BRITISH STANDARD

BS EN
15456:2008

Heating boilers — Electrical power consumption for heat generators — System boundaries — Measurements

ICS 91.140.10

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 15456:2008.

The UK participation in its preparation was entrusted to Technical Committee RHE/10, Heating boilers.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 May 2008

ISBN 978 0 580 56451 2

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15456

April 2008

ICS 91.140.10

English Version

Heating boilers - Electrical power consumption for heat generators - System boundaries - Measurements

Chaudières de chauffage - Puissance électrique des générateurs de chaleur - Limites du système - Mesurages

Heizkessel - Elektrische Leistungsaufnahme für Wärmeerzeuger - Systemgrenzen - Messungen

This European Standard was approved by CEN on 29 February 2008.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 15456:2008: E

Contents

Page

Foreword

This document (EN 15456:2008) has been prepared by Technical Committee CEN/TC 57 “Central heating boilers”, the secretariat of which is held by DIN.

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 October 2008, and conflicting national standards shall be withdrawn at the latest by October 2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This document specifies the measurement methods for evaluating auxiliary power consumption. This document also provides the parameters for boilers necessary for the calculation of the total power consumption according to prEN 15316-4-1 [4].

1 Scope

This European Standard applies to heating boilers (e.g. with forced-draught burners (unit)) and burners equipped with a fan including all components specified by the manufacturer to be required for the designed boiler operation.

This European Standard also applies to heating boilers sold without burners.

This European Standard covers the required definitions, the system boundaries, the measurements for the determination of the electrical power consumption and, where applicable, the water side resistance in order to establish the electric auxiliary energy for:

— Oil-fired forced-draught burners in accordance with EN 267;

— Automatic forced-draught burners for gaseous fuels in accordance with EN 676;

— Flued oil stoves with vaporizing burners in accordance with EN 1;

— Heating boilers sold without burners for:

  — Oil-fired forced-draught burners in accordance with EN 303-1 [6], EN 303-2 [7] and EN 304;

— Condensing boilers for liquid fuels in accordance with EN 15034;

— Room sealed boilers for fuel oil in accordance with EN 15035;

— Heating boilers - Heating boilers with forced-draught burners - Nominal heat output not exceeding 10 MW and maximum operating temperature of 110 °C in accordance with EN 14394;

— Pellet burners for small heating boilers in accordance with EN 15270.

NOTE All measurements for boilers are carried out in the heating mode only. For hot water production this mode is also relevant.

2 Normative references

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

EN 1, *Flued oil stoves with vaporising burners*

EN 267, *Forced draught oil burners — Definitions, requirements, testing, marking*

EN 304:1992, *Heating boilers — Test code for heating boilers for atomizing oil burners*

EN 676, *Automatic forced draught burners for gaseous fuels*

EN 14394, *Heating boilers — Heating boilers with forced draught burners — Nominal heat output not exceeding 10 MW and maximum operating temperature of 110 °C*

EN 15034, *Heating boilers — Condensing heating boilers for fuel oil*

EN 15035, *Heating boilers — Special requirements for oil fired room sealed units up to 70 kW*

EN 15270, *Pellet burners for small heating boilers — Definitions, requirements, testing, marking*

3 Terms and definitions

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

3.1
reference conditions
15 °C and 1 013,25 mbar, unless otherwise stated

3.2
fuel mass flow
$\dot{m}_B$
fuel mass which is consumed during each unit of time by the boiler in continuous operation

NOTE Fuel mass flow is expressed in cubic metre per hour or kilogram per hour.

3.3
fuel volumetric flow
$\dot{V}_B$
volume of the fuel supplied to the boiler during continuous operation for each unit of time

NOTE Fuel volumetric flow is expressed in cubic metre per hour.

3.4
electrical power consumption

P_{aux}

3.4.1
electrical power consumption for heat generation
$P_{aux,gen}$
electric energy consumed by the system components (e.g. pump, fan, valves and control unit) required for the heat generator‘s designed operation:

— at full load (100 %) $P_{aux\ 100,}$

— at part load (30 %) $P_{aux\ 30}$ and

— at stand-by operation $P_{aux\ sb.}$

NOTE Electrical power consumption for heat generation is expressed in watts.

3.4.2
electrical power consumption for other use
$P_{aux,\ dis}$

electric energy consumed by the system components which are not required for the heat generator‘s designed operation, e.g. heat distribution pump, valves for heat distribution

NOTE Electrical power consumption for other use is expressed in watts.

3.5
draught
pressure differential between the static air pressure in the place of installation and the static pressure of the exhaust gases, as measured in the exhaust gas measuring section, which is required for correct operation of the boiler in the test room

3.6
calorific value
quantity of heat produced by the complete combustion, at a constant pressure equal to 1 013,25 mbar, of a unit volume or mass of gas or oil, the constituents of the combustible mixture being taken at reference conditions and the products of combustion being brought back to the same conditions

A distinction is made between:

— gross calorific value H_s the water produced by combustion is assumed to be condensed;

— net calorific value H_i the water produced by combustion is assumed to be in the vapour state.

NOTE The calorific value is expressed:

— either in mega joules per cubic metre (MJ/m³) of dry gas under the reference conditions;

— or in mega joules per kilogram (MJ/kg) of dry gas;

[EN 437:2003 [3]]

— or in mega joules per kilogram (MJ/kg) of oil.

3.7
nominal heat input
P_N
maximal value of heat input for the heating mode declared by the manufacturer

NOTE Nominal heat input is expressed in kilowatts.

3.8
nominal heat output
Φ_N
maximal value of heat output declared by the manufacturer

NOTE Nominal heat output is expressed in kilowatts.

3.9
test room
room in which the heat generator has been installed during the measurement in which the ambient parameters corresponding to the reference conditions are found

3.10
residual pump head
h_R
available pump head after deduction of the hydraulic resistance of the boiler

NOTE Residual pump heat is expressed in metre.

3.11
stand-by operation
operating mode without any heat demand, the system immediately starts up in the required mode as soon as there will be a heat demand

3.12
temperature spread
temperature difference between flow and return connection of the heat generator

3.13
unit
assembly of a boiler and a forced-draught burner, offered as a factory-assembled unit

3.14
heat input
P
product of the volumetric flow or mass flow and the net or gross calorific value of the fuel referred to the same reference conditions:

$$P_{\mathrm{N,Hi}} = \dot{V}_{\mathrm{B}} \cdot H_{\mathrm{i}}\text{, or } P_{\mathrm{N,Hs}} = \dot{V}_{\mathrm{B}} \cdot H_{\mathrm{s}} \quad (1)$$

or

$$P_{\mathrm{N,Hi}} = \dot{m}_{\mathrm{B}} \cdot H_{\mathrm{i}}\text{, or } P_{\mathrm{N,Hs}} = \dot{m}_{\mathrm{B}} \cdot H_{\mathrm{s}} \quad (2)$$

NOTE Heat input is expressed in kilowatts.

3.15
water side resistance
h_{i}
pressure loss across the boiler measured between the flow and return connection of the boiler, with a volume flow corresponding to the nominal heat output

NOTE Water side resistance is expressed in metres.

3.16
circulator (pump)

3.16.1
circulator (pump) for heat generation
device required for the heat generator‘s designed operation

3.16.2
circulator (pump) for heating distribution
device required for the distribution of the generated heat in the heating system (pipes, radiators)

NOTE In some cases a single circulator (pump) can be used for heat generation and for heating distribution.

4 System boundaries for measurements

4.1 General

Boilers are sold with heat generation pumps, with heat generation as well as heat distribution pumps or without any pump. For the purpose of this European Standard, the following system boundaries shall be used accordingly.

4.2 System with circulator (pump) for heat generation

The system boundary starts at the manual shut-off device (for water and fuel) and ends at the flue outlet of the heating boiler or of the test flame tube for burners. The energy consumption of the burner for testing heating boilers sold without burners shall not be taken into account.

The following components shall be part of the heating boiler and also covered by measurement provided they are required for the designed operation:

— shut-off valves in the fuel supply;

— integrated fuel supply (pump);

— integrated oil pre-heater;

— supply of combustion air (air fan), respectively flue gas removal (flue exhauster);

— control and monitoring devices (programming units, monitoring device/detector, etc.);

— regulating devices with a complete equipment offered sometimes even as an option;

— circulator (pump) for heat generation.

NOTE If the circulator (pump) is used for heat generation and for heating distribution the pump has to be measured separately according to 4.3.

4.3 System with a single circulator (pump) for heat generation and heat distribution

In addition to 4.2 the components which are not required for the heat generation; e.g. heat distribution circulator (pump), valves for heat distribution shall be measured and stated separately.

4.4 System without any circulator (pump)

According to 4.2 without any circulator (pump).

4.5 Burner

The following components shall be part of the forced-draught burner and also covered by measurement provided they are required for the designed operation:

— shut-off valves in the fuel supply;

— integrated fuel supply (pump);

— integrated oil pre-heater;

— supply of combustion air (air fan);

— control and monitoring devices (programming units, monitoring/detector, etc.).

5 Measurement

5.1 Heating boiler

5.1.1 Setting of the heating boiler

For the measurements, at least two different input points corresponding to the nominal heat input P_N at full load 100 % and at part load 30 % as well as at stand-by operation of the heating boiler shall be taken as a basis to determine the respective values with respect to the required electrical power consumption P_{aux}.

All measurements shall be carried out in the heating mode. The test shall be carried out in accordance with the requirements of the efficiency measurement of the relevant appliance standard.

The measurements shall be carried out with a spread of (20 ± 2) K between flow and return at nominal heat input.

Before starting with the measurement, the boiler shall be set in accordance with the manufacturer's instructions. The measurements shall be carried out in accordance with the requirements for the type test of the respective appliance standard.

5.1.2 Determination of the water side resistance

For all heat generators the water side resistance, which is equal to the nominal heat input P_N , shall be determined in a first step with a temperature difference of 20 K between flow and return. The tests shall be carried out according to 5.6 and A.10 of EN 304:1992.

NOTE An additional determination procedure is proposed, see Annex B.

5.1.3 Measurement modes

5.1.3.1 At nominal heat input P_N

For boilers with or without a setting range, the electrical power consumption P_{aux} shall be determined at nominal heat input P_N.

The electrical power consumption at nominal heat input P_N shall be measured:

— for heating boilers with oil-fired forced-draught burner under the conditions of EN 304 (efficiency);

— for condensing boilers for liquid fuels under the conditions of EN 15034;

— for room sealed boilers under the conditions of EN 15035.

5.1.3.2 At part load of 0,3 P_N

For boilers the electrical power consumption shall be determined at part load under the conditions of EN 304 (efficiency), EN 15034 or EN 15035.

It shall be ensured that the electrical power consumption $P_{aux\ 30}$ is measured only by using the direct procedure – mode n° 2 - to determine the 30 % part load efficiency for heating boilers.

5.1.3.3 At stand-by operation

One measurement shall be carried out at stand-by operation with heat demand of the boiler, where the electrical power consumption $P_{aux\ sb}$ for stand-by loss shall be measured under the conditions of EN 304, EN 15034 or EN 15035.

An additional measurement shall be carried out at stand-by operation without heat demand of the boiler for the determination of the electrical power consumption of the control and monitoring devices.

5.1.3.4 Electrical power consumption of the regulation with burner in off-mode

The boiler shall be switched to power-on. Only the electrical power consumption of the boiler control shall be measured. There shall be no heating to compensate the stand-by loss.

5.2 Forced-draught burners

Forced-draught burners shall only be tested in the measuring points, point 1 and point 4, of the test diagram according to EN 267 and EN 676 respectively. The electrical power consumption P_{aux} at permanent operation shall be measured in the points at the test diagrams according to EN 267 and EN 676 respectively. The electrical power consumption P_{aux} at nominal heat input P_N or at maximum rate of the burner shall be given as the mean value of the electrical power consumption at the maximum rate of the burner in the points of the test diagrams.

The fuel mass flow shall be set to 30 % of the nominal load if this point is within the working diagram of the burner. Alternatively the burner shall be synchronised with a medium power consumption of 30 % of the nominal load.

Modulating burners shall be determined at 30 % of the rate of the burner.

Three working points shall be checked:

1) min/max load at the pressure in the combustion chamber (mean value form the working points);

2) to find out a standard working points and 30 % part load operation;

3) stand-by.

5.3 Pellet burner

Pellet burner shall be tested under the conditions of EN 15270.

5.4 Oil stoves

Oil stoves shall be tested under the conditions of EN 1.

5.5 Determination of the water side resistance

The water side resistance shall be determined according to EN 304 or Annex B.

5.6 Test report and documentation

The electrical power consumption of the heat generator or burner according to 5.1 to 5.4 shall be given at the nominal heat input P_N of the heat generator and at the nominal heat output Φ_N of the burner and for part load operation according to the test report in Annex A.

Annex A
(normative)

Test report

A.1 Summary

client:

manufacturer:

design: (indication of: with integrated heating pump/without or alternatively usable heating pumps)

type:

for heat generators/burners: the nominal heat input P_N/range:

for heat generators: the nominal heat output Φ_N

type variants:

admissible flow temperature:

required draught for the flue gas:

electrical power consumption P_{aux} of the heating boiler:

— xxx W at a heat output of zz kW ($P_{aux\ 100}$, nominal heat output Φ_N respectively nominal heat input P_N);

— xxx W at a heat output of vv kW ($P_{aux\ 30}$, 30 % of nominal heat output Φ_N respectively nominal heat input P_N);

— xxx W at stand-by operation ($P_{aux\ sb}$).

A.2 Testing the electrical power consumption P_{aux}

Testing the electrical power consumption shall be carried out according to Table A.1.

Table A.1 — Testing the electrical power consumption P_{aux}

Test conditions					
Test n°	Unit	Nominal heat input	Part load	Stand-by operation	
				with heat demand	without heat demand
Test date	—				
Test duration	h				
Operation mode (cycles)	—	continuous	cycling (3 cycles)		
Fuel type					
Net caloric value H_i or	—				
Gross caloric value H_s	—				
Fuel consumption	—				
Heat input	kW				
Flue gas measuring valves					
Mean flue gas temperature	°C				
Combustion air temperature	°C				
O_2 or CO_2 content	Vol. %				
Measured valves of the hydraulic circuit					
General valves for heating operation					
Heating water flow	Kg/h				
Operating pressure	bar				
Mean flow temperature	°C				
Mean return temperature	°C				

Table A.1 — (continued)

Test conditions					
Test n°	Unit	Nominal heat input	Part load	Stand-by operation	
				with heat demand	without heat demand
Temperature spread flow/return	K				
Corresponds of load	%				
Pressure in heating operation					
Water side resistance h_i	m				
Measured pressure drop of the boiler	mbar				
Residual pump head h_r	m				
Measured values for the calculation of the water side resistance h_i for heating boilers without a pump according to Annex B					
Temperature spread	K				
Flow	kg/h				
Electrical power consumption P_{aux} (mean value of test duration at stable operation conditions)					
Electrical power consumption for heat generation $P_{aux, gen}$	W				
Electrical power consumption of circulator $P_{aux, dis}$	W				
Sum of electrical power consumption P_{aux}	W				

Annex B
(informative)

Determination of the water side resistance

B.1 Operating conditions

B.1.1 General

Define a methodology to determine the hydraulic performance of boilers with or without integrated pumps at different operating conditions.

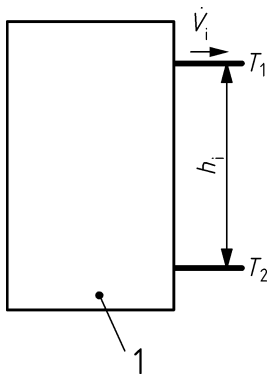
NOTE The hydraulic power is the electrical energy required to get the water flow through the boiler. In prEN 15502-1 [5] the electrical energy is defined including the energy required to circulate the water through the heating system. A minimum pressure of 0,15 bar should be available for this purpose.

The water side resistance to the flow at nominal heat input P_N shall be determined at a water temperature difference between flow and return equal to 20 K. This shall be the reference operating condition.

Two cases are possible.

B.1.2 Boilers without integrated pump

The water side resistance h_i, at the reference operating conditions at a temperature difference ΔT_i of 20 K, is measured between the inlet and the outlet of the boiler, see Figure B.1.



Key

1 boiler

T_1 temperature at the outlet in °C

T_2 temperature at the inlet in °C

Figure B.1

If the operating conditions are different than the reference operating conditions, then the water side resistance h_i shall be calculated according to equation (B.1):

$$h_{\mathrm{i}} = h_{\mathrm{wp}} \times \left(\frac{\Delta T_{\mathrm{wp}}}{\Delta T_{\mathrm{i}}} \right)^2 \text{ in m} \qquad \text{(B.1)}$$

and the working flow rate $\dot{V}_{\mathrm{i}}$ shall be calculated according to equation (B.2):

$$\dot{V}_{\mathrm{i}} = \dot{V}_{\mathrm{wp}} \times \left(\frac{\Delta T_{wp}}{\Delta T_{\mathrm{i}}} \right) \text{ in m}^3\text{/h} \qquad \text{(B.2)}$$

where

h_{i} is the water side resistance;

h_{WP} is the maximum water side resistance at the operating condition which are different than the reference conditions;

$\dot{V}_{\mathrm{i}}$ is the working flow rate;

$\dot{V}_{\mathrm{wp}}$ is the maximum flow rate at the operating condition which are different than the reference conditions;

ΔT_{wp} is the temperature difference between the flow and the return in K at the operating condition which are different than the reference conditions.

These equation (B.1) and (B.2) can also be adopted to 30 % P_{N}.

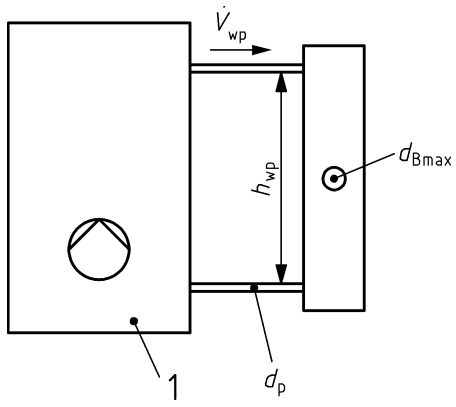
B.1.3 Boilers with integrated pump

The boiler should be connected to a heat exchanger with a flow meter with low resistance on the water side in relation to the boiler.

The electrical consumption shall be measured at P_{N} and at 30 % P_{N} described in 5.1.

To determine the water side resistance, the following methodology can be used if the pump is integrated to the boiler.

The mechanical characteristics of the integrated calibrated pump in accordance with EN 1151-1 [8] and EN 1151-2 [9] are required.



Key

1 boiler

d_{Bmax} diameter of the bypass pipe

d_P diameter of the connecting pipe

Figure B.2

The measurement accuracy is correct if the connector water side resistance h_i ~ 0.

This corresponds to a connector with a larger diameter.

$$d_{Bmax} \geq 3 \times d_P$$

The measurement shall be carried out when the boiler average water temperature is equal to 70 °C.

The water flow rate which goes through the boiler is the maximum flow rate $\dot{V}_{wp}$ in m^3/h. The maximum water side resistance of the boiler h_{wp} corresponding to $\dot{V}_{wp}$ shall be determined from Figure B.3.

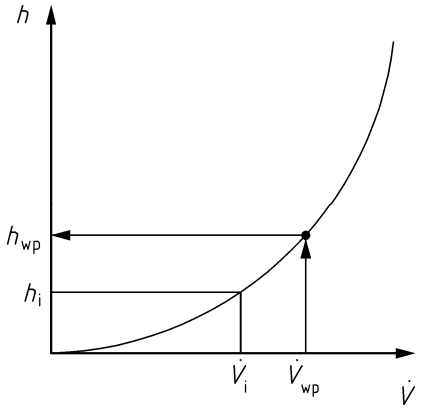


Figure B.3

B.1.4 Determination of operating conditions of boilers with integrated pump

The working flow rate $\dot{V}_i$ in m^3/h, shall be measured in the reference operating conditions corresponding to P_N, in kW, and ΔT_i in K,

$\Delta T_i = T_2 - T_1 = 20$ K.

It is possible to determine the water side resistance h_i according to equation (B.3):

$$h_i = \left(\frac{\dot{V}_i}{\dot{V}_{wp}} \right)^2 \times h_{wp} \text{ , in m} \qquad \text{(B.3)}$$

Bibliography

[1] EnEV, Regulations on the energy-saving thermal protection and energy-saving installation technology in buildings (Energy savings regulations – EnEV).

[2] 92/42/EWG, Directive of the Council dated 21 Mai 1992, on the efficiencies of new warm water heating boilers fired with liquid or gaseous fuels.

[3] EN 437:2003, Test gases — Test pressures — Appliance categories.

[4] prEN 15316-4-1, Heating systems in buildings — Method for calculation of system energy requirements and system efficiencies — Part 4-1: Space heating generation systems, combustion systems (boilers)

[5] prEN 15502-1, Gas-fired central heating boilers — Part 1: General requirements and tests

[6] EN 303-1, Heating boilers — Part 1: Heating boilers with forced draught burners — Terminology, general requirements, testing and marking

[7] EN 303-2, Heating boilers — Part 2: Heating boilers with forced draught burners — Special requirements for boilers with atomizing oil burners

[8] EN 1151-1, Pumps - Rotodynamic pumps - Circulation pumps having a rated power input not exceeding 200 W for heating installations and domestic hot water installations - Part 1: Non-automatic circulation pumps, requirements, testing, marking

[9] EN 1151-2, Pumps - Rotodynamic pumps - Circulation pumps having a rated power input not exceeding 200 W for heating installations and domestic hot water installations - Part 2: Noise test code (vibro-acoustics) for measuring structure- and fluid-borne noise

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL