



BSI Standards Publication

Solar supported gas-fired domestic appliances producing hot water — Appliances not exceeding 70 kW heat input and 500 litres water storage capacity

Part 3: Assessment of energy consumption

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National foreword

This British Standard is the UK implementation of EN 13203-3:2010.

The UK participation in its preparation was entrusted to Technical Committee GSE/29, Gas-fired central heating boilers (domestic and non-domestic) and domestic gas-fired water heaters.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Solar supported gas-fired domestic appliances producing hot water - Appliances not exceeding 70 kW heat input and 500 litres water storage capacity - Part 3: Assessment of energy consumption

Appareils domestiques produisant de l'eau chaude sanitaire utilisant les combustibles gazeux couplés à un capteur solaire - Appareils de débit calorifique inférieur ou égal à 70 kW et de capacité de stockage inférieure ou égale à 500 litres - Partie 3 : Évaluation de la consommation énergétique

Solar unterstützte gasbeheizte Geräte für die sanitäre Warmwasserbereitung für den Hausgebrauch - Geräte, die eine Nennwärmebelastung von 70 kW und eine Speicherkapazität von 500 Liter Wasser nicht überschreiten - Teil 3: Bewertung des Energieverbrauchs

This European Standard was approved by CEN on 9 July 2010.

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Foreword

This document (EN 13203-3:2010) has been prepared by Technical Committee CEN/TC 109 “Central heating boilers using gaseous fuels”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2011, and conflicting national standards shall be withdrawn at the latest by February 2011.

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1 Scope

This European Standard is applicable to solar supported gas-fired appliances producing domestic hot water. It applies to a system marketed as single unit or a system fully specified by a manufacturer that:

- has a gas heat input not exceeding 70 kW; and
- has a hot water storage capacity not exceeding 500 l; and
- is equipped with at least one solar collector; and
- is, with regard to the solar hydraulic circuit, considered as a forced circulation system (definition according to EN ISO 9488:1999).

The appliances covered by this European Standard are described in Annex C.

This European Standard does not apply to thermo-siphon or integral collector storage systems (definitions according to EN ISO 9488:1999).

NOTE In principle, the energy consumption of thermo-siphon solar preheat systems and integral collector storage preheat systems can also be assessed on the basis of this standard. One appropriate procedure for that purpose is to calculate the temperature level of the domestic hot water withdrawn from the thermal solar system for the reference conditions defined in this standard by using the numerical system model and the thermal solar system performance parameters according to ISO 9459-5. Based on the temperature level of the hot water withdrawn from the store the energy consumption of the gas appliance should be determined. This determination can either be done by means of calculations or by performing a test according to EN 13203-2 and using instead of the cold water inlet temperature the hot water temperature withdrawn from the store.

This standard is not intended to assess the performance:

- of the solar collector(s), which should comply with EN 12975-1 and EN 12975-2; and
- thermal solar systems and components, which should comply with EN 12976-1 and EN 12976-2.

This European Standard, EN 13203-3, sets out a method for assessing the energy performance of a solar supported appliance. It defines a number of daily tapping cycles for each domestic hot water use, kitchen, shower, bath and a combination of these, together with corresponding test procedures including information about the available solar radiation. It enables the energy performances of different gas-fired appliances to be compared and matched to the needs of the user.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12975-1, *Thermal solar systems and components — Solar collectors — Part 1: General requirements*

EN 12975-2, *Thermal solar systems and components — Solar collectors — Part 2: Test methods*

EN 12976-1, *Thermal solar systems and components — Factory made systems — Part 1: General requirements*

EN 12976-2:2006, *Thermal solar systems and components — Factory made systems — Part 2: Test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

aperture area of solar collector

maximum projected area through which solar radiation enters the collector

NOTE See definition and explanation according to EN ISO 9488:1999.

3.2

controls

all hydraulic, thermal and electronic components necessary for the operation of the system

3.3

control cycle

time cycle for keeping components and/or the storage of the domestic hot water circuit at predetermined temperature level, consisting of an "ON" duration time during which the heating of the domestic hot water (by gas energy and auxiliary energy) is operating, and an "OFF" duration time during which no heating occurs

3.4

domestic water mean temperature

average temperature of the water delivered during the time Δt

SYMBOL T_m

NOTE
$$T_m = \frac{1}{\Delta t} \int T \cdot dt$$

3.5

domestic water test temperature

temperature of the delivered water at which the tests are conducted

3.6

measurement period

ongoing 24 h period during which the system is continuously operated

NOTE Measurement period starts at 0h00.

3.7

nominal domestic hot water heat input

value of the heat input stated by the manufacturer for the production of domestic hot water¹⁾

SYMBOL Q_{nw}

NOTE Q_{nw} is expressed in kilowatts (kW).

3.8

off mode

state of an appliance, selected by the user, in which hot sanitary water cannot be provided

3.9

solar collector field

either one or a combination of more than one solar collectors

1) The manufacturer is the organisation or company that assumes responsibility for the product.

3.10
solar collector simulator

device delivering the thermal power to the system (store) instead of a real solar collector based on the solar collector efficiency parameters according to EN 12975-2

NOTE The solar collector simulator is described in Annex B.

3.11
solar collector simulator circuit

circuit containing the piping, the pump, the controls, the heat-exchanger and the collector solar simulator

3.12
solar cycle

day of a year representative for middle European climate conditions

NOTE The total daily radiation of that day is 3,0 kWh/m² and the mean value of the outdoor ambient temperature is 6,7 °C.

3.13
solar supported system

system marketed as single unit or a system fully specified by a manufacturer, and composed of solar collector, water storage tank, controls, pipework and the gas appliance

3.14
stand by mode

operating state in which the appliance can provide hot sanitary water at any time

NOTE In the case of an appliance with a control cycle for keeping components and/or the storage (if any) of the domestic hot water circuit at predetermined temperature level no tapping is made.

3.15
storage

reservoir for domestic hot water

3.16
summer mode

conditions during which the appliance supplies energy only for the production of domestic hot water

3.17
useful water

quantity of water delivered for which the temperature increase is in accordance with the requirement fixed for each individual delivery of the tapping cycles

3.18
wasted water

quantity of water delivered for which the temperature increase is not in accordance with the requirement fixed for each individual delivery of the tapping cycles

3.19
winter mode

conditions during which the appliance supplies energy for the production of domestic hot water and/or space heating

4 General test conditions

4.1 General

In order to apply the test procedures specified in this standard, it is required:

- that the collectors of the system fulfil the requirements of EN 12975-1 and are already tested according to EN 12975-2; and
- that factory made thermal solar systems fulfil the requirements of EN 12976-1 are tested according to EN 12976-2.

4.2 Reference conditions

Unless otherwise stated, the general test conditions are as follows:

- cold water temperature: $(10 \pm 2) ^\circ\text{C}$;
- cold water pressure: $(2 \pm 0,1) \text{ bar}$;
- ambient air temperature: $(20 \pm 3) ^\circ\text{C}$;
- electrical supply voltage: $(230 \pm 2) \text{ V}$.

4.3 Measurement uncertainties

Except where otherwise stated in the clauses describing the tests, the uncertainties of measurements carried out shall be not greater than the maximum uncertainties indicated below.

These uncertainties correspond to two standard deviations.

The laboratory evaluates these standard deviations taking account of the various sources of uncertainty: contribution from the instrument, repeatability, calibration, ambient conditions, etc.

- a) Water rate: $\pm 1 \%$;
- b) gas rate: $\pm 1 \%$;
- c) time: $\pm 0,2 \text{ s}$;
- d) temperatures :
 - 1) ambient: $\pm 1 ^\circ\text{C}$;
 - 2) water: $\pm 0,5 ^\circ\text{C}$;
 - 3) gas: $\pm 0,5 ^\circ\text{C}$;
- e) mass: $\pm 0,5 \%$;
- f) gas pressure: $\pm 2 \%$;
- g) gas calorific value: $\pm 1 \%$;
- h) gas density: $\pm 0,5 \%$;

- i) electrical energy: $\pm 2 \%$.

The stated measurement uncertainties relate to individual measurements. For measurements that combine a number of individual measurements, smaller uncertainties on the individual measurements may be necessary to ensure a total uncertainty within $\pm 2 \%$.

4.4 Test conditions

4.4.1 General

Except where otherwise stated, the appliance is tested under the following conditions.

For combination gas appliances, the tests are carried out only in summer mode as defined in 3.16, and the appliance is set in summer mode.

4.4.2 Installation for test procedure

The installation for testing, including thermal insulation of the components, shall be in accordance with the manufacturer specifications.

The maximum length of the piping between the gas appliance and the storage tank(s) shall not exceed 3 m in total (inlet plus outlet).

The minimum length of the piping between the solar collector simulator and the storage tank(s) shall be 6 m in total (inlet plus outlet) and shall not exceed 10 m.

If not specified by the manufacturer of the appliance, the piping shall be in accordance with EN 12976-2:2006, Annex B and Table B.2 (pipe diameter and insulation thickness).

For drain back solar thermal systems only the mass flow rate according to the collector circuit specifications ($\dot{m}$) supplied by the manufacturer shall be used.

4.4.3 Test room

The appliance is installed in a well-ventilated, draught-free room (air speed less than 0,5 m/s).

The appliance is protected from direct solar radiation.

4.4.4 Water supply

For the tests:

- the domestic water pressure is the static inlet pressure under dynamic conditions measured as close as possible to the system;
- the inlet and outlet temperatures of the domestic water are measured in the centre of the flow and as close as possible to the system.

The inlet temperatures are measured immediately upstream of the water inlet connection. Except where otherwise stated, the outlet temperatures are measured immediately downstream of the outlet connection or, in the case of a system with spout delivery, by means of an immersed temperature measuring device, e.g. a U-tube fitted at the outlet of a tube of the same length as the minimum length of the spout normally supplied by the manufacturer.

The hot water temperature is measured with a rapid response thermometer.

"Rapid response thermometer" means a measuring instrument with a response time such that 90 % of the final temperature rise, from 15 °C to 100 °C, is obtained within about 1 s, when the sensor is plunged into still water.

4.4.5 Solar circuit

For the tests, the fluid used in the solar collector simulator circuit is water at the pressure specified by the manufacturer.

4.4.6 Initial adjustment of the appliance

The system is installed in accordance with the manufacturer's instructions.

The heat input of the gas appliance shall be adjusted to within ± 2 % of the nominal domestic hot water heat input under the conditions prevailing at the time of the test with solar collector simulator off.

The delivered water temperature at the system outlet is defined as follows:

- a) System with an adjustable temperature: the tests are carried out at a temperature not greater than 65 °C, with a minimum temperature increase equal to or greater than 45 K above cold water inlet temperature.
- b) System with a fixed temperature: the tests are carried out at the temperature specified by the manufacturer, with a minimum temperature increase equal to or greater than 45 K above cold water inlet temperature.

The same conditions of initial adjustment stated by the manufacturer are used for all the tests. These conditions are included in the test report.

4.4.7 Electrical supply

The appliance is supplied with the nominal voltage or a voltage included within the range of nominal voltages.

4.4.8 Solar thermal input

The solar thermal input is supplied to the solar heat exchanger of the solar tank as follows.

Instead of installing the solar collector field, a solar collector simulator is connected to the hydraulic connections of the storage tank originally foreseen for the connection to the solar collector field as described in Annex D. The flow rate in the solar hydraulic circuit shall be according to the specifications of the appliance manufacturer. If not specified by the appliance manufacturer, a flow rate of 50 l/h for each square metre of aperture area of the solar collector field shall be used.

5 Determination of the energy consumption of the solar supported gas-fired appliance

5.1 General

This clause defines the test methods to be employed in determining the energy consumption of the appliance.

5.2 Tapping cycles

All patterns define a 24 h measurement cycle and within that cycle the starting times and the total energy content (in kilowatt hours equivalent of hot water tapped) of each draw-off are defined.

Furthermore, the draw-off can be characterised in two ways, either: