





SAFETY REQUIREMENTS FOR MACHINERY

MEG

WHY SIGNALING DEVICES?







IEC 61310-1 - Safety of Machinery – Indication, marking and actuation

Part 1: Requirements for visual, acoustic and tactile signals

ISO 7731 - Ergonomics – Danger signals for public and work areas –

Auditory danger signals

ISO 11428 - Ergonomics - Visual danger signals –

General requirements, design and testing



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Sécurité des machines – Indication, marquage, manœuvre

Partie 1: Exigences pour les signaux visuels, acoustiques et tactiles

Safety of machinery – Indication, marking and actuation –

Part 1: Requirements for visual, acoustic and tactile signals



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Safety of Machinery – Indication, marking and actuation

Part 1: Requirements for visual, acoustic and tactile signals

Specific Directives

Where, for machinery, the hazards referred to in Annex I are wholly or partly covered more specifically by other Community Directives, this Directive shall not apply, or shall cease to apply, to that machinery in respect of such hazards from the date of implementation of those other Directives.

General Principeles

The manufacturer of machinery or his authorized representative must ensure that a risk assessment is carried out in order to determine the health and safety requirements which apply to the machinery. The machinery must then be designed and constructed taking into account the results of the risk assessment.





Definitions

(a) 'hazard' means a potential source of injury or damage to health;

(b) 'danger zone' means any zone within and/or around machinery in which a person is subject to a risk to his health or safety;

(c) 'exposed person' means any person wholly or partially in a danger zone;

(d) 'operator' means the person or persons installing, operating, adjusting, maintaining, cleaning, repairing or moving machinery;

(e) 'risk' means a combination of the probability and the degree of an injury or damage to health that can arise in a hazardous situation;

(f) 'guard' means a part of the machinery used specifically to provide protection by means of a physical barrier;

(g) 'protective device' means a device (other than a guard) which reduces the risk, either alone or in conjunction with a guard;





Principles of safety integration

(e) Machinery must be supplied with all the special equipment and accessories essential to enable it to be adjusted, maintained and used safely.

Control devices

Machinery must be fitted with indicators as required for safe operation. The operator must be able to read them from the control position.

From each control position, the operator must be able to ensure that no-one is in the danger zones, or the control system must be designed and constructed in such a way that starting is prevented while someone is in the danger zone.

If neither of these possibilities is applicable, before the machinery starts, an acoustic and/or visual warning signal must be given. The exposed persons must have time to leave the danger zone or prevent the machinery starting up.





Signs, signals and warnings

Where the health and safety of persons may be endangered by a fault in the operation of unsupervised machinery, the machinery must be equipped in such a way as to give an appropriate acoustic or light signal as a warning.

Where machinery is equipped with warning devices these must be **unambiguous and easily perceived**. The operator must have facilities to check the operation of such warning devices at all times.

The requirements of the specific Community Directives concerning colours and safety signals must be complied with. (here e.g. ISO 7731)

Warning of residual risks

Where risks remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted, the necessary warnings, including warning devices, must be provided.



Auditory danger signals

Ergonomics – Danger signals for public and work areas –



INTERNATIONAL ISO STANDARD 7731

> Second edition 2003-11-01

Ergonomics — Danger signals for public and work areas — Auditory danger signals

Ergonomie — Signaux de danger pour lieux publics et lieux de travail — Signaux de danger auditifs



Reference number ISO 7731:2003(E)

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This International Standard specifies criteria applicable to the recognition of auditory danger signals, especially in cases where there is a high level of ambient noise. It covers auditory danger signals, desigated in the text of this standard by the use of the phrase "danger signals", which apply to emergency signals and warning signals (see Table 1).

Type of danger signal	Response
Auditory emergency evacuation signal	Leave the danger zone immediately
Auditory emergency signal	Take urgent action for rescue or protection
Auditory warning signal	Take preventative or preparatory action





1 Scope

This International Standard specifies the physical principles of design, ergonomic requirements and the corresponding test methods for danger signals for public and work areas in the signal reception area and gives guidelines for the design of the signals. It may also be applied to other appropriate situations. The relevance given in the definitions as to the difference between an auditory emergency signal, auditory emergency evacuation signal and an auditory warning signal should be noted. The emergency evacuation signal is covered in ISO 8201.









3 TERMS, DEFINITIONS AND SYMBOLS

3.1 ambient noise - all sounds in the signal reception area not produced by the danger-signal transmitter
3.2 danger signals - depending on the degree of urgency and the possible effect of the danger on people, a distinction is made between three types of auditory danger signals: an auditory emergency signal, an auditory emergency evacuation signal and an auditory warning signal

3.2.1 auditory emergency signal - signal marking the onset and, if necessary, the duration and the end of a dangerous situation

3.2.2 auditory emergency evacuation signal - signal indicating the beginning or the actual occurrence of an emergency involving the possibility of injury and instructing the person(s) to immediately leave the danger zone in the recognized manner

3.2.3 auditory warning signal - signal indicating the possibility or actual occurrence of a dangerous situation requiring appropriate measures for the elimination or control of the danger

Note 1 to entry: The auditory warning signal may also provide information concerning the conduct and courses of action to be taken.



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ISO 7731

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3 TERMS, DEFINITIONS AND SYMBOLS

3.3 effective masked threshold - level of auditory danger signal just audible over the ambient noise, taking account of the acoustic parameters of both the ambient noise in the signal reception area and the listening deficiencies (hearing protection, hearing loss and other masking effects)

3.7 signal reception area - area in which persons are intended to recognize and react to a signal







General:

The nature of the danger signal shall be such that people in the reception area can hear and react to the signal as intended. If persons with hearing impairment (deafness) or hearing protection (helmets, ear plugs, etc.) are likely to be present, special care should be taken. The characteristics of the audible signal shall be adapted to take account of the characteristics relevant to the situation.

Recognition:

The reliable recognition of a danger signal requires that the signal be clearly audible, be sufficiently different from other sounds in the environment and have an unambiguous meaning.

In order of priority, any emergency evacuation signal shall take precedence over all other danger signals and danger signals shall take precedence over all other auditory signals.





Audibilty:

The danger signal shall be clearly audible. The effective masked threshold shall be distinctly exceeded.

To ensure its audibility, the A-weighted sound-pressure level of the danger signal shall not be lower than 65 dB at any position in the signal reception area.

In addition, at least one of the criteria in 4.2.2.2 to 4.2.2.4 shall be met.









4.2.2.2 For measurements of the A-weighted sound-pressure level [method a) in 5.2.2.1], the difference between the two A-weighted sound-pressure levels of the signal and the ambient noise shall be greater than 15 dB (LS, A − LN, A > 15 dB).
→ General measurement procedure

4.2.2.3 For measurements of the octave-band sound-pressure level [method b) in 5.2.3.1], the soundpressure level of the signal in one or more octave-bands shall exceed the effective masked threshold by at least 10 dB in the octave-band under consideration (LSi, oct – LTi, oct > 10 dB).

4.2.2.4 For measurements of the 1/3 octave-band sound-pressure level [method c) in 5.2.3.2], the soundpressure level of the signal in one or more 1/3 octave-bands shall exceed the effective masked threshold by 13 dB in the 1/3 octave-band under consideration (LSi, 1/3oct – LTi, 1/3oct > 13 dB).





DIN EN ISO 7731

4.2.3 Distinctiveness:

Parameters of the danger signal (signal level, frequency spectrum, temporal pattern, etc.) shall be designed to stand out from all other sounds in the reception area and shall be distinctly different from any other signals. (See Clause 6.)

Review of the signal

The effectiveness of the danger signal shall be reviewed at both regular intervals and whenever a new signal (whether a danger signal or not) or a change in the ambient noise occurs, or any other relevant changes are made.

Recommended maximum level of the danger signal

If the A-weighted sound-pressure level of the ambient noise in the signal reception area exceeds 100 dB, the use of additional visual, rather than solely auditory, danger signals is recommended (e.g. visual danger signals according to ISO 11428 and ISO 11429). In any case, the maximum signal level should not exceed 118 dB(A) in the signal reception area.





6.1 General

When designing auditory danger signals the following are relevant:

- \Box the sound-pressure level;
- \Box spectral characteristics;
- □ temporal characteristics.Schalldruckpegel

6.2 Sound-pressure level

Danger signals are deemed to be clearly audible in the signal reception area if their A-weighted soundpressure levels exceed the sound-pressure level of ambient noise by 15 dB or more (4.2.2.2) and if the A-weighted sound-pressure level of the signal is not lower than 65 dB (4.2.2.1). Together, these two requirements are sufficient but not always necessary for unfailing recognition. If the frequency and/or the temporal distribution of the danger signal clearly differ from the corresponding characteristics of the ambient noise, a lower sound-pressure level of the signal may be sufficient. This level, however, shall comply with that specified in 4.2.2.

The maximum sound-pressure level of the danger signal should be designed so that the signal is clearly audible. Reactions due to fright (e.g. more than 30 dB in 0,5 s) may be caused by using too high a soundpressure level. Fright may also be expected whenever there is an unexpected steep increase in the soundpressure level.





Spectral characteristics

The danger signal should include frequency components in the 500 Hz to 2 500 Hz frequency range. However generally two dominant components from 500 Hz to 1 500 Hz are recommended.

In the case of persons wearing hearing protection or having a hearing loss, sufficient signal energy should be present in the frequency range below 1 500 Hz.









6.5 Information required from suppliers

Manufacturers and agents of sound sources for danger signals shall present at least the following information

in their data sheets:

a) the minimum and maximum values of the A-weighted sound-power level (LW, A) or, if not available, the A-weighted sound-pressure level (LS, A) measured in the free field at a distance of 1 m from the sound source in the main direction of radiation;

b) spectral components, by octave or 1/3 octave, in the centre frequencies from 125 Hz to 8 000 Hz at a distance of 1 m from the sound source in the main direction of radiation;

c) the temporal envelope of the danger signal for a representative time period.







Ergonomics - Visual danger signals -

General requirements, design and testing

INTERNATIONAL	
STANDARD	

INT

ISO 11428

First edition 1996-12-15

Ergonomics — Visual danger signals — General requirements, design and testing

Ergonomie — Signaux visuels de danger — Exigences générales, bonception et essais



Reference number ISO 11428:1996(E)



Foreword

The technical content of ISO 11428 and European Standard EN 842, Safety of machinery - Visual danger signals -General requirements, design and testing is identical. However, the limits of applicability of the standards to other technical fields are different, thus direct transformation of the International Standard into a European standard is not possible. EN 842 was prepared in order to fulfil the Council Directive on essential health and safety requirements relating to the design and construction of machinery and therefore the applicability of the European standard is restricted to this Directive.

Scope

This International Standard describes criteria for the perception of visual danger signals in the area in which people are intended to perceive and to react to such a signal. It specifies the safety and ergonomic requirements and the corresponding physical measurements and subjective visual check. It also provides guidance for the design of the signals so that they can be clearly perceived and differentiated as described in ISO!TR 12100-2:1992, 5.3.



Definitions

- 3.1 visual danger signal: Visual signal indicating imminent onset or actual occurrence of a dangeraus Situation,
- involving risk of personal injury or equipment disaster, and requiring some human response to eliminate or control
- the danger or requiring other immediate action.
- 3.2 signal reception area: Area in which the signal is intended to be perceived and reacted upon.
- 3.3 field of vision (visual field): Physical space visible to an eye in a given position



Safety and ergonomic requirments

The characteristics of the visual danger signal shall ensure that any person in the signal reception area can detect, discriminate and react to the signal as intended. Visual danger signals shall be:

clearly seen under all possible lighting conditions;

clearly discriminated from general lighting and other visual signals;

allocated a specific meaning within the signal reception area.

NOTE: A visual danger signal should, if not Contradicted by special reasons, be associated with an auditory danger signal. When the danger signal is an emergency signal, auditory and visual signals should be presented together



4.2.3 Location within the field of vision

Visual danger signals should be located where appropriate in the direct vicinity of the potential danger in order to

allow its immediate detection by all persons within the signal reception area, or about to enter this area. Additional

visual danger signals located outside the direct vicinity, such as in a control room or a control panel, are not excluded.

The signal reception area of a visual danger signal shall be explicitly stated in the design for every installation, indicating whether the signal reception area is, for example, just a single operator's console or parts of a factory or a whole plant.

For directly displayed danger signals, the signal lights shall be located within the field of vision inside the workplace being considered (signal reception area)



4.2.3 Location within the field of vision

When the direction of the eye changes as a result of the work activity, or when the fields of vision of several

people are non-overlapping, additional signal lights shall be installed. The signaling devices shall be positioned so

that at least one danger signal is visible from any point within the signal reception area.

- 4.3.2 Colour of signaling light
- A visual warning signal shall be yellow or yellow-orange.

A visual emergency signal shall be red.

If visual warning and visual emergency signals are both used in a working area, and if despite the difference in colour the signals cannot be clearly discriminated, the emergency signal shall have at least twice the intensity of that of the warning signal.





Field of vision imposed by external

Field of vision not imposed by external