BS EN 12173:2012

BSI Standards Publication

Chemicals used for treatment of water intended for human consumption — Sodium fluoride

raising standards worldwide™

National foreword

This British Standard is the UK implementation of EN 12173:2012. It supersedes BS EN 12173:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CII/59, Chemicals for drinking water treatment.

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.

ISBN 978 0 580 77784 4

ICS 13.060.20; 71.100.80

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 November 2012.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12173

October 2012

ICS 71.100.80

Supersedes EN 12173:2005

English Version

Chemicals used for treatment of water intended for human consumption - Sodium fluoride

Produits chimiques utilisés pour le traitement de l'eau destinée à la consommation humaine - Fluorure de sodium

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Natriumfluorid

This European Standard was approved by CEN on 23 September 2012.

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-CENELEC 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-CENELEC Management Centre has the same status as the official versions.

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

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 12173:2012: E

Contents

Page

Foreword

This document (EN 12173:2012) has been prepared by Technical Committee CEN/TC 164 “Water supply”, the secretariat of which is held by AFNOR.

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 April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.

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.

This document supersedes EN 12173:2005.

The significant technical differences between this edition and EN 12173:2005 are as follows:

— Modification of 6.2 on labelling, deletion of the reference to EU Directive 80/778/EEC of 15 July 1980 in order to take account of the latest Directive in force.

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

Introduction

In respect of potential adverse effects on the quality of water intended for human consumption caused by the product covered by this European Standard:

a) this European Standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;

b) it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

NOTE Conformity with this European Standard does not confer or imply acceptance or approval of the product in any of the Member States of the EU or EFTA. The use of the product covered by this European Standard is subject to regulation or control by National Authorities.

1 Scope

This European Standard is applicable to sodium fluoride used for treatment of water intended for human consumption. It describes the characteristics of sodium fluoride and specifies the requirements and the corresponding test methods for sodium fluoride. It gives information on its use in water treatment. It also determines the rules relating to safe handling and use (see Annex B).

2 Normative references

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

EN ISO 3696, *Water for analytical laboratory use — Specification and test methods* (ISO 3696)

ISO 2831, *Sodium fluoride for industrial use — Determination of water-insoluble matter*

ISO 2832, *Sodium fluoride for industrial use — Determination of moisture content*

ISO 2833, *Sodium fluoride for industrial use — Determination of fluorine content — Modified Willard-Winter-method*

ISO 3165, *Sampling of chemical products for industrial use — Safety in sampling*

ISO 5993, *Sodium hydroxide for industrial use — Determination of mercury content — Flameless atomic absorption spectrometric method*

ISO 6206, *Chemical products for industrial use — Sampling — Vocabulary*

ISO 6353-1, *Reagents for chemical analysis — Part 1: General test methods*

ISO 8213, *Chemical products for industrial use — Sampling techniques — Solid chemical products in the form of particles varying from powders to coarse lumps*

3 Description

3.1 Identification

3.1.1 Chemical name

Sodium fluoride.

3.1.2 Synonym or commons name

Sodium fluoride.

3.1.3 Relative molecular mass

42.

3.1.4 Empirical formula

NaF.

3.1.5 Chemical formula

NaF.

3.1.6 CAS-Registry Number [1)]

7681-49-4.

3.1.7 EINECS reference [2)]

231-667-8.

3.2 Commercial form

The product is a solid (crystals or powder).

3.3 Physical properties

3.3.1 Appearance and odour

The product is a colourless fine crystalline odourless powder or crystals.

3.3.2 Density

The density of the crystals is 2,8 g/cm^3 at 20 °C.

The bulk density of the product is 0,6 g/cm^3 to 1,4 g/cm^3 at 20 °C.

3.3.3 Solubility (in water)

The solubility of the product in water is 40 g/l at 20°C.

3.3.4 Vapour pressure

Not applicable.

3.3.5 Boiling point at 100 kPa [3)]

The product boils at approximately 1 700 °C.

3.3.6 Crystallisation point

The product melts at approximately 988 °C.

3.3.7 Specific heat

Not known.

---

1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3) 100 kPa = 1 bar.

3.3.8 Viscosity dynamic

Not applicable.

3.3.9 Critical temperature

Not applicable.

3.3.10 Critical pressure

Not applicable.

3.3.11 Physical hardness

Not applicable.

3.4 Chemical properties

Sodium fluoride releases hydrogen fluoride when in contact with acids.

4 Purity criteria

4.1 General

This European Standard specifies the minimum purity requirements for sodium fluoride used for the treatment of water intended for human consumption. Limits are given for impurities commonly present in the product. Depending on the raw material and the manufacturing process other impurities may be present and, if so, this shall be notified to the user and when necessary to relevant authorities.

Users of this product should check the national regulations in order to clarify whether it is of appropriate purity for treatment of water intended for human consumption, taking into account raw water quality, required dosage, contents of other impurities and additives used in the products not stated in this product standard.

Limits have been given for impurities and chemical parameters where these are likely to be present in significant quantities from the current production process and raw materials. If the production process or raw materials leads to significant quantities of impurities, by-products or additives being present, this shall be notified to the user.

4.2 Composition of commercial product

The content of sodium fluoride shall not be less than a mass fraction of 98 % (NaF).

The concentration of sodium fluoride shall be within ± 5 % of the manufacturer's declared value.

4.3 Impurities and main by-products

The product shall conform to the requirements specified in Table 1.

Table 1 — Impurities

Impurity		**Limit** in mass fraction in % of commercial product
Water-insoluble matter	max	0,5
Moisture	max	0,5

4.4 Chemical parameters

The product shall conform to the requirements specified in Table 2.

Table 2 — Chemical parameters

Parameter		Limit mg/kg of commercial product
Antimony (Sb)	max	1
Arsenic (As)	max	5
Cadmium (Cd)	max	0,1
Chromium (Cr)	max	4
Lead (Pb)	max	4
Mercury (Hg)	max	0,1
Nickel (Ni)	max	4
Selenium (Se)	max	1
NOTE Other chemical parameters and indicator parameters are not relevant in sodium fluoride because the raw materials used in the manufacturing process are free of them. For parametric values of sodium fluoride on trace metal content in drinking water, see [1].		

5 Test methods

5.1 Sampling

Observe the general recommendations of ISO 3165 and take account of ISO 6206.

Prepare the laboratory sample(s) required by the relevant procedure described in ISO 8213.

5.2 Analyses

5.2.1 General

All reagents shall be of a recognised analytical grade and the water used shall conform to the grade 3 specified in EN ISO 3696.

5.2.2 Main product

The mass fraction of fluorine (C_1) in % shall be determined in accordance with ISO 2833. The sodium fluoride content, C_2, expressed as mass fraction in % is given by the following formula:

$$C_2 = C_1 \times 2{,}2101 \quad (1)$$

5.2.3 Impurities

5.2.3.1 Water-insoluble matter

The content of insoluble matter shall be determined in accordance with ISO 2831.

5.2.3.2 Moisture

The content of moisture shall be determined in accordance with ISO 2832.

5.2.4 Chemical parameters

5.2.4.1 General

The content of chemical parameters shall be determined using the procedures specified in Table 3.

Table 3 — Procedures for the determination of chemical parameters

Element	Reference	Method	Wavelength nm	Flame
As	see 5.2.4.3	Hydride AAS	193,7	n.a.
Sb	see 5.2.4.3	Hydride AAS	217,6	n.a.
Cd	ISO 6353-1 GM 29 See 5.2.4.2	AAS	228,8	air-acetylene
Cr	ISO 6353-1 GM 29 See 5.2.4.2	AAS	357,8	air-acetylene
Pb	ISO 6353-1 GM 29 See 5.2.4.2	AAS	217,0 or 283,3	air-acetylene
Ni	ISO 6353-1 GM 29 See 5.2.4.2	AAS	232,0	oxidising air-acetylene
Se	see 5.2.4.3	Hydride AAS	196,0	n.a.
Hg	in accordance with ISO 5993	flameless AAS	253,6	n.a.
AAS = Atomic absorption spectrometry n.a. = not applicable.				

5.2.4.2 Determination of cadmium (Cd), chromium (Cr), lead (Pb) and nickel (Ni)

5.2.4.2.1 General

The content of Cd, Cr, Pb and Ni shall be determined taking into account ISO 6353-1, modified as described in 5.2.4.2.2.

5.2.4.2.2 Procedure

The elements Cd, Cr, Pb and Ni shall be determined using the standard addition method. The reference solutions shall be made by spiking the sample with standard solutions, which contain stepwise increasing contents of the elements to be determined. The amount of internal standard to be added can be estimated from a preliminary investigation, determining roughly the element content of the test sample from simple calibration. The steps in which internal standards are added shall be at least as high as the estimated content of the test sample.

Carry out a blank determination by repeating the procedure using the same quantities of all reagents but omitting the test sample.

5.2.4.2.3 Expression of results

Determine the correlation line by plotting the measured absorbencies of the spiked measurement solutions in relation to the element content. The spiked measurement solutions are produced by adding defined quantities of element to the measurement solution. They contain stepwise increasing contents of the elements to be determined.

Read the concentration of each element in the test solution by extrapolation of the correlation line to absorbance A = 0 (see Figure 1). Similarly determine the element concentration of the blank solution (see Figure 2) and subtract from the result obtained for the test solution. Alternatively, the evaluation can be carried out by linear regression. Additional dilution steps shall be compensated in the calculation.

This interim result (y) expressed in micrograms per litre needs to be converted to give the final concentration according to the formula in 5.2.4.2.4.

5.2.4.2.4 Calculation

From the interim result (y) determined (see 5.2.4.2.3) the content, C_3, of each element in the laboratory sample, expressed in milligrams per kilogram of sodium fluoride, is given by the following formula:

$$C_3 = \frac{y \times V_3 \times 100 \times 1\,000}{m_2 \times C_2} \qquad (2)$$

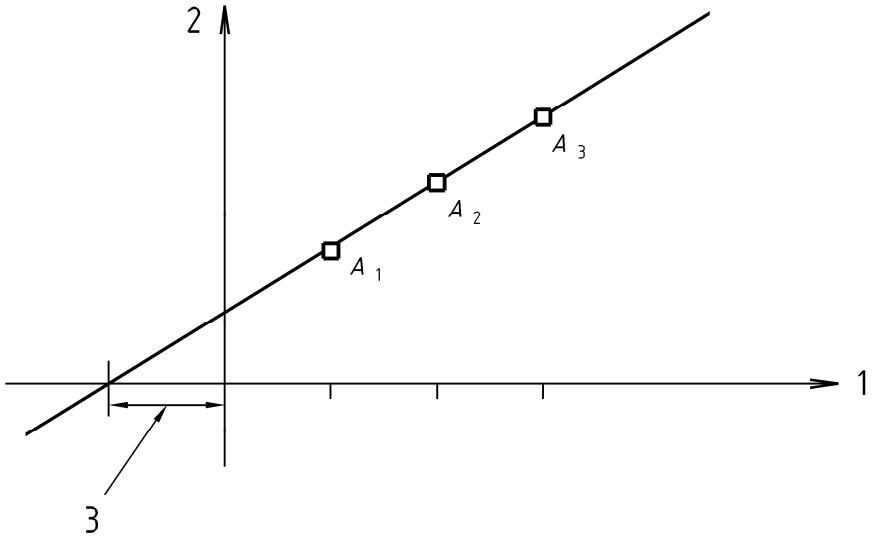
where

y is the interim result (5.2.4.2.3);

V_3 is the volume, expressed in millilitres, of the test solution;

m_2 is the mass ,expressed in grams ,of the test portion;

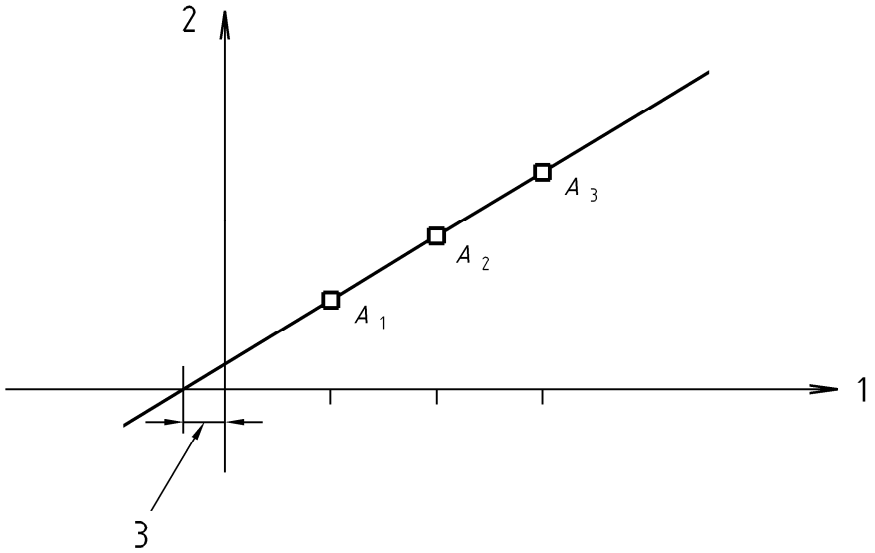
C_2 is the content, expressed in mass fraction in % of sodium fluoride (see 5.2.2).



Key

1 concentration of added standard in micrograms per litre
2 absorbance A
3 concentration in the test solution in micrograms per litre
A_1; A_2; A_3 spiking

Figure 1 — Calculation of the element concentration in the test solution



Key

1 concentration of added standard in micrograms per litre
2 absorbance A
3 concentration in the blank solution in micrograms per litre
A_1; A_2; A_3 spiking

Figure 2 — Calculation of the element concentration in the blank solution

5.2.4.3 Determination of arsenic (As), antimony (Sb) and selenium (Se)

5.2.4.3.1 Principle

The elements arsenic, antimony, and selenium are determined by hydride-atomic absorption spectrometry. The elements are reduced by sodium borohydride ($NaBH_4$) to form the hydrides. These volatile compounds flow through the heated measuring cuvette of an atomic absorption spectrometer where the content of the individual element is determined.

5.2.4.3.2 Reagents

5.2.4.3.2.1 Hydrochloric acid, high purity analytical grade, mass fraction 30 %, density ρ = 1,15 g/ml.

5.2.4.3.2.2 Preliminary reduction agent.

Dissolve 10 g sodium iodide and 100 g *L*-ascorbic acid, in 1 000 ml of water.

5.2.4.3.2.3 Reduction agent.

Dissolve in water $NaBH_4$ and NaOH in concentrations specified in the manufacturer's handbook for the spectrometer.

5.2.4.3.2.4 Standard solution, (100 µg/l As, Sb or Se).

The standard solution shall be freshly prepared on the day of use by individual dilution of a stock solution. This stock solution with an As, Sb or Se content of at least 1 mg/l shall be made by dilution of standard solutions of Se, As and Sb which are available from all major suppliers of laboratory chemicals. This stock solution shall be kept in containers of tetrafluoroethylene-hexafluoropropylene copolymer (FEP), polytetrafluorethylene (PTFE) or polyethylene (PE).

The stock solution should not be kept for longer than four weeks.

5.2.4.3.3 Apparatus

Ordinary laboratory apparatus and:

5.2.4.3.3.1 One one-mark volumetric flasks, 100 ml.

5.2.4.3.3.2 Nine one-mark volumetric flasks, 10 ml.

5.2.4.3.3.3 Pipettes, 5 ml, 10 ml, and 25 ml.

5.2.4.3.3.4 Micropipettes, volume adjustable to maximum 500 µl.

5.2.4.3.3.5 Atomic absorption spectrometer, with the measurement parameters specified in Table 3.

The width of the slit, the measuring time, flushing with argon before and after the measurement and the reaction time shall be adjusted in accordance with the manufacturer's instructions. The background compensation shall be activated for the measurement of As and Sb, but not for the measurement of Se.

5.2.4.3.4 Procedure

For As (procedure for Sb and Se in parentheses if different from As procedure):

Weigh a test portion of 0,5 g to the nearest 0,1 mg and transfer it into a 100 ml one-mark volumetric flask and make up to the mark at 20 °C with water. Pipette 10 ml (Sb, Se: 25 ml) of this solution into a 50 ml one-mark volumetric flask and add 5 ml of HCl and 5 ml of preliminary reduction agent. Do not add preliminary reduction

agent to the flasks for Sb and Se determination. Allow 3 h for reaction to occur and fill to the mark with water. Pipette 5 ml of this solution into three 10 ml one-mark volumetric flasks labelled A, B, C. Add 0,8 ml of HCl (5.2.4.3.2.1) to each flask. For the purpose of internal calibration, add those quantities of standard solutions as given in Table 4 to the flasks B and C. Using the spectrometer (5.2.4.3.3.5) carry out the measurement with the addition of the reduction agent (5.2.4.3.2.3) and the parameters of measurement in accordance with the manufacturer's instructions for the spectrometer.

Carry out a blank determination by repeating the procedure using the same quantities of all reagents but omitting the test sample.

Table 4 — Standard solution

	Volume of standard solution to be added		
	As	Sb	Se
Flask B	50 µl	100 µl	200 µl
Flask C	100 µl	200 µl	500 µl

5.2.4.3.5 Expression of results

See 5.2.4.2.3.

5.2.4.3.6 Calculation

See 5.2.4.2.4.

6 Labelling - Transportation - Storage

6.1 Means of delivery

Sodium fluoride shall be delivered for example in paper bags with polyethylene lining.

In order that the purity of the product is not affected, the means of delivery shall not have been used previously for any different product or it shall have been specially cleaned and prepared before use.

6.2 Labelling according to the EU legislation [4)]

The following labelling requirements shall apply to sodium fluoride at the date of the publication of this European Standard.

<table>
<tr>
<td>Hazard pictograms
 
GHS 05
 
GHS 06</td>
<td>— Signal word: Danger
— Hazard statements:
H301: Toxic if swallowed
H315: Causes skin irritation
H319: Causes serious eye irritation
EUH032: Contact with acids liberates very toxic gas
Precautionary statements ("P statements") should be provided by the company being responsible for the marketing of the substance. They should be indicated on the packaging label and in the extended safety data sheet (eSDS) of the substance.</td>
</tr>
</table>

The legislation [2], and its amendments for the purposes of its adaptation to technical and scientific progress, contains a list of substances classified by the EU. Substances not listed in this regulation should be classified on the basis of their intrinsic properties according to the criteria in the regulation by the person responsible for the marketing of the substance.

4) See [2].

6.3 Transportation regulations and labelling

Sodium fluoride is listed as UN Number [5] 1690.

RID [6] /ADR [7]: class 6.1, classification code T5, packing group III.

IMDG [8]: class 6.1, packing group III.

IATA [9]: class 6.1, packing group III.

6.4 Marking

The marking shall include the following:

— name "sodium fluoride", trade name and grade;

— net mass;

— name and the address of supplier and/or manufacturer;

— statement "this product conforms to EN 12173".

6.5 Storage

6.5.1 Long term stability

The product is stable when stored in tightly closed containers in a cool and dry well-ventilated place.

6.5.2 Storage incompatibilities

The product shall be kept away from acids and acid salts to avoid the risk of hydrogen fluoride evolution.

---

5) United Nations Number.

6) Regulations concerning International carriage of Dangerous goods by rail.

7) European Agreement concerning the international carriage of Dangerous goods by Road.

8) International Maritime Transport of Dangerous Goods.

9) International Air Transport Association.

Annex A
(informative)

General information on sodium fluoride

A.1 Origin

A.1.1 Raw materials

Sodium fluoride is manufactured from either sodium hydroxide and hydrofluoric acid or sodium hydroxide and hexafluorosilicic acid.

A.1.2 Manufacturing process

Hydrofluoric acid is neutralised with sodium hydroxide to produce sodium fluoride. Hexafluorosilicic acid is reacted with sodium hydroxide and the sodium fluoride is separated by filtration.

A.2 Use

A.2.1 Function

Sodium fluoride is used for the fluoridation of drinking water to increase the resistance of consumers to dental decay.

A.2.2 Form in which it is used

Sodium fluoride is used as an aqueous solution with contents up to 40 g/l.

A.2.3 Treatment dose

A typical dose of sodium fluoride is that which in order to achieve a final concentration of 1 mg/l as F^- in the drinking water. It is important to avoid overdosing. In the EU Directive 98/83/EC the parameter value is 1,5 mg/l of fluoride.

A.2.4 Means of application

It is usually applied using a metering pump.

A.2.5 Secondary effects

None.

A.2.6 Removal of excess product

It is practically impossible to remove excess product.

Annex B
(normative)

General rules relating to safety

B.1 Rules for safe handling and use

The supplier shall provide current safety instructions.

B.2 Emergency procedures

B.2.1 First aid

In case of contact with skin, wash immediately with plenty of water.

In case of contact with eyes, treat by irrigation with water, with the eyelids held open. Consult a doctor (or eye specialist) immediately.

In case of ingestion, take orally immediately a large quantity of calcium gluconate solution.

If there is a risk of unconsciousness, position and transport in stable lateral position. Obtain medical treatment as soon as possible.

B.2.2 Spillage

Dry powder: Collect and remove avoiding the formation of dust

Solution: Remove any spillage by means of inert absorbent material.

NOTE Any remaining product can be flushed away with plenty of water.

B.2.3 Fire

The product is not combustible.

There are no restrictions on extinguishing media in fire situations.

Bibliography

[1] 98/83/EC, Council Directive of 3 November 1998 on the quality of water intended for human consumption

[2] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (REACH)

This page deliberately left blank

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards and other standards-related publications, information and services. It presents the UK view on standards in Europe and at the international level.

BSI is incorporated by Royal Charter. British Standards and other standardisation products are published by BSI Standards Limited.

Revisions

British Standards and PASs are periodically updated by amendment or revision. Users of British Standards and PASs 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 British Standards would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Similary for PASs, please notify BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001

BSI offers BSI Subscribing Members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of British Standards and PASs.

Tel: +44 (0)20 8996 7669 Fax: +44 (0)20 8996 7001
Email: plus@bsigroup.com

Buying standards

You may buy PDF and hard copy versions of standards directly using a credit card from the BSI Shop on the website **www.bsigroup.com/shop.** In addition all orders for BSI, international and foreign standards publications can be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

In response to orders for international standards, BSI will supply the British Standard implementation of the relevant international standard, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Knowledge Centre.

Tel: +44 (0)20 8996 7004 Fax: +44 (0)20 8996 7005
Email: knowledgecentre@bsigroup.com

BSI Subscribing Members 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@bsigroup.com

Information regarding online access to British Standards and PASs via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about British Standards is available on the BSI website at **www.bsi-group.com/standards**

Copyright

BSI

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™