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## Raising the efficiency of boiler installations

**Deliverable 6.4: Advice to the boiler industry, what can / should be changed by the boiler regulation**

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CO	Confidential, only for members of the consortium (including the Commission Services)	

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## 1 General

Insufficient installation of heating systems often leads to low efficiency of new boilers. Although test cases demonstrate that new boilers may achieve high efficiency, their real performance is often much lower.

BOILeff project was initiated to develop and to assess two new market approaches for improving the efficiency of boiler installations.

The first market approach is a high quality declaration (DHQUI). This declaration is included in the contract between installers and end consumers. It provides a checklist of quality criteria for a “high quality installation”. The second approach is a “performance guarantee (GPQU)”. The installer should be able to guarantee a certain efficiency of the boiler as a result of a “high quality installation”.

These two approaches are tested and evaluated by field tests under real conditions in work package 5. This initiated a lively exchange of ideas between installers and the project group to improve the boilers and other central components available on the market.

This paper provides recommendations for manufacturers derived from the suggested improvements analysed during the course of BOILeff project and supplemented with recommendations from various relevant studies (DBU Brennwertkessel 2004, DBU Optimus 2005, Wuppertal Institute 2009 (2)).

## 2 Recommendations for manufacturers of boilers and their components for detached and semidetached houses and small apartment buildings

### 2.1 Improving the hydraulics of small wall-mounted and floor-standing compact boilers

The biggest part of the gas boilers (and gas combination water heaters) available today are constructed either as low temperature or as condensing boilers. They are wall-mounted multi-purpose devices with integrated or separate small storage tanks; sometimes they are also floor-standing compact boilers with an integrated small storage tank.

Boilers of this construction type have to provide space heating as well as domestic hot water. They have a very low water content (about 3 to 6 litres at 14 to 24 kW of power); this is the only way to ensure comfortable and appropriately quick hot water supply using the instant water heater principle. The low boiler water content of these appliances induces:

- the need of a minimum water circulation inside the boiler to avoid overheating,
- the installation of integrated pumps which are usually too big for downstream heating circuits (causing a high auxiliary energy consumption) because of the high hydraulic resistance of the heat exchanger,
- the installation of bypass valves and sometimes the use of hydraulic nodes. This causes an increased return temperature, which will often impede condensation and thereby increase the fuel consumption of condensing boilers.

#### *Suggestions for the optimisation of wall-mounted and floor-standing compact boilers up to 24 kW with low water content*

- Realisation of a **higher power modulation range** than the current 1:3 or 1:4 between the lowest and highest power possible. The optimum is at 1:15 (DBU Brennwert, p. 67), in combination with a base load as low as possible (below 4 kW) to avoid the need for a minimum water circulation inside the boiler.
- Constructive **redesign of the appliance hydraulics** including the increase of boiler water content (at least 10-20 l) aiming at a low overall pressure loss in the heat generator (about 50 mbar at rated load).

### 2.2 Installation of measurement devices in heating systems for an automated energy balance

If the installation contractor wants to guarantee the achieved energy efficiency improvement via the standardised annual overall efficiency, **a targeted energy monitoring** of small heating appliances by measuring fuel input and heat output is required. It will be advantageous, if the measuring is not conducted manually – causing high effort – but automatically using appropriate measurement devices.

Appropriate heat meters with a small pressure loss (for example using ultrasound) should measure the energy transfer to the heating system respectively to the domestic water heating as well as further energy input (solar, biomass, ...).

Fuel use may be monitored with gas or oil quantity meters. It is also possible to additionally gauge the condensate quantity of condensing boilers, which is a measure for the effectiveness of operation in the condensing mode.

Using these data, it will be possible to set up an energy balance, which can be used to control the boiler efficiency.

The data must be saved and stored on site; they may be gathered and analysed once a year at the end of the heating season by the installation contractor on-site or via remote access.

### ***Suggestions for the installation of measurement devices in heating systems for an automated energy balance***

- The heat and fuel meters and interfaces for data transfer needed for automatic data logging should be integrated into heating systems by default.<sup>1</sup>

## **2.3 Reduction of auxiliary electrical energy consumption in small heating systems for detached and semi-detached houses**

The auxiliary energy use of a heating system normally consists of the energy requirements of the various pumps (space heating water circulation, domestic hot water circulation, and boiler charging pump), the energy requirement of the fan and the electronics. Starting points for the reduction of auxiliary energy use are particularly the pumps. Energy-saving EC-motor pumps are now available on the market, enabling savings of up to 80%. Additional savings can be achieved by demand-driven control of pumps.

Often operating times of hot water circulation pipes are set too high. Reliable recommendations for use-oriented, hygienically safe system operation standards are lacking. Another factor causing high energy consumption are control electronics. This is mainly caused by inefficient transformers with a high stand-by consumption and would be easily avoidable by using electronic power supplies.

### ***Suggestions for the reduction of auxiliary energy:***

- Boiler and space heating circuits, hot water circulations and the boiler charging circuit should be fitted with class A (rsp. EC motor) circulating pumps as standard. For boiler and heating circuits, the EuP regulation makes class A pumps mandatory anyway from 2015 onwards, therefore it will be useful to start with the integration as early as possible.<sup>2</sup>

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<sup>1</sup> This advice is not based on present costs but assumes reduction of costs in case of integration and therewith mass production.

<sup>2</sup> Also for the hot drinking water circulation and the boiler charging pumps, the use of EC-pumps is profitable, if their prices will decrease in future because of mass production.

- The controls of the boiler must allow individual settings for an efficient and demand-orientated mode of operation of the different hydraulic elements (pumps, valves).
- Concerning the determination of reliable parameters (operation time, temperatures, etc.) and concepts for an energy-efficient and hygienically safe operation of the domestic hot water circulation, comparative EU-wide studies should be conducted. These should take into account the differences between typical storage concepts in compact systems: instant heater for hot water, buffer storage concept, external fresh water station.
- Reduction of the stand-by energy consumption of the heating controls.

## **2.4 Improving the overall efficiency of integrated heating systems, especially heating systems in combination with thermal solar systems for hot water generation and space heating**

Extensions of heating systems by solar thermal systems have been more and more successful recently. In space heating and hot water generation it offers a big potential for saving fossil fuels and reducing emissions. But often the interaction of heating systems with solar thermal systems, following current studies and the Boileff metering results (BFE 2007, ZAE 2009, test 2009, Wuppertal Institute 2009(1)), leads to inefficient operation because of missing hydraulic optimisation.

### ***Suggestions for boiler producers and component suppliers for a better hydraulic integration of several heat generating systems into a complete system***

- Optimisation of the hydraulic integration of several heat generating systems into a highly efficient complete system. The installation contractors can be qualified by manufacturers through training courses on site, using optimised demonstration systems and well-known hydraulic standard schemes combined with practice-oriented guidelines.
- Mandatory installation of heat meters and - where required - retrofitting of a so-called “acoustic function control” into the controls panel of solar thermal systems for heating support.

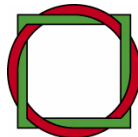
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