SLOVENSKI STANDARD
SIST ENV 342:1999

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Varovalna obleka - Sistem oblaį il za zaġį ito pred mrazom

Protective clothing - Ensembles for protection against cold

Schutzkleidung - Kleidungssysteme zum Schutz gegen Kälte

Vetements de protection - Ensembles de protection contre le froid

Ta slovenski standard je istoveten z: **ENV 342:1998**

ICS:

13.340.10 Varovalna obleka Protective clothing

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Descriptors: personal protective equipment, protective clothing, thermal resistance, specifications, thermal insulation, air permeability, water vapor tests, low temperature tests

English version

Protective clothing - Ensembles for protection against cold

Vêtements de protection - Ensembles de protection contre le froid

Schutzkleidung - Kleidungssysteme zum Schutz gegen Kälte

This European Prestandard (ENV) was approved by CEN on 22 January 1998 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

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

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Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 162 "Protective clothing including hand and arm protection and lifejackets" the secretariat of which is held by DIN.

This European Prestandard 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 standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This prestandard as a prospective standard for provisional application is published to achieve at least a common basis in Europe for requirements and test methods for protective clothing ensembles against cold in the interest of especially manufacturers, test institutes and end-users. The measured properties and their subsequent classification are intended to ensure an adequate protection level under different user conditions: Thermal insulation of the whole ensemble and the air permeability are the essential properties to be tested and marked on the label.

Thermal insulation is the most important property and it is measured on the complete clothing ensemble with a full-sized thermal manikin in order to account for the effect of layers, fit, drape, coverage and shape. In this respect this prestandard differs from many other standards specifying only material properties. The insulation is tested with new ensembles. It should be recognized that ensembles in frequent use may loose significant insulation capacity due to laundry and wear. In general high quality products and well maintained clothing are less affected in this respect.

Wind may considerably increase convective heat losses. Therefore, the air permeability of the outer garment material is an important factor to be taken into account in relation to the protection of the wearer against cold. The insulation requirements and air effects for given conditions can be assessed by methods given in ISO/TR 11079.

Sweating must be avoided in continuous cold exposure, since moisture absorption will progressively reduce insulation. This is best controlled by selecting optimal rather than maximal insulation and flexible, adjustable garments rather than fixed and closed ensembles. It is more efficient to get rid of heat and moisture by ventilation of clothing through adjustable openings and button-up, than by passive diffusion through layers of garments. In the very cold, very little, if any, water vapour escapes through the material because of condensation and, eventually, is freezing in clothing. In some conditions with intermittent exposures (e. g. cold store work) or in conditions close to and above 0°C the water vapour resistance value of fabrics become increasingly important and fabrics with a low value may contribute to improved heat balance and thermal comfort.

Because this prestandard only deals with ensembles, it is intended to draft a standard with requirements and test methods for garments against local cooling of the body.

1 Scope

This European Prestandard specifies requirements and test methods for performance of clothing ensembles (i. e. two piece suits and coveralls) for protection against cold environment.

It does not include specific requirements for head wear, footwear and gloves intended to prevent local cooling.

2 Normative references

This European Prestandard 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 herafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Prestandard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 340	Protective clothing – General requirements
EN 511	Protective gloves against cold
ENV 343	Protective clothing – Protection against foul weather
EN 23758	Textiles – Care labelling code using symbols (ISO 3758:1991)
EN 31092	Textiles – Physiological effects – Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test) (ISO 11092:1993)
EN ISO 9237	Textiles – Determination of permeability of fabrics to air
ISO/TR 11079	Evaluation of cold environments – Determination of required clothing insulation (IREQ)
ISO 4674	Fabrics coated with rubber or plastics – Determination of tear resistance
ISO 5085-1	Textiles – Determination of thermal resistance – Part 1: Low thermal resistance

3 Definitions

For the purposes of this prestandard, the following definitions apply:

3.1 cold environment: Environment characterized by the combination of a low temperature, humidity, wind and thermal radiation (see ISO/TR 11079).

3.2 ensemble: Clothing consisting of a two-piece suit or one-piece suit (coverall).

3.3 outer shell material: The outermost material of which the protective clothing is made.

3.4 liner: An insert with a watertight property.

3.5 thermal lining: A non-watertight layer providing thermal insulation.

3.6 thermal liner: A layer with a watertight property providing additional thermal insulation.

3.7 lining: An innermost material without watertight property and thermal insulation.

3.8 properties of clothing materials or material combinations (composites)

3.8.1 thermal resistance (insulation) $R_{ct}\left[\frac{m^2 \cdot K}{W}\right]$

Temperature difference between the two faces of a material divided by the resultant heat flux per unit area in the direction of the gradient. The dry heat flux may consist of one or more conductive, convective and radiant components. Thermal resistance R_{ct}, expressed in square metres kelvin per watt, is a quantity specific to textile materials or composites which determines the dry heat flux across a given area in response to a steady applied temperature gradient.

3.8.2 water vapour resistance $R_{et}\left[\frac{m^2 \cdot Pa}{W}\right]$

Water vapour pressure difference between the two faces of a material divided by the resultant evaporative heat flux per unit area in the direction of the gradient. The evaporative heat flux may consist of both diffusive and convective components.

Water vapour resistance R_{et}, expressed in square metres pascal per watt, is a quantity specific to textile materials or composites which determines the "latent" evaporative heat flux across a given area in response to a steady applied water vapour pressure gradient.

3.8.3 water vapour permeability index i_{mt} (dimensionless): Ratio of thermal and water vapour resistances in accordance with equation

$$i_{mt} = \frac{S \cdot R_{ct}}{R_{et}} \qquad (1)$$

where S equals 60 Pa/K.

i_{mt} is dimensionless, and has values between 0 and 1. A value of 0 implies that the material is water vapour impermeable, that is, it has infinite water vapour resistance, and a material with a value of 1 has both the thermal resistance and water vapour resistance of an air layer of the same thickness.

3.9 thermal insulation of the protective clothing ensemble

3.9.1 resultant basic thermal insulation, $I_{cl,r}$

Thermal insulation from skin to outer clothing surface under defined conditions measured with a moving manikin.

Depending on the end use of the garment different thermal insulation values apply. For the purpose of this prestandard the resultant basic thermal insulation $I_{cl,r}$ is used.

The resultant basic thermal insulation value is determined in relation to the naked body surface area.

The value is given in

$$\frac{m^2 \cdot K}{W}$$

or in clo with the following conversion factor:

$$1 \text{ clo} = \frac{0{,}155 \ m^2 \cdot K}{W} \qquad (2)$$

3.9.2 resultant total thermal insulation, $I_{t,r}$: Total thermal insulation from skin to ambient atmosphere including clothing and boundary air layer under defined conditions measured with a moving manikin.

3.9.3 resultant thermal insulation of boundary air layer, $I_{a,r}$: Resistance against heat exchange by radiation and convection from the bare skin or the outer clothing surface to the ambient atmosphere measured with a moving manikin.

3.9.4 IREQ (= insulation required): Required resultant thermal insulation calculated on the basis of the thermal parameters of the environment (e.g. air temperature, mean radiant temperature, air velocity, relative humidity) and the body metabolism (see ISO/TR 11079).

4 Performance assessment and requirements

4.1 Thermal insulation, $I_{cl,r}$

Requirements for thermal insulation of the human body in a specific cold environment are assessed on the basis of ISO/TR 11079 Technical Report IREQ.

To provide adequate protection against cold within the scope of this prestandard, the resultant basic thermal insulation $I_{cl,r}$ shall have a minimum value of 0,15 $m^2 \cdot K/W$, when measured in accordance with 5.1.

Thermal insulation of a clothing ensemble (protective suit and underwear) is classified on the basis of measured resultant basic insulation values. Performance of a clothing ensemble in terms of preserving heat balance at normal body temperature depends on internal body heat production. Therefore the protective value of a clothing ensemble is evaluated by comparing its measured insulation value and the calculated required insulation value (IREQ). This comparison is the basis of table C.1.

4.2 Air permeability, R_A

Classification shall be in accordance with table 1.

Table 1: Classification of air permeability

$R_A \left[\frac{Pa}{m^2 \cdot s}\right]$	Class
$150 < R_A$	1
$20 < R_A \leq 150$	2
$R_A \leq 20$	3

Air permeability shall be measured in accordance with 5.2.

4.3 Water vapour permeability

4.3.1 Water vapour resistance, R_{et} of the outer shell material

When tested in accordance with 5.3, the outer shell material or the combination of outer material with the liner (see Figure D.1, D.2 and D.3 in Annex D) shall be classified in accordance with table 2, unless 4.3.2 applies.

Table 2: Classification of water vapour resistance

$R_{et} \left[\frac{m^2 \cdot Pa}{W}\right]$	Class
$20 < R_{et}$	1 *)
$13 < R_{et} \leq 20$	2
$R_{et} \leq 13$	3
*) Clothing falling within class 1 can in certain circumstances only be worn for a limited period (see Annex C).	

4.3.2 Water vapour permeability index (i_{mt}) of thermal liner

When the composite includes a thermal liner (e. g. nonwoven/membrane-laminate, see Figure D.4 in Annex D) 4.3.1 is not applicable and replaced by the following requirement:

When the water vapour permeability index i_{mt} and the thermal resistance of the thermal liner are measured in accordance with 5.4 and 5.5 respectivley, the thermal liner shall be classified as specified in table 3 in relation to the minimum value $i_{mt\ min}$, defined as :

$$i_{mt\ min} = \frac{S \cdot R_{ct}}{133{,}3 \cdot R_{ct} + 20} \qquad (3)$$

where S equals 60 Pa/K.

Table 3: Classification of water vapour permeability index

i_{mt}	Class
$i_{mt} \geq i_{mt,\ min}$	2
$i_{mt} < i_{mt,\ min}$	1

4.4 Tear resistance of outer shell material

The tearing force of the outer shell material shall be at minimum 25 N in both directions of the material.

Testing of the tear resistance, see 5.6.

5 Testing methods

5.1 Resultant basic thermal insulation, $I_{cl,r}$

The resultant basic thermal insulation is measured with a thermal manikin with a test procedure as given in Annex A.

The resultant basic thermal insulation of clothing ensembles (protective suit and standard underwear) is measured. The resultant basic thermal insulation of the protective clothing is measured in combination with any of the underwears A or B as specified in Annex B.

5.2 Air permeability, R_A

Air permeability is measured in accordance with EN ISO 9237.

In case that the composite material cannot be tested in one piece because of technical reasons, it is necessary to separate the individual components and measure the component with the lowest value.

Measurements shall be carried out at a pressure differential of 100 Pa and a test area of 20 cm^2.

5.3 Water vapour resistance, R_{et}

a) Testing of three specimens in accordance with EN 31092;

b) Another reproducible method other than method a), e. g. a nationally recognized non-desiccant type cup method may be applied, to test the water vapour permeability for other use than classification or testing to meet specified values as laid down in related standards.

The results obtained using methods a) and/or b) can be correlated for individual materials. Note that this correlation will be different between the individual materials.

5.4 Water vapour permeability index, i_{mt}

Test method in accordance with EN 31092.

This index is calculated from water vapour resistance and thermal resistance in accordance with formula (1) in 3.8.3.