SLOVENSKI STANDARD
SIST EN 13921:2007

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Osebna varovalna oprema ï Ergonomska naļ ela

Personal protective equipment - Ergonomic principles

Persönliche Schutzausrüstung - Ergonomische Grundsätze

Equipements de protection individuelle - Principes ergonomiques

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Personal protective equipment - Ergonomic principles

Equipements de protection individuelle - Principes ergonomiques

Persönliche Schutzausrüstung - Ergonomische Grundsätze

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Foreword

This document (EN 13921:2007) 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of an identical text or by endorsement, at the latest by November 2007, and conflicting national standards shall be withdrawn at the latest by November 2007.

This document 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 Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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 United Kingdom.

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Introduction

This European Standard provides guidance for the writers of personal protective equipment (PPE) product standards on the specification of ergonomic requirements.

Ergonomics involves the application of scientific methods and appropriate data to the design and specification of machines, equipment, environments and systems that people use. The successful use of ergonomics in designing PPE will enhance the acceptability of the PPE and through this improve the safety, health, performance and effectiveness of the user.

PPE is used in situations where a risk to health or safety has been identified. The preferred solution is to reduce the risk to zero and thereby to remove the need for PPE. If this is not possible, the threat should be reduced so that practical PPE can minimise the risk to people exposed to that hazard. In some working conditions some PPE may be more comfortable than none and not to be considered as an additional weight (shoes etc.). Side effects of using PPE can range from discomfort to severe constraint and physical load. The application of ergonomic principles to PPE allows optimisation of the balance between protection and usability.

Some aspects of the design and specification of PPE require specialist knowledge of the particular job the PPE is used for; the particular hazard against which the PPE is to be effective or particular ergonomics issues. Although this European Standard covers many aspects, the writers of product standards should be aware that it cannot be expected to identify all the possible future problem points for which ergonomic requirements and test methods will be required in product standards. It will remain the responsibility of the relevant experts, to identify and quantify the hazards in the work and to foresee the potential ergonomic problems, and thus to ensure that the PPE specified and manufactured is fit for the purposes intended in all respects.

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For practical reasons, this European Standard presents ergonomics factors separately. However, it should be recognised that the overall acceptability of an item of PPE will be determined by a combination of these and other factors by the individual user.

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1 Scope

This European Standard provides guidance on the generic ergonomic characteristics related to personal protective equipment (PPE).

It specifies for the writers of PPE product standards, principles relating to:

— anthropometric characteristics related to PPE;

— the biomechanical interaction between PPE and the human body;

— the thermal interaction between PPE and the human body;

— the interaction between PPE and the human senses: vision; hearing; smell and taste; and skin contact.

This European Standard does not cover requirements related to the specific hazard for which PPE is designed.

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.

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EN ISO 12894, *Ergonomics of the thermal environment — Medical supervision of individuals exposed to extreme hot or cold environments (ISO 12894:2001)*

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3 Terms and definitions

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

3.1
anthropometrics of PPE
application of human body measurements to the design of PPE including variation in dimensions within the user group

3.2
auditory aspects
qualities which interfere with the users ability to hear

3.3
biomechanics of PPE
application of principles and methods from physics and engineering to describe the effect undergone by the human body and various body segments and the forces acting on these body segments including physical loading which may be caused by PPE

3.4
body heat balance
increase or decrease in the heat content of the body caused by an imbalance between heat production and heat loss, usually expressed in terms of unit area of total body surfaces

3.5
evaporative resistance of a clothing ensemble
***R*$_{e, cl}$**
resistance of vapour transport of a uniform layer of insulation covering the entire body that has the same effect on evaporative heat loss as the actual clothing under standardized (static, wind-still) conditions

NOTE The definition of $R_{e, cl}$ also includes the uncovered parts of the body, like head and hands.

3.6
general thermal comfort
total subjective satisfaction with the thermal environment, based on whole body sensation

3.7
hazard
potential source of harm

NOTE 1 The term "hazard" can be qualified in order to define its origin (e.g. mechanical hazard, electrical hazard) or the nature of the potential harm (e.g. electric shock hazard, cutting hazard, toxic hazard, fire hazard).

NOTE 2 The hazard envisaged in this definition:

— either is permanently present during the intended use of the machine (e.g. motion of hazardous moving elements, electric arc during a welding phase, unhealthy posture, noise emission, high temperature);

— or may appear unexpectedly (e.g. explosion, crushing hazard as a consequence of an unintended/unexpected start-up, ejection as a consequence of a breakage, fall as a consequence of acceleration/deceleration).

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[EN ISO 12100-1:2003; 3.6]

3.8
local thermal comfort
subjective satisfaction with the thermal environment, based on local body area sensations

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3.9
masking effect
process by which the threshold of hearing of one sound is raised due to the presence of another

3.10
PPE user group
group of people exposed to a hazard which requires the use of PPE

3.11
risk
combination of the probability of occurrence of harm and the severity of that harm

[EN ISO 12100-1:2003; 3.11]

3.12
skin contact
information from skin contact and touch, such as irritation, tickle, cold, hot, pressure and pain

3.13
smell
odours or the modification of existing odours which may adversely affect any performance-related sensation or otherwise impair acceptability

3.14
thermal insulation
reciprocal of the rate at which heat is conducted between unit area of two parallel surfaces in a medium when unit temperature difference is maintained between them

3.15
thermal sensation
subjective perception of thermal state

3.16
thermal state
relation between heat production and heat loss in the human body

3.17
thermal strain
physiological responses of the human body to cold or heat exposure

3.18
vestibular orientation
sensations of the orientation of the head, together with movement and accelerative forces

3.19
visual aspects
prevention or impairment of the ability to see visual signals or information

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4 Factors to be considered on general specification of ergonomic requirements

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4.1 General

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Harmonised product standards for PPE should contain ergonomic requirements and test methods, or should make normative reference to other standards to be applied.

Usually, ergonomic assessments of PPE have to be made while people are wearing it. Wherever possible, the assessments should be objective, although some aspects can only be assessed subjectively. Examples of how to make assessments are given in Annex A.

4.2 Integration of performance and ergonomic requirements

The primary purpose of PPE is to provide protection against specific hazards that cannot be eliminated or adequately reduced by other means. Product standards should therefore contain performance requirements and test methods to ensure that the products provide the appropriate protection against the identified hazards, and that they are ergonomically suitable for the users.

Product standards writers should consider the tasks being performed; the equipment being used; the duration of the usage of the PPE; and the environments likely to be encountered. They should ensure as far as possible that the PPE does not create hazards for the users. This may be by incorporating in product standards requirements and test methods based on this European Standard.

Where the presence of more than one risk or the need to cover more parts of the body makes it necessary for a worker to use simultaneously more than one item of PPE, such equipment shall be mutually compatible and continue to be effective against the risk or risks in question.

In addition to interactive effects on technical performance, interaction between different forms of PPE may influence ergonomic aspects. Thus, although the effect of individual items of PPE tested in isolation may not be significant, it will be the combined effect that will determine the overall load and consequent acceptability. For example, both a half-mask respirator and a safety helmet may intrude upon the visual field. Either in isolation may be acceptable but, when worn together the combined impact may not be. At its most extreme,

extensive body coverage by PPE, or wearing several forms of protection may result in sensory and social isolation.

Ergonomics requirements can be taken into account by determination of performance levels on the basis of a risk assessment.

4.3 Factors to be considered in the determination of the best ergonomic solution

4.3.1 General

PPE is to be worn or held by an individual for protection against one or more health and safety hazards. This protection is the intended effect of the PPE, but wearing PPE can also result in unintended negative effects, which can interfere with the user's normal performance of the risk related activities.

Product standards writers should consider how to specify the best compromises between protection; practicality; and any potentially adverse impact of wearing the PPE. If different solutions apply, equivalent compromises may be possible.

4.3.2 Factors to be considered in specifying the optimum level of protection to be provided

Product standards writers should consider the following variable aspects of the use of PPE:

— the duration of use of the PPE (some PPE such as smoke hoods is worn for only a few minutes when it is perceived that a hazard is present, but other PPE such as high visibility garments and protective helmets may be worn throughout a working day);

— whether there are different situations in which the PPE is used, that require different amounts of the body to be covered and for various other PPE to be used in addition;

— the reasonable balance between the severity of the hazard, protection, burden and duration.

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4.3.3 Factors to be considered in specifying the optimal practicability

The designs of PPE that result from compliance with product standards should allow, as far as possible, normal pursuit of an activity, whether the product is for occupational, recreational, or domestic use. To ensure this is achieved, product standards should include test procedures and requirements based on the performance of prescribed movements, or should make normative reference to such procedures and requirements. Standards writers shall, where relevant, include reference to any other PPE or protective clothing likely to be worn and should incorporate such items in performance testing. Tests should be selected to represent a range of the normal movements made by users of the PPE while wearing it. They should always include, for example, the following:

— understanding instructions and warnings given by the manufacturers;

— putting on, adjusting and taking off the PPE;

— general activities, such as moving and communicating;

— activities specific to situations where the PPE is to be used.

Interpretation of the results should take into account the levels of hazard against which the PPE is intended to provide protection, the inevitable burdens such PPE will impose, and the environmental conditions under which it will be used. Guidance on the choice of movements and the overall conduct of ergonomic assessment of PPE using human subjects is given in Annex A.

4.3.4 Factors for measuring the physiological impact of PPE

The following indicators might be considered to determine the physiological impact in relation to the use of PPE:

— heart rate;

— oxygen consumption;

— alveolar gas composition;

— breathing rate;

— body temperature change;

— blood flow;

— sweat rate;

— fatigue or strain of muscles.

Examples where they might be used include where the mass of the PPE may result in an excessive burden or where the insulative or other characteristics of PPE may give rise to thermal strain.

NOTE All use of human beings in tests should be in accordance with the Declaration of Helsinki (as amended) (see Annex A).

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4.4 Factors to be considered in specifying requirements for the adjustability of PPE and its appropriate fixation to the body

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Product standards writers should consider whether requirements and test methods need to be included to test the adjustments and restraint of PPE. In deciding that need, they should consider the seriousness of the consequences of displacement of the PPE, and the maximum tolerable displacement. The following are examples of aspects that could be taken into account:

— the information and instructions for fitting and adjusting;

— the adjustability and the stability of adjustments;

— determining that the PPE has been correctly fitted.

When writing a test, consideration should be given to the static and dynamic forces that might be exerted on the PPE in normal wear, and during the circumstances in which it is intended to provide protection and how these may be represented in test methods.

4.5 Factors to be considered in specifying requirements to ensure that PPE does not irritate or cause discomfort

PPE shall not irritate or cause discomfort which may later lead to injuries for the users who may come into contact with it. Factors to be taken into account include:

— whether the PPE will be in contact with the skin and how sensitive this particular area of skin is to the effects of rubbing and pressure;

— for how long the PPE will normally be in contact with the skin;

— whether the type of PPE may have sharp or hard edges or points;