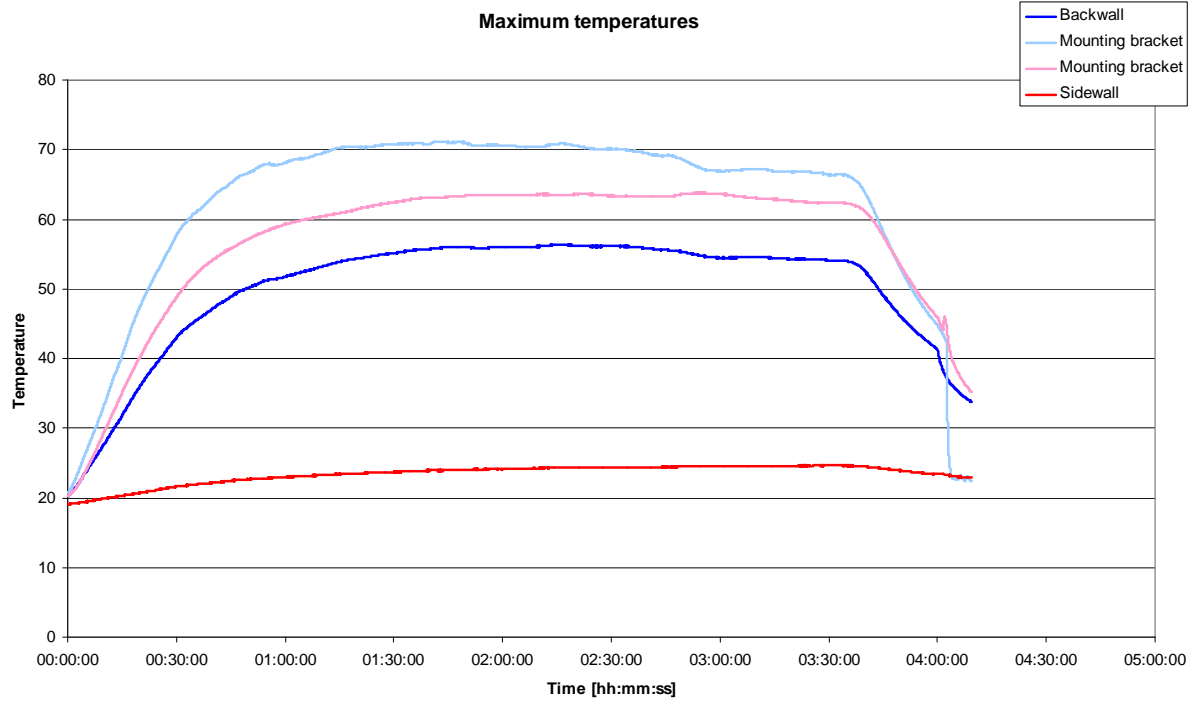
Test results [°C]	
Back wall	40,3
Side wall	40,5
Mounting bracket	82,2
Ambient temp.	21,3

## Test 4



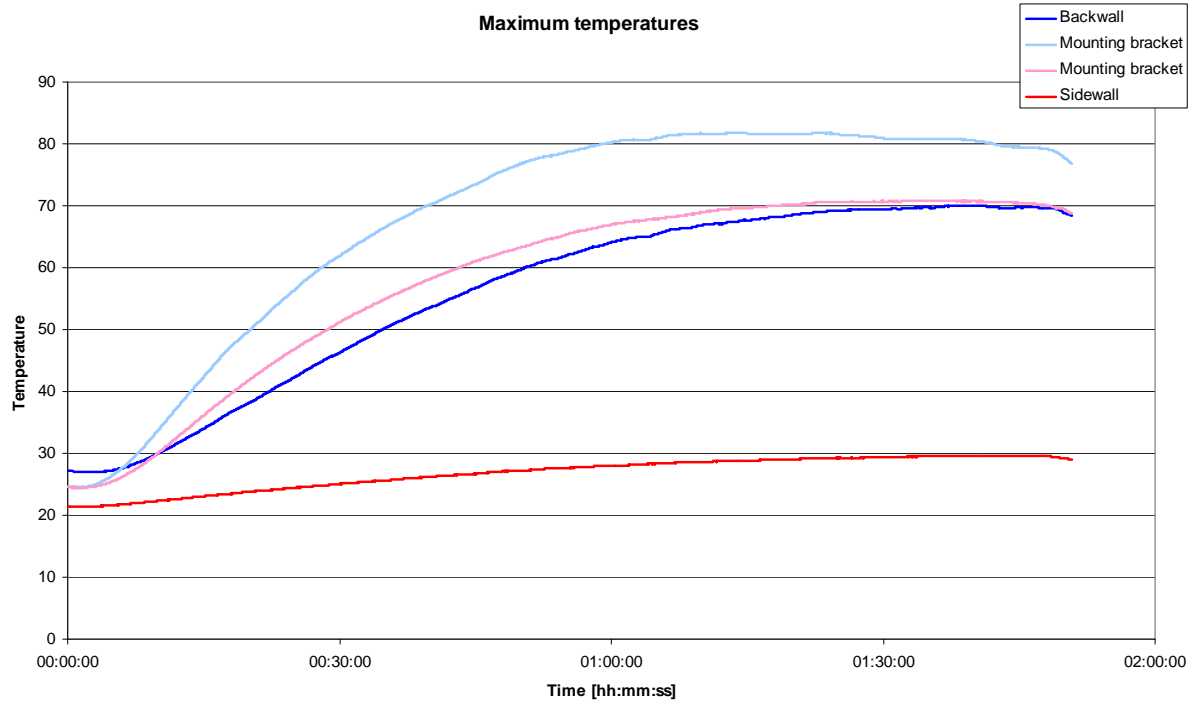
Test results [°C]	
Back wall	53,1
Side wall	24,7
Mounting bracket	68,1
Ambient temp.	21,6

## Test 5



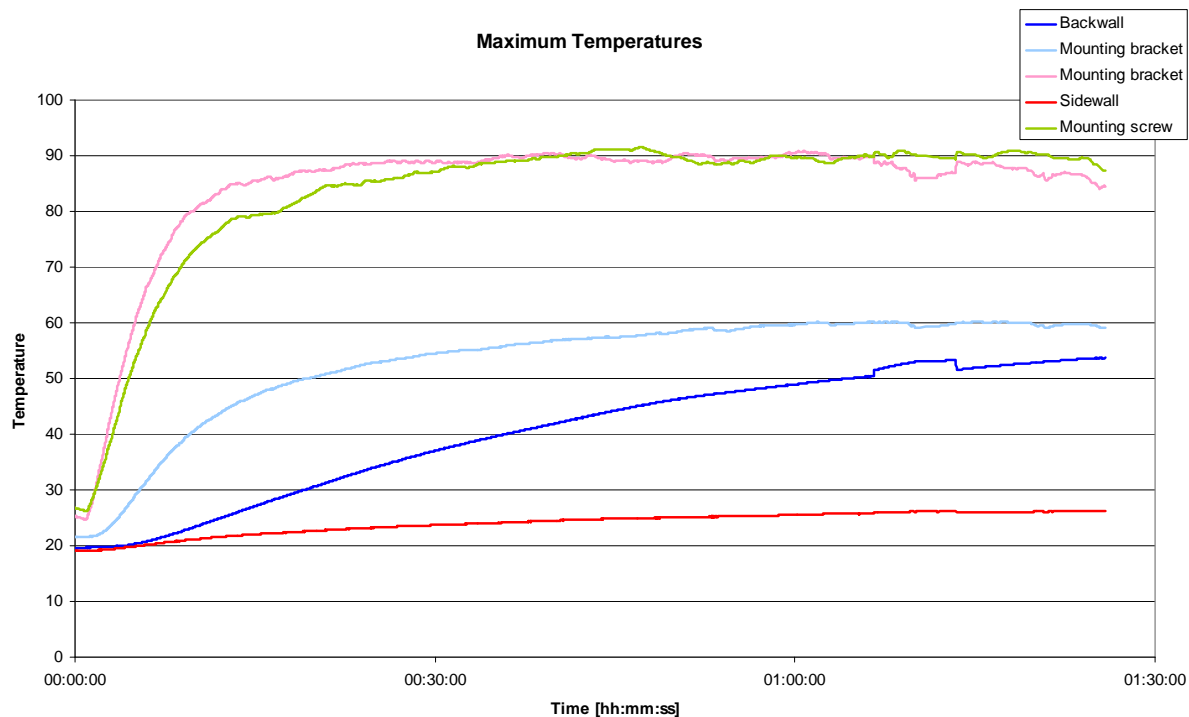
Test results [°C]	
Back wall	56,4
Side wall	24,6
Mounting bracket	71,2
Ambient Temp.	21,5

## Test 6



Test results [°C]	
Back wall	70,1
Side wall	29,7
Mounting bracket	81,8
Ambient temp.	21,6

## Test 7

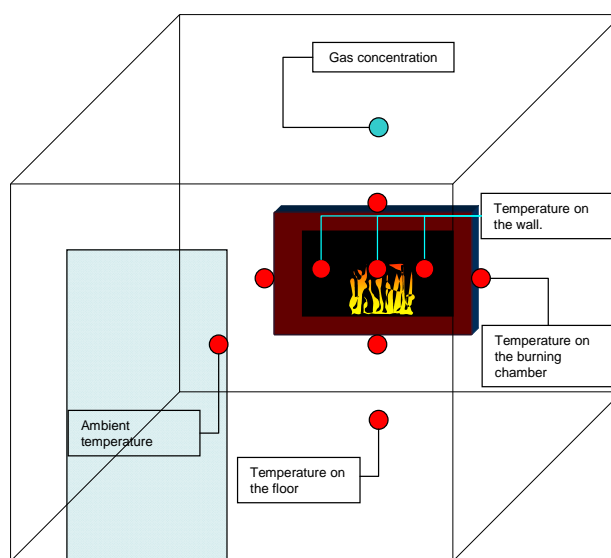


Test results [°C]	
Back wall	91,5
Side wall	26,2
Mounting screw	91,5
Mounting bracket	60,2
Ambient temp.	-



## Appendix H – Test criteria

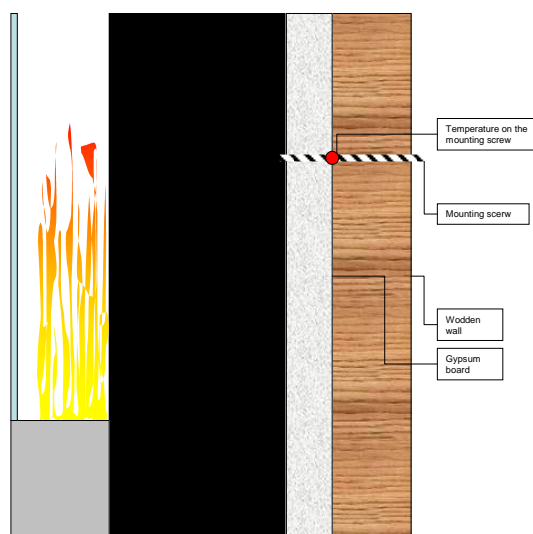
It was decided to utilize the same test corner which is used for testing wood-fired fireplaces. The test corner is made up by combustible walls with studs and isolation. Figure 1 presents a detailed sketch showing the measuring points.



**Figure 1** Sketch showing the test rig with measuring points.

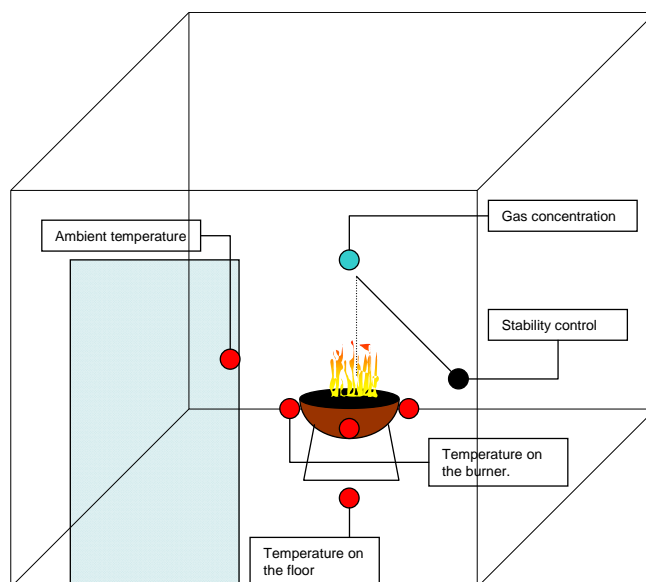
It was desirable to measure the temperatures on the securing screws. If heat is conducted from the screws to the wooden wall, fire may occur. A schematic sketch is presented in Figure 2.

In addition to measuring the temperatures and gas concentrations, the combustion rate was calculated. In order to collect as much as possible of the exhaust gasses (to determine the gas concentrations), an exhaust hood was placed over the fireplace.



**Figure 2** Schematic sketch showing how the temperature on mounting screw will be measured.

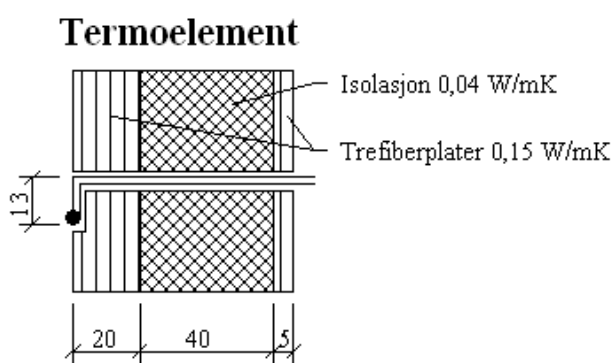
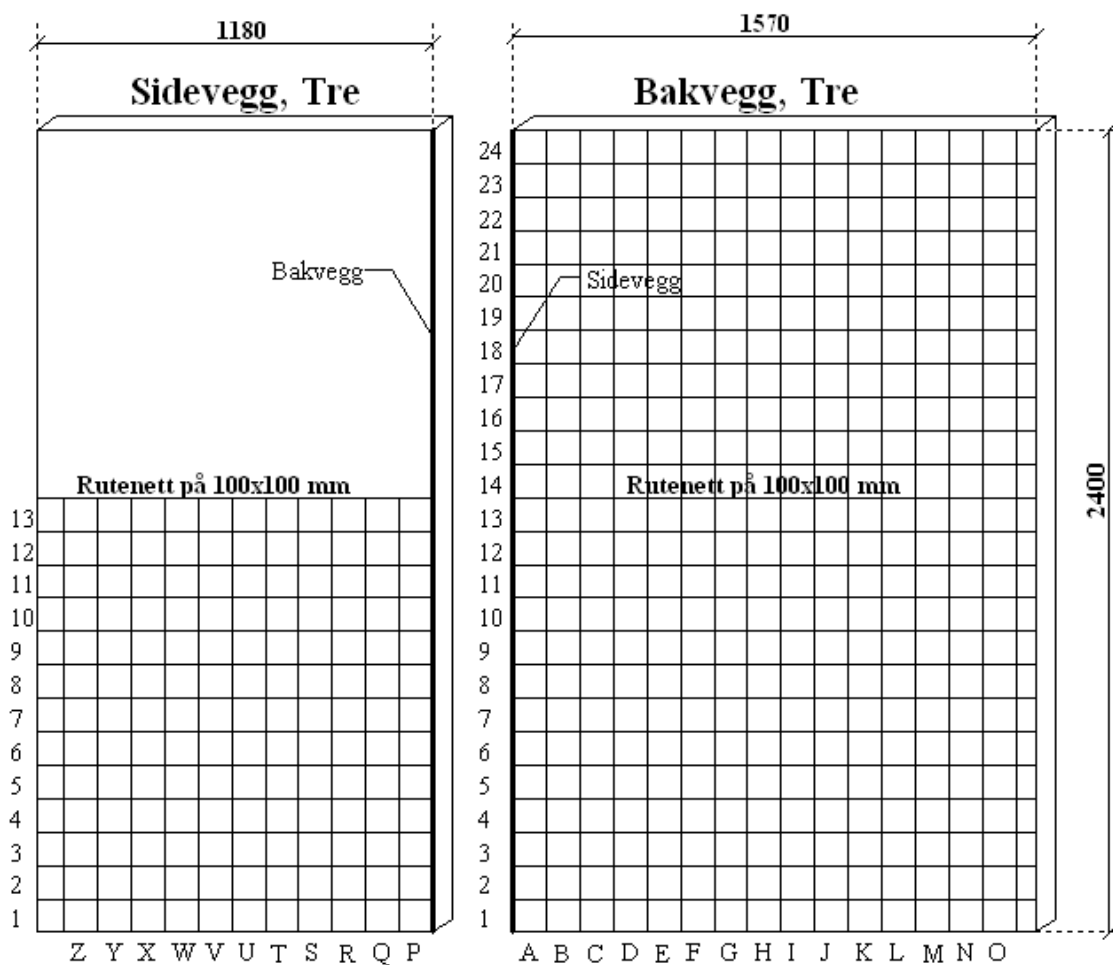
For free-standing fireplaces, the stability shall be examined. The stability test, which was based on SP-method 4160, involves a sustained weight being dropped into the side of the fireplace. For more details, please consult the method. A sketch showing the measuring points is presented in Figure 3.



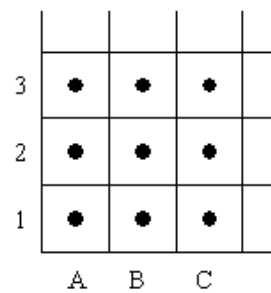
**Figure 3** *Schematic sketch showing the measuring points.*

In addition, the flame's sensitivity to draught shall be examined, according to SP-method 4160.

**Appendix 1** Sketch showing the test corner. All measures in mm.



**Plassering av termoelement i rutenettet**



Alle mål i mm

**Figure 4** Sketch showing the test corner. All measures in mm



**Figure 5** *Photo demonstrating the test corner in use.*

