BRITISH STANDARD

BS EN
981 : 1997

Safety of machinery — System of auditory and visual danger and information signals

The European Standard EN 981 : 1996 has the status of a British Standard

ICS 13.110; 13.320

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PH/9, Applied Ergonomics, upon which the following bodies were represented:

British Industrial Truck Association
British Occupational Hygiene Society
British Retail Consortium
Chartered Institution of Building Services Engineers
Chemical Industries Association
Consumer Policy Committee of BSI
Engineering Employers' Federation
Ergonomics Society
Federation of the Electronics Industry
Furniture Industry Research Association
Health and Safety Executive
Ice (Ergonomics)
Institute of Occupational Medicine
Ministry of Defence
Society of Motor Manufacturers and Traders Limited

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Institute of Sound and Communications Engineers
Institute of Sound and Vibration Research
Loughborough University of Technology
Professional Lighting and Sound Association

This British Standard, having been prepared under the direction of the Health and Environment Sector Board, was published under the authority of the Standards Board and comes into effect on
15 March 1997

Amendments issued since publication

Amd. No.	Date	Text affected

The following BSI references relate to the work on this standard:
Committee reference PH/9
Announced in *BSI Update*
December 1992

ISBN 0 580 27165 X

Contents

National foreword

This British Standard has been prepared by Technical Committee PH/9, and is the English language version of EN 981 : 1996, *Safety of machinery — System of auditory and visual danger and information signals*, published by the European Committee for Standardization (CEN).

Cross-references

Publication referred to	Corresponding British Standard
	BS EN 292 *Safety of machinery. Basic concepts, general principles for design*
EN 292 : 1991/ A1 : 1995	BS EN 292-2 : 1991 *Technical principles and specifications*
EN 457 : 1992	BS EN 457 : 1992 *Safety of machinery. Auditory danger signals. General requirements, design and testing*
EN 842 : 1996	BS EN 842 : 1996 *Safety of machinery. Visual danger signals. General requirements, design and testing*
EN 60073 : 1993	BS EN 60073 *Specification for coding of indicating devices and actuators by colours and supplementary means*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, the EN title page, pages 2 to 8, an inside back cover and a back cover.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 981

December 1996

ICS 13.320

Descriptors: Safety of machines, accident prevention, signalling hazard, acoustic signal, visual signal, design, ergonomics, control light, safety colour, specification, quality

English version

Safety of machinery — System of auditory and visual danger and information signals

Sécurité des machines — Système de signaux auditifs et visuels de danger et d'information

Sicherheit von Maschinen — System akustischer und optischer Gefahrensignale und Informationssignale

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 981 : 1996 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 122, Ergonomics, 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 June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

For the relationship to EU Directive(s), see informative annex ZA, which is an integral part of this standard.

On the international level the International Standard ISO 11429 *Ergonomics — System of auditory and visual danger and information signals* has been prepared by WG 3, Danger signals and speech communication in noisy environments, of ISO/TC 159/SC 5, Ergonomics of the physical environment. The technical content of both the European Standard EN 981 and the International Standard ISO 11429 is identical, with the exception of the emergency evacuation signal which is not dealt with in this European Standard, however the limits of applicability of the standards to other technical fields are different.

Due to the different limits of applicability still existing on the european and international level, direct transformation of the International Standard into a European Standard is not possible. The reason is that EN 981 has been prepared in order to fulfil the essential safety and health requirements of annex I of the Council Directive 89/392/EEC of 14 June 1989 on the approximation of the laws of the Member States relating to machinery: Essential health and safety requirements relating to the design and construction of machinery (see annex A of EN 292-2 : 1991/A1 : 1995) and that therefore the limits of applicability of the European Standard is restricted to this Directive.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

To reduce risks associated with misinterpretation of visual and auditory danger signals, a system of danger and information signals is specified taking into account the different degrees of urgency.

This European Standard is applicable to all danger and information signals which have to be clearly perceived and differentiated as specified in **5.3** of EN 292-2 : 1991, by other requirements, or by the work situation, and to all degrees of urgency — from an extreme urgency to an 'ALL CLEAR' situation. Where visual signals are to be complementary to sound signals, the signal character is specified for both.

This European Standard does not apply to certain fields covered by specific standards or other conventions in force (international or national); in particular, fire alarms, medical alarms, alarms used in the field of public transport, navigation signals and signals for special fields of activity (for example, military). When new signals are being planned, however, this European Standard should be considered in order to avoid inconsistency.

For auditory signals, the system of signal character is a guideline for a signal language based on message categories which are classified according to urgency. Certain characters are specified for purposes which require safe and rapid recognition. Certain categories allow possibilities for variants, e.g. control and warning signals at workplaces where the signalling is intended for personnel with specific training.

For visual signals the established meanings of the safety colours are not affected by this European Standard. For different needs, complementary meanings have been assigned to the signals by timed patterns, and in a very few cases by alternating colours.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 292-2 : 1991/ A1 : 1995	*Safety of machinery — Basic concepts, general principles for design – Part 2: Technical principles and specifications*
EN 457 : 1992	*Safety of machinery — Auditory danger signals — General requirements, design and testing* (ISO 7731 : 1986 modified)
EN 842 : 1996	*Safety of machinery — Visual danger signals — General requirements, design and testing*
EN 60073	*Coding of indicating devices and actuators by colours and supplementary means* (IEC 73 : 1991)
ISO 8995	*Principles of visual ergonomics — The lighting of indoor work systems*
ISO 9921-1	*Ergonomic assessment of speech communication — Part 1: Speech interference level and communication distances for persons with normal hearing capacity in direct communication (SIL method)*

3 Definitions

For the purpose of this standard the following definitions apply:

3.1 alternating sound (light)

Shifts between two or three acoustical [optical] spectra, with equal duration of the segments, at least 0,15 s each.

3.2 bursts of sound

Normally recurrent group of sound pulses with short but distinct interruptions. The pulse period, including interruption, being between 0,25 s to 0,125 s.

3.3 character of a signal

Combination of one or more auditory or visual components differentiating one signal from another.

3.4 flash

Light of duration less than 0,5 s.

3.5 quick-pulse

Sound of duration less than 0,5 s.

3.6 segment

One of a number of parts in a sound or light signal during which the signal character is constant.

3.7 spectrum of sound (light)

Intensity or sound pressure level of sound (light) represented as function of frequency or wavelength.

3.8 sweeping (sound)

Continuously or discretely varying frequency.

4 Ergonomic principles for the design and application of auditory and visual signals

4.1 General

4.1.1 Auditory and visual signals shall be rapidly recognizable under all environmental conditions anticipated for their use. The recognition of a signal depends on many physical and psychophysical characteristics.

To ensure that signal effectiveness is not compromised by lack of reliability of signals, false alarm should be minimized or eliminated.

Signals shall be effective under all conditions of use, including conditions of environmental disturbance of the recognition process and situations involving the highest degree of importance and urgency for action. Signal intensity shall be in accordance with EN 457 and EN 842.

4.1.2 The risk of panic caused by signalling is to be considered, but should not be overestimated. In principle, two steps of panic reaction can be apparent:

The first sound impulse or flash of light can generate unintended fright. To avoid this shock-effect, the initial intensity of the sound should not be too high but should increase during the duration of the signal.

The sudden question: 'What is happening?' can generate feelings of uncertainty and panic. Therefore, regular information is most essential.

4.2 Principles for distinctive characters

The primary requirement for a signal is some kind of typical pattern, which makes the signal unambiguous and ensures recognition under different difficult environmental conditions. The necessary variations can be produced in several ways, but are basically achieved by variation in intensity or in spectrum of light or sound.

Although there is an analogy between the spectrum of light and sound, there are limitations to how this analogy can be used in order to make auditory and visual signals similar. For example, it is not wise to try to use sweeping colour like the sweeping pitch of sounds. For light, five colours are used which each carry some meaning, while for sound five analogous constant pitches are not used because pitch is a major tool which makes the signal audible with respect to the acoustical environment. In practice, any physical similarity between sound and light signals shall be based on temporal variation (i.e. variation in intensity over time) like characters from, e.g. Morse Code.

Most people have the ability to remember and identify only very few different time patterns of signals. Echoes and acoustical delay can change the perceived character of a signal, especially when separate sound sources are used.

4.3 Qualities of auditory signals

The design of auditory signals shall be in accordance with EN 457. The use of speech signals shall be in accordance with ISO 9921-1.

A priority classification of auditory signal character according to importance or urgency has been applied (see table 1). Signals with frequency variation — sweeping or alternating — are reserved for the most dangerous situations. Signals with constant frequency segments can be short grouped pulses (bursts), or sequences of equal or unequal segments. More than two different lengths of sound in each sequence shall not be used. The ratio of lengths should not be less than 1:3. Higher pitch is associated with greater urgency, but particular frequency distributions are not specified.

Variants in character (maintaining specified features) are available for numerous specific purposes within the two message categories DANGER and CAUTION. By applying the main scheme (see table 1) which specifies significant but not detailed character, a number of variants will be available.

Table 1. Signals for general purposes, listed after degree of urgency

Message category	Auditory signal		Visual signal
	Character available for ON phase	Temporal pattern	
DANGER Urgent action for rescue or protection	– Sweeping – Bursts – Alternating pitch (two or three frequency steps) NOTE: Urgency can be implied by rapid rhythm, dissonance or high pitch	continous or alternating ON/OFF alternating ON/OFF continuous or alternating ON/OFF Any DANGER signal shall have a temporal pattern clearly differentiated from EMERGENCY EVACUATION	Red
CAUTION Act when necessary	Only one sound with constant spectrum, minimum duration 0,3 s.	Alternating ON/OFF Clearly distinct from EMERGENCY EVACUATION At most two different lengths of ON segments in pattern; the first one long	Yellow
COMMAND Need for mandatory action	Two or three different sounds, each with constant spectrum	Continuous or alternating ON/OFF	Blue (see EN 60073)
ANNOUNCING INFORMATION Public instruction	Two-tone chime	High-low non-recurrent (followed by instruction)	No light signal, normally. If needed: Yellow non-recurrent double flashes
ALL CLEAR Danger past	Sound with constant spectrum	Continuous, at least 30 s Signal following a preceding warning signal	Green
NOTE. Synchronism between sound and light is not generally required, but can improve perception.			

4.4 Qualities of visual signals

The design of visual signals shall be in accordance with EN 842 and ISO 8995.

Certain special light sources for extremely short but high intensity flashes play an important role for warning, but the requirements of **4.2.2** of EN 842 : 1996 shall be met.

NOTE. Reduction in duration of a light also reduces its brightness. This effect applies also to sound pulses lasting less than approximately 0,2 s. However, short flashes and sound pulses are often preferred for technical reasons.

5 System of auditory and visual signals

5.1 Scheme of purpose and character

The principal requirements for the system of signals are summarized in tables 1 and 2. More detailed design parameters and remarks are listed in table 3 for sound coding and in table 4 for colour coding. According to the degree of urgency, the message category as well as the appropriate signal character shall be chosen from table 1.

In case of public alarm, table 2 shall be applied.

Table 2. Character of signals for public alarm

Message category	Auditory signal		Visual signal	Remarks
	Character available for ON phase	Temporal pattern		
PUBLIC ALARM Important action for personal safety	– Sweeping	Continuous	Red intermittent light	– Standing instructions for in-doors or shelter protection (gas),
	– Constant spectrum	Alternating ON/OFF, period 4 s to 20 s		– Radio message follows
NOTE. Synchronism between sound and light is not generally required, but can improve perception.				

5.2 Scheme of auditory signal character

Additional characters of auditory signals are given in table 3.

Table 3. Scheme for character of auditory signals

Sound	Light	Meaning	Remarks
SWEEPING Sliding increase or decrease in frequency at a rate of 5 Hz/s to 5 Hz/ms (variation permitted during cycle)	RED	Danger, act urgently	Highest sweeping rate principally for high tone frequencies, and vice versa. Lowest rate not to be used for sound segments shorter than 5 s, and not for tone frequencies above 400 Hz.
BURSTS, quick-pulses When grouped, at least five pulses in each group. Pulse frequency 4 Hz to 8 Hz (pulse length 60 ms to 100 ms)	RED	Danger, act urgently	Reverberation can cause perceptual difficulty at pulse frequencies above 5 Hz. See EN 457.
ALTERNATING Stepwise sequence of two or three distinct pitches, each segment 0,15 s to 1,5 s	RED	Danger, act urgently	Intensity as well as duration of the ON phase of sound segments equal
SHORT sound Constant spectrum, minimum duration 0,3 s	YELLOW	Caution, be alert	When different sound segment lengths are used, a ratio of 1:3 is recommended
SEQUENCE Two or three different sounds, each with constant spectrum	BLUE	Command, mandatory action	—
PROLONGED sound Constant spectrum	GREEN	Normal condition All clear	Signal given after PUBLIC ALARM shall not be interrupted within 30 s

5.3 Scheme of visual signal colours

Additional characters for visual signals are given in table 4.

Table 4. Scheme for colours of visual signals

Colour	Meaning	Objective	Remarks
RED	Danger Abnormal condition	Emergency Alarm Stop Prohibition Failure	Red flashes shall be used for EMERGENCY EVACUATION
YELLOW	Caution	Attention required Change of condition Intervention	—
BLUE	Indication of need for mandatory action (see EN 60073)	Action Protection Special attention Safety-related regulation or priority arrangement	For objectives not unambiguously covered by Red, Yellow or Green
GREEN	All clear Normal condition	Revert to normal Proceed	For energized device monitoring (normal)

6 Testing

Regular routine tests according to clause **6** of EN 457 : 1992 and clause **6** of EN 842 : 1996 shall be carried out, including testing for detection of character and understanding of their meaning.

Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU directives:

Council Directive of 14 June 1989 on the approximation of the laws of the Member States relating to machinery (89/392/EEC);

Council Directive of 20 June 1991 amending Directive 89/392/EEC on the approximation of the laws of the Member States relating to machinery (91/368/EEC);

Council Directive of 14 June 1993 amending Directive 89/392/EEC on the approximation of the laws of the Member States relating to machinery (93/44/EEC).

WARNING. Other requirements and other EU directives may be applicable to the products falling within the scope of this standard.

The clauses of this standard are likely to support requirements of the three directives mentioned above.

Compliance with this standard provides one means of conforming with the specific essential requirements of the directives concerned and associated EFTA regulations.

List of references

See national foreword.

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: 020 8996 9000. Fax: 020 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: 020 8996 9001. Fax: 020 8996 7001.

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: 020 8996 7111. Fax: 020 8996 7048.

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: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL