

SAVE II ACTION
Contract no. XVII/4.1031/ Z/99/283
Labelling and other measures for heating systems in dwellings

Appendix 2

Standards governing design and installation

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The contents of this appendix, and revisions resulting from comments by the eight project partners, are the responsibility of the task authors.

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This review of standards aims to describe the partner country's national standards which are applied to improve energy efficiency, governing design, installation & maintenance of heating systems in dwellings.

This review does not describe security & safety regulations in detail. Also, laws and regulations concerning the general framework regarding the practical application of energy efficiency are not described here.

This description distinguishes between:

- existing buildings,
- new buildings.

Heating systems in new buildings are mainly regulated by national Building and Heating System Regulations, resulting from national policy concerning energy efficiency. The present document gives a comparison between European countries.

A – National Standards

1 – Heating systems in existing buildings

With regard to design and/or installation procedure for heating systems in **existing buildings**, the main rules concern **security and safety**, and not especially efficiency. For security and safety reasons, a new heating system (for gas-fired, and in France for new electric installations) must be checked or installed by a competent contractor. However, a boiler replacement does not always require a specific procedure or a qualified person.

The size of a domestic boiler is generally estimated by an installer, and calculated by experts in large buildings.

1 – 1 Procedure for design

Except in Italy and Germany, there is no rule or procedure required regarding the design of heating systems in existing buildings.

In **Germany**, qualified companies are involved in a high percentage of replacement heating systems. Thus standard boilers are only allowed as an exception, and generally low-temperature or condensing boilers are requested. However, if a standard boiler is installed, a calculation of the buildings' energy-requirement is obligatory. According to the building order, a certificate of compliance with public rules, signed by a qualified company or an independent expert, is obligatory for new or changed heating systems. New boilers have to be controlled by 'chimney sweeps'.

In **Italy**, the Presidential Decree 412/1993 requires that the design of new buildings, or significant restructuring of existing ones, must include aiming to reducing heat and electricity consumption. A technical report confirming compliance with the rules limiting energy consumption must be submitted. This report has different formats for :

- all new or restructured heating systems
- replacement of heat generators if power exceeds 35 kW.

Sizing of plant must follow the procedure as set down by the presidential decree. A number of calculations are identified by the decree which were subsequently standardised by UNI (national unification institute).

1 – 2 Procedure for installation

There are regulations for installation procedures for new buildings. For existing buildings, except in Italy and Germany, there are no specific regulations on installation procedure.

1 – 3 Procedure for maintenance

Maintenance procedure is required depending of the size of the boiler.

1 – 3 – 1 Domestic boilers

For domestic boilers there is no regulation, except in Germany, requiring regular testing of heating systems efficiency in existing buildings. But for safety reasons, regulations impose an annual check of the boiler combustion, and cleaning of the flue by competent contractors.

In **Germany**, energy saving rules state that heating systems bigger than 50 kW have to be serviced twice a year. The service has to be carried out by qualified personnel. This includes a check of combustion efficiency. In the case of non-compliance, the boiler has to be adjusted.

1 – 3 – 2 Very Large Power : Periodic check of energy systems

In **France**, the Decree 98-833 of 16 September 1998 concerns energy installations and states:

- If the sum of nominal power is equal to or greater than 1 MW, a periodic check has to be effective for 3 years.

This decree also specifies that the check procedure has to verify the existence and correct functioning of control systems, distribution systems and combustion of the boilers. If the system fails the check procedure, the owner or the operator of the installation has to adjust the system to the norms within the next 3 months.

In **Italy**, the Presidential decree 412/1993 defines three different categories of heat generators, each of which have different regulations. The responsible person (for apartment blocks this is the owner or administrator, or a delegated professional) must ensure regular maintenance of the whole system which includes:

- For heat generators whose power exceed 350 kW
 - checking the thermostatic control devices,
 - cleaning the heat generator twice a year,
 - checking the combustion efficiency and regulation of the burners twice a year, in order to maximise energy efficiency,
 - self-certification, which must be sent to local authorities.
- For heat generators whose power is between 35 and 350 kW
 - same as above but only once a year.
- For heat generators whose power is under 35 kW
 - cleaning the heat generator,
 - generic check of the generator.

All these operations are strictly defined through UNI (National Unification Institute) norms. If the combustion check fails the minimum requirements, then the responsible person must carry out all the required corrective operations.

Also, Local authorities must:

- check all heat generators whose power exceeds 350 kW at least once every two years,
- check all heat generators whose power exceeds 35 kW where the responsible person failed to send self-certification (with all expenses to be paid by the responsible person),
- make a random check of 5% of all heat generators.

These checks include an efficiency check.

In the **Netherlands**, the regulatory requirements for heat generator servicing concerns the following type of boiler :

- Boilers > 130 kW must be inspected/serviced every year; there is mandatory environmental legislation on this issue.
- For boilers <130 kW there is no law prescribing that the boiler needs to be inspected/serviced every year. There are guidelines (safety guidelines) that encourage people to do yearly maintenance/inspections. Manufacturers' installation guides and user manuals mention this need for a yearly inspection. If the product is not serviced adequately for a period of years, the manufacturer will no longer accept product liability.

In both cases (> 130 kW and < 130 kW) a boiler inspection includes a check on the combustion products and if necessary a re-tuning of the gas/air-ratio, according to the manufacturer's specifications in the installation & service guide.

In **other countries**, in general there is no regulation of this.

1 – 4 Qualification of System Designer, Installers & Maintenance Staff

In every EU country, Maintenance Staff, Installers, and Systems Designers are qualified or their experience is recognised. However, qualified persons are not always required for design, installation, or to maintain heating systems in existing buildings, especially with regard to the power installed. There is no specific regulation requiring the use of qualified persons for large power plants.

However, for security and safety reasons, and for new installations of complete heating systems of gas-fired (including boiler, duct, pipes) or electric installations, qualified and/or competent persons are required.

Except in Italy and Germany, the qualification is not an obligation.

1 – 4 – 1 Qualification of System Designer & Installers

In the **Netherlands**, boiler replacements in the residential sector are mainly done by small companies (15 or less employees).

Business licensing requirements are:

- requirements concerning general entrepreneur-skills (marketing, operational management, financial accounting, financial management).
- requirements concerning installation technique and skills.

The entrepreneur is the one who has to be in possession of these two qualifications. Only with these qualifications can one get a business license and start a company as a heating installer. Several certificates (Intermediate Technical School, Technical College, and others) qualify, as well as several separate vocational training courses.

Most qualified installers have general knowledge on the efficiency classes of boilers (heat-generators). The condensing boiler has been on the Dutch market since 1980, and most installers have experience of installing and servicing this type of appliance. Within the VNI, installers can establish special interest groups; Solar Energy is a special interest group that was established at the request of the installers.

The qualification of an employee of a certified heating installer can be:

- a. assembly assistant heating installations (level 1)
- b. assistant installer heating techniques (level 2)
- c. assistant heating installer (level 2)
- d. heating installer (level 3)
- e. maintenance engineer heating techniques (level 3)
- f. service engineer heating techniques (level 3)

At present there is no training or procedure for evaluating the energy-efficiency of the overall heating system in the residential sector. Only when heating systems do not function adequately and consumers complain, is the overall heating system re-evaluated and modified.

In **Italy**, installations of new systems, and significant restructuring (this excludes only a boiler replacement) must be carried out by installation companies registered in the local registers of craftsmen's guild. To qualify for registration at least one member of the company staff must have one of the following:

- A. University equivalent degree in technical field
- B. High school diploma in scientific subjects and 1 year minimum experience
- C. Technical (Professional) school qualification and 2 years minimum experience
- D. No academic qualification but 3 years minimum experience

In **Germany**, installers have to have a minimum qualification which is part of the German system of craftsmanship:

- Installations have to be done by a qualified company (Meisterbetrieb) which means that they have to employ one leading master (Meister) who is qualified in the field of installation / installation of heating systems. Usually the company owner bears this qualification himself. Often there are one or more employed masters as well (often younger ones without their own company).
- The German craftsmen are divided into specific fields. For heating, the installers are suitable. This field covers working with plumbing etc and heating. Until 1999 there were two professions, the sanitary installer and the heating installer, who usually worked together in one company. The masters usually had a double qualification, for sanitary, and for heating. Since 2000 both branches are one profession. The exact details for qualifications etc. are to be worked out.

To carry out plumbing work on water-systems, one must become accredited with the local water supplier. For this one needs a special qualification (courses and tests are obligatory).

The same situation exists for gas-installations.

Possibility	Academic Qualification	Minimum Experience
A	University equivalent degree or diploma	0.5 years
B	Technical (Professional) school qualification Handwerksmeister	6 years
C	Technical (Professional) school qualification Geselle	3 years
D	No qualification	

- For carrying out installation-works you usually need B (or A) and C qualification. This is common in the majority of all installations.
- Some installers only have a C qualification, but this is not correct. DIY work is legal, but it has to be certified by a qualified company with a B qualification.
- Most installation workers are installers by profession, which means that they have learned the job for three and a half years, and have been successfully tested (C qualification).

The qualified company which is central to guarantee standards must employ at least one master with further qualifications and more experience. (B qualification). There is a significant trend to academic qualifications among company leaders, either in a technical degree or in business administration.

Special engineers have usually reached a qualification as professional installers before starting their studies; they need at least half a year practical experience during their studies. (qualification C). They are mainly needed for specialised calculations for bigger buildings.

1 – 4 – 2 Qualification of Maintenance Staff

In all partner countries, people who work on gas-fired equipment must have been suitably trained and must have achieved a Certificate in gas servicing. Generally, there is no similar restriction on persons maintaining oil-fired or solid fuel fired heaters and boilers.

1 – 5 Standards applied to heating system components

With regard to energy efficiency, the boiler is generally the only component of heating systems which is regulated.

In existing buildings, the complete heating system does not have to comply with regulations, except in Italy, when a significant restructuring of the building is carried out. In this case, the Thermal Insulation Regulation for new buildings is applied.

In **Germany**, control systems are obligatory.

1 – 5 – 1 The boiler

1 – 5 – 1 – 1 Domestic boilers

In every European country, the regulation applied to the **boiler** is the EU **Directive 92/42/EEC**. See §B2 followed.

In **Germany**, in general, installed boilers have to be low-temperature boilers or condensing boilers (only with very limited exceptions). This is governed by energy saving laws (Heizungsanlagenverordnung).

1 – 5 – 1 – 2 Boiler power between 400kW and 50MW

In **France**, the Decree 98-817 of 11 September 1998 specifies minimal energy efficiency and equipment for boilers with power between 400kW to 50MW.

1 – 5 – 2 Boiler auxiliaries: circulation pump

Only in Germany is there an efficiency standard applied to circulation pumps of warm-water heating systems, and to circulation pumps for sanitary hot water. Also, in all European countries, there are no minimum standards and/or measures for retrofitting old systems.

In **Germany**, the situation is the following :

- Warm water circulation pumps must have a timer so that the user is able to interrupt the sanitary hot-water circulation during the night. Timers are obligatory, but it is difficult to say how much they are used. In bigger houses with more than two or three flats they are probably not used very often, to avoid problems of not being accepted by the tenants.
- Pumps for a heating circuit, for heating greater than 50 kW must have an automatic power adjustment with at least three speeds (e.g. 60, 85, 110 watts).
- The obligatory controls for heating systems must be able to control the electric drives (pumps, fans) as well. This means that pumps are interrupted when the heating system is not on duty. But the heating use time is about 5,500 hours/yr in Germany (Heizungsbetriebsstunden). If the boiler is controlled only by an outdoor thermostat, the heating circulation pumps often run, even when there is no demand for heat. For pumps, better regulations are necessary which should, for example, be controlled by pressure-difference or temperature-difference. New systems often have a combination of indoor and outdoor thermostats; in this case some heating controls switch off the pumps when there is no demand from the indoor thermostat, which generally reduces pump running hours, depending on the insulation standard of the building, and the sizing of the heating system.
- The pumps for heating systems above 50 kW have to be sized according to the technical norms. But for smaller houses this is not obligatory. In new detached and semi-detached houses, the typical standard pump (in the range between 50 and 120 watts) is oversized. New pump designs based upon speed controls etc. are not very common yet in this sector.

2 – Heating systems in new buildings

All EU countries apply National Thermal Insulation Regulations. These Regulations concern mainly **new buildings and new extensions of old buildings**. They do not apply to existing buildings, except in Italy where Presidential Decree 412/1993 concerns new or significant restructuring of existing buildings,.

Generally, Thermal Regulations are applied to the **complete heating system** (boiler, control system, ducts & pipes, heat emitters) and define the **procedure of design and installation**. But this regulation doesn't define maintenance procedure.

The legislation for **minimum boiler efficiency** is usually the **Directive 92/42/EEC**. But some countries have decided to define a higher point of reference.

2 – 1 Comparison of Thermal Insulation Regulations : Summary of regulations to reduce heating energy consumption

This comparison is issued by the MURE Database Case Study.

Country	Denmark	Finland	France	Germany	Ireland	Italy	Netherlands	Sweden	UK
Introduction of regulation									1965
	1972								1974/76
	1977	1976	1974	1977		1977		1980	1985
	1982	1978	1982	1982		1986	1991	1985	1991
	1995	1985	1989	1994	1991	1989	1995	1994	1994
Degree day figures (basis 20°C average)	3191	5978	2850	3845	2979	2234	2550	4355	3210
Number of climatic zones	1	1	3	1	1	6	1	1	1
Difference fuels/electricity	No	No	Yes	No	No	No	No	No	No
Classification									
- Unit approach building shell	Yes	Yes	No	Yes	Yes	No	No	No	Yes
- Average transmission of building shell	No	No	No	No	Yes	No	Yes (91)	Yes	Yes
- Heating demand of building	Yes	¹ Disc.	No	Yes	No	No	No	No	No
- Fully integrated approach	No	¹ Disc.	Yes	¹ Disc.	No	Yes	Yes (95)	No	Yes
Reduction of energy consumption compared with previous stage	25%	10%	25%	30%	25%				25%
Applicability									
- New buildings	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
- New extensions to old buildings	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
- Old buildings	No	No	No	No	No	No	No	No	No
Revision planned for :		1998+	2000						
	2005	2003	2005	1999	1997	_	1998+2001	1998	2001

¹Disc. - the corresponding approach is under discussion

B – European Regulations & Standards

1 – General Regulations

Directive 89/106/EEC, concerning energy efficiency and thermal insulation, indicates that the building and its installation (heating, air conditioning and ventilation) must be designed so that the energy consumption is moderate considering the climatic local conditions, without prejudice to the occupants comfort.

Directive 90/396/EEC, concerns energy efficiency relating to appliances which burn gaseous fuels.

2 – Boilers

Directive 92/42/EEC of 21 May 1992 specifies the efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels, with a rated output of no less than 4kW and no more than 400kW.

Boilers must comply with minimum efficiency requirements, specified according to boiler type, power, and fuel, and which are established from efficiency tests undertaken (a) at rated output and (b) at part load (30% of full load). The efficiency requirements are set out in the Article 5 of the Directive.