SLOVENSKI STANDARD
SIST-TP CEN/TR 15419:2018

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Varovalna obleka - Smernice za izbiro, uporabo, nego in vzdrževanje varovalne obleke, ki varuje pred kemikalijami

Protective clothing - Guidelines for selection, use, care and maintenance of chemical protective clothing

Schutzkleidung - Empfehlungen für die Auswahl, die Verwendung, die Pflegung und die Bereithaltung von Schutzkleidung gegen Chemikalien

Vêtements de protection - Recommendations pour la sélection, l'utilisation, l'entretien des vêtements de protection chimique

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Protective clothing - Guidelines for selection, use, care and maintenance of chemical protective clothing

Habillement de protection - Recommandations pour la sélection, l'utilisation, l'entretien et la maintenance des vêtements de protection chimique

Schutzkleidung - Empfehlungen für die Auswahl, die Verwendung, die Pflegung und die Bereithaltung von Schutzkleidung gegen Chemikalien

This Technical Report was approved by CEN on 29 October 2017. It has been drawn up by the Technical Committee CEN/TC 162.

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European foreword

This document (CEN/TR 15419:2017) 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.

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This document supersedes CEN/TR 15419:2006.

Introduction

Although the general SUCAM document developed within CEN/TC 162 provides a lot of useful information, it was felt that a specific SUCAM document for chemical protective clothing (CPC) was necessary, in view of the very specific problems linked with the use of CPC (very large variety of risks, disinfection, etc.).

Workplace hazards should be reduced to the lowest level reasonably achievable. This can be done by eliminating the risk, by taking engineering measures such as encapsulation of the risk, by system control and/or by providing safe work place practices, which can include the use of CPC.

This means that the role of CPC in controlling the residual risk should be established in the correct context. The performance requirements for CPC should be characterized in terms of the nature, quantity and physical form of the hazardous chemical and the likelihood of contamination.

PPE should be evaluated as a whole, not only by its performance related to protection. Other factors such as usability and maintenance should also be taken into account to match the equipment and the intended use. Selection and use are more people-related, whereas care and maintenance are more product-related.

The risk related to the use of chemicals varies widely with the nature of the hazard and the conditions and duration of exposure to the chemicals. Therefore, risk and exposure assessment should be done very carefully in order to avoid overprotection and to ensure full acceptance of the protective clothing, which is often used in extremely dangerous work environments.

1 Scope

This Technical Report is primarily intended for users, specifiers and others with responsibility for the procurement and provision of chemical protective clothing. It is also intended to be used by manufacturers in their dialogue with the users of PPE.

This Technical Report is intended to clarify the inter-relationship of the set of standards, developed by CEN/TC 162 WG 3, and to explain the main ideas behind these standards. This set of standards has been developed in support of the European legislation on PPE and is currently used as a major technical tool for the assessment and certification of CPC before it is put on the European market.

These guidelines are intended to assist users and specifiers in selecting the correct type of CPC for the task to be performed, and to help them ensure it is used according to the manufacturer's instructions to provide adequate protection during its entire lifetime. Lifetime and effectiveness of protective clothing depend largely on care and maintenance. When cleaning, disinfection and end-of-life disposal are considered the environmental impact should also be taken into account.

This Technical Report does not address chemical nuisance factors without potential impact on a person's health and safety, e.g. smell.

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.

CEN ISO/TR 11610, Protective clothing - Vocabulary (ISO/TR 11610)

EN 420, *Protective gloves - General requirements and test methods*

EN 863, *Protective clothing - Mechanical properties - Test method: Puncture resistance*

EN 13034, *Protective clothing against liquid chemicals - Performance requirements for chemical protective clothing offering limited protective performance against liquid chemicals (Type 6 and Type PB [6] equipment)*

EN 13274-4, *Respiratory protective devices - Methods of test - Part 4: Flame tests*

EN 14325:2004, *Protective clothing against chemicals - Test methods and performance classification of chemical protective clothing materials, seams, joins and assemblages*

EN 14605:2005+A1:2009, *Protective clothing against liquid chemicals - performance requirements for clothing with liquid-tight (Type 3) or spray-tight (Type 4) connections, including items providing protection to parts of the body only (Types PB [3] and PB [4])*

EN 16523-1, *Determination of material resistance to permeation by chemicals - Part 1: Permeation by liquid chemical under conditions of continuous contact*

EN ISO 6530, *Protective clothing - Protection against liquid chemicals - Test method for resistance of materials to penetration by liquids (ISO 6530:2005)*

EN ISO 7854, *Rubber- or plastics-coated fabrics - Determination of resistance to damage by flexing (ISO 7854)*

EN ISO 9073-4, *Textiles - Test methods for nonwovens - Part 4: Determination of tear resistance (ISO 9073-4)*

EN ISO 13688, *Protective clothing - General requirements (ISO 13688)*

EN ISO 13982-2, *Protective clothing for use against solid particulates - Part 2: Test method of determination of inward leakage of aerosols of fine particles into suits (ISO 13982-2)*

EN ISO 13938-1, *Textiles - Bursting properties of fabrics - Part 1: Hydraulic method for determination of bursting strength and bursting distension (ISO 13938-1)*

EN ISO 13934-1, *Textiles - Tensile properties of fabrics - Part 1: Determination of maximum force and elongation at maximum force using the strip method (ISO 13934-1)*

EN ISO 17491-3, *Protective clothing - Test methods for clothing providing protection against chemicals - Part 3: Determination of resistance to penetration by a jet of liquid (jet test) (ISO 17491-3)*

EN ISO 17491-4, *Protective clothing - Test methods for clothing providing protection against chemicals - Part 4: Determination of resistance to penetration by a spray of liquid (spray test) (ISO 17491-4)*

ISO 6529, *Protective clothing - Protection against chemicals - Determination of resistance of protective clothing materials to permeation by liquids and gases*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN ISO/TR 11610 and the following apply.

3.1.1
ageing
change of one or more initial properties of the materials during the passage of time

3.1.2
air-impermeable materials
materials through which gases cannot pass except by a diffusion process on a molecular level

3.1.3
air-permeable materials
materials with pores or apertures that allow the transmission of gases

3.1.4
breakthrough time
time elapsed between the initial application of a chemical to the outer surface of a material and its subsequent presence on the other (inner) side of the material, measured by the test method described in the relevant standard

3.1.5
care
provisions for cleaning, decontamination and storage of the protective clothing

3.1.6
chemical hazard
potential of a chemical to cause harm or damage to a person's health or to the human body

3.1.7
chemical protective clothing (CPC)
combination of garments worn to provide protection to the skin against exposure to or contact with chemicals

3.1.8
exposure
mass flow of chemical against and through the protective garment. Exposure to chemicals depends on the type and duration of work and the dermal effects of chemicals.

3.1.9
limited use CPC
CPC for limited duration of use, i.e. to be worn until hygienic cleaning becomes necessary or chemical contamination has occurred and disposal is required. This includes protective clothing for single use and for limited re-use according to the information supplied by the manufacturer

3.1.10
maintenance
Provisions for inspection, cleaning, decontamination and repair with the aim of retaining the protective properties and preventing excessive deterioration of the clothing/refurbishment and ultimate removal from service

3.1.11
rapid deterioration
unexpected loss of the essential requirements listed in the PPE directive

3.1.12
re-usable CPC
CPC made from materials that allow repeated cleaning after exposure to chemicals such that it remains suitable for subsequent use

3.1.13
risk
likelihood of a harmful effect occurring as a consequence of a hazard

3.1.14
risk assessment
quantification of the risk relating to one or several hazards (including the process of determining these)

3.1.15
selection
process of determining the type of protective equipment (garments) that is necessary for the required protection

3.1.16
use
application of protective clothing including its limitations

3.2 Abbreviations

For the purposes of this document the following abbreviations apply.

CPC chemical protective clothing

PPE personal protective equipment

SUCAM selection, use, care and maintenance

4 Selection

4.1 General

Selection is a step by step procedure starting with risk assessment for a given work situation.

Risk assessment should take into account the use of preventive measures other than the use of CPC and related PPE. If the chemical risk cannot be adequately reduced by these preventive measures, CPC and related PPE should be specified to protect against the residual risk.

To ensure the correct choice and use of CPC by the user, the protective performance of the CPC, its correct use and the limitations to its use should be made clear.

The following steps should be considered:

— Assessment of the nature of the hazard;

— Assessment of risk;

— Assessment of need of protection;

— Additional considerations;

— Definition of CPC material criteria;

— Selection of CPC;

— Conditions of use;

— Workplace legislation, including REACH.

4.2 Assessment of the nature of the hazard

To assess the nature of the hazard, "safety data sheets"(SDS), including “extended safety data sheets” (eSDS), and other relevant literature should be used. The eSDS, summarising the REACH use exposure scenarios, should provide safe use conditions including potential use of PPE in the description of operational conditions and risk management measures that are mandated to ensure safe use during production or use of chemicals. The following considerations should be taken into account in assessing the hazardous nature of the chemical:

a) The access route of the chemical to the body: an assessment of the adverse health effects from chemical contact is the most important factor in the determination of the right CPC, with an emphasis on the local effects on the skin (e.g., effects of skin contact such as chemical burns, corrosion, staining, irritation, etc.), and the systemic effects of chemicals that might permeate the skin and enter the blood stream

    1) by skin damage: corrosive chemicals destroy the unprotected skin and flesh by direct attack. Other chemicals such as petrol, paint, solvents and cleaning fluids will dissolve the skin's

natural oils, leaving the skin dry and liable to form painful cracks or to develop dermatitis and/or sensitization. Such damage to the skin, together with any existent cuts and grazes, provides entry points for foreign substances and thus increases the risk of harm to the body,

2) by absorption through the skin: chemicals can pass through the skin and be carried in the bloodstream resulting in injury to other parts of the body that are remote from the initial point of contact. Rapid absorption by the skin is a very important issue to consider. Poisoning due to phenol and related compounds can be quoted as an example where skin exposure and subsequent absorption is of particular concern. A large contact surface area on the skin provides a significant route of chemical entry,

3) by other access routes, e.g. the eyes or the respiratory or digestive tract;

b) The body's tolerance and rate of elimination of a foreign substance varies from person to person, and can also vary within the same individual at different times or under different circumstances;

c) The harmful effects will depend roughly on the amount of substance in contact with the skin or absorbed by it. Hence they will be related to the mass of substance to which the body has been exposed, the area of contact, the in-use concentration, and to the frequency and duration of exposure;

d) Exposure to high doses of a chemical, e.g. by a jet of liquid or a copious splash, should be an immediate major concern, besides the risk of exposure through inadvertent ingestion and inhalation;

e) The pattern of skin exposures to substances will vary across the spectra of frequency, duration and concentration. Long term adverse health effects can be linked with low level exposures (small amounts of substances) on a regular basis. Because acute and chronic exposures can result in very different adverse effects on human health, both need to be considered in the overall risk assessment;

f) Mixtures (multi-components of chemicals) can increase the risk from exposure, e.g. the rate of absorption through the skin can be higher if a chemical is used in conjunction with some solvents. The effects of mixtures (whether or not they include solvents) can be greater than those of their constituent parts.

4.3 Assessment of the risk

Risk assessment should be carried out by suitably qualified personnel and should take into account the REACH exposure scenarios that provide safe use conditions. The knowledge and experience of the PPE users should be taken into account.

A risk assessment procedure includes:

— identification of the activities that require the use of CPC;

— a list of the hazards present;

— a quantification of the risks that would result from exposure to the hazards at the foreseeable level and duration;

— whether CPC is needed or whether the problem can be solved by other measures; considerations of the protection provided by other control measures;

— determination of the level and extent of protection required from the CPC (in absolute or relative terms);

— the environment where the protection has to be worn;

— additional risks inherent to the use of PPE (ergonomic considerations, heat stress, etc.).

A number of risk assessment models may be used to determine the level of risk associated with the activities. Annex A gives an example of a risk assessment scheme.

Furthermore the following factors should be considered:

— permeation takes place without visible evidence;

— even the best CPC will not perform properly if torn, cut, damaged, degraded or contaminated;

— a barrier may protect against one chemical properly, but perform poorly against another or a mixture of chemicals;

— higher temperatures usually decrease the breakthrough time, whereas lower temperatures increase the time;

— degradation may be the most important factor in chemical resistance for many chemicals (acids, etc.);

— generally, thicker barrier material increases the time to break through, but reduces glove tactility and dexterity;

— once a chemical has been absorbed by the barrier material, it continues to permeate through the material after chemical exposure has ceased.

4.4 Assessment of the need of protection (developing a product specification for CPC)

The determination of a product specification for CPC should not focus exclusively on chemical risk. Other types of risk (accumulation of electrostatic charges, biological risks, flammability, thermal risks, mechanical risks, etc.) should also be considered.

A step-by-step procedure should be followed (from the German BBA guidelines for pesticides – see Annex A):

— quantify the risk (see risk assessment);

— determine if all steps have been taken to reduce the risk, i.e. if the residual risk is such that the use of CPC is justified;

— determine which parts of the body require protection;

— conditions of use (wear and tear of the CPC during use);

— identify the relevant product standard(s) (and/or test methods) for the type of PPE needed for this work situation;

— determine the level(s) of protection required (for the relevant parts of the body) in relative or absolute terms for each item of protective clothing;

— determine ease of undressing contaminated clothing after wear and potential for cross-contamination if reused.

— determine the residual risk after introduction of the PPE.

4.5 Additional considerations

4.5.1 General

All other elements that influence the overall performance and the total cost of ownership of limited-use and reusable protective clothing, need to be considered.

4.5.2 Quality assurance offered by the supplier

— Service pre- and after-sales;

— quality assurance measures put in place by the supplier (e.g. certified quality management system in accordance with EN ISO 9001);

— if relevant, quality assurance guarantees offered by the rental company.

4.5.3 Logistics

— available sizes, delivery time for standard and special sizes;

— delivery from stock held by the supplier;

— provision of corporate identity clothing (without affecting performance);

— arrangements for collection of soiled items and delivery of clean items;

— stock within the organisation;

— internal distribution to the end-users.

4.6 Garment material selection criteria (definition of CPC material criteria)

4.6.1 General

The performance of CPC in a specific work situation is largely determined by the performance of the materials used for its construction, and the way they are assembled into a protective garment.

A large variety of material product families is used for the production of CPC materials, e.g. woven and knitted textiles, nonwovens, nonwoven laminates, coated fabrics, films, and rubber. Moreover, each of these groups comes in an infinite variety of combinations, modifications or variations. Hence a generic material performance indication is not sufficient to characterize a specific material.

It should not be assumed that the use of a specific polymer material will provide the level of chemical protection required. Neither should weight or thickness of a fabric be assumed to relate automatically to its ability to protect. The specifier should always seek written confirmation from the manufacturer that the material used in the garment has been tested against the specific hazardous chemical encountered in the work situation, and that the level of protection measured is sufficient for the task.

The applied test procedure should be clearly referenced. References to the appropriate test method standards and conventional performance levels can be found in EN 14325. The various tests are only carried out on new garments – so you do not necessarily know how that barrier will perform once the garment has been worn for a few hours (or, in some cases, even less). Protective garments must perform from the moment they are put on to the moment they are taken off.

The European standards for chemical protective clothing use the approach of "performance profiles" for material assessment. For a series of relevant parameters (chemical, mechanical, burning behaviour) test methods are established and performance classes are defined. This creates a common base for discussion between users and manufacturers. The manufacturers have a tool to express the performance profile of their product and the user should try to define his "needs profile" with the same parameters, based on the interpretation of his risk assessment.

4.6.2 Chemical barrier properties

4.6.2.1 Resistance to permeation by chemicals

These tests intend to assess the barrier properties of materials against the ingress of chemicals, several factors need to be taken into account including the state of the substance as well as its concentration, temperature and pressure. Chemical permeation test method standards are ISO 6529 (clothing materials) and EN 16523-1 (gloves).

Principle of test: The test cell is divided in two compartments by the protective material, which acts as a barrier. One of the compartments is filled with a determined quantity of chemical. The concentration of that chemical on the other side of the barrier is monitored and the breakthrough time is established. The time established is the normalised breakthrough time, i.e. the time to reach a permeation rate of 1,0 µg/(cm² · min). But normalized breakthrough time alone cannot be the only parameter for assessing the barrier properties. A second parameter – cumulative permeated mass – is of particular importance for more hazardous chemicals as it is entirely possible that a significant amount of a chemical permeates through chemical protective clothing and accumulates to a possibly harmful amount before that the permeation rate has reached the value of 1,0 µg/(cm² · min), i.e. before that the time has reached the normalized breakthrough time.

Performance classes: from 1 to 6 based on normalized breakthrough times. Class 1 corresponds to a normalized breakthrough time of at least 10 minutes, whereas class 6 represents a normalized breakthrough time of more than 8 hours.

Comments:

— Breakthrough times should be considered as an indication of the resistance of materials to diffusive permeation, not as real use times. Real use times depend on a lot of other factors, e.g. temperature, movements, pressure etc.

— The test methods of ISO 6529 are only applicable to gases and liquids. Some solids, such as phenol, permeate barrier materials as well.

— Although class 6 performance is to be preferred, fabrics that only achieve class 2 or 3 may still give adequate protection. For the selection of the adequate protection class one shall also consider whether surface contamination can be washed off the garment promptly and that no gross chemical degradation will be apparent.

— Permeation data should be made available by the manufacturer for the chemicals encountered in the actual work situation. If the chemical hazard is not known in advance, for example in emergency situations, a test-battery of chemicals may be used. Such a battery includes examples of many different types of chemicals and includes some of those that are most likely to permeate fabrics. An example is given in EN 943-2.

A chemical protective clothing material shall provide at least Class 1 protection against several, but at least against one chemical as desired by the manufacturer. The standards for Type 1, 2, 3 and 4 chemical protective clothing do not specify, which shall be the one chemical, against which the material is offering at least Class 1 protection.

Clothing materials for suits for emergency teams (e.g. Type 1-ET) have to provide a set of minimum performance classes of resistance to permeation against a chemical test battery specified in the Type 1-ET standard.

4.6.2.2 Resistance to penetration by chemicals

At present, there exists no recognized standard test method for resistance of chemical protective clothing materials against particulate chemicals, which would be required for quantifying the protective performance of materials for Type 5 clothing.

The test method standard for the resistance of materials against penetration by liquids, specified for Type 6 clothing, is EN ISO 6530.

Principle of test: A small quantity of liquid is dispensed onto the surface of the protective clothing material, which is laid in an inclined gutter at an angle of 45°. The liquid is allowed to run off and the quantity that penetrates the material is measured. Results are expressed as repellency and penetration indexes (in %).

Performance classes: From 1 to 3 for both repellency and penetration. The highest class marks the best performance, i.e. the highest repellency (> 95 %) and the lowest penetration (< 1 %).

Comments:

— The test is less accurate for volatile liquids, which partly evaporate during the test.

— The test is only applicable to liquid chemicals. Protection against solid chemical particles and dusts is evaluated according to EN ISO 13982-2, which is not a material test but a whole suit test.

— The ability of a garment as a whole to protect against liquids is tested according to EN ISO 17491-4 (Spray-Test) and EN ISO 17491-3 (Jet-Test).

— Liquid repellency is often caused by the presence of a repellent finish on the outer surface of the material. The durability/ageing of this finish is of utmost importance. The manufacturer should provide data on the durability (cleaning) and potentially the re-application of the finish.

A chemical protective clothing material for Type 6 chemical protective clothing shall provide at least a class 2 protection against at least one of the 4 chemicals of the test battery specified in subclause 4.13 of EN 14325:2004.

4.6.2.3 Materials resistant to permeation by at least one liquid chemical and to penetration by at least the same or another liquid chemical

For many chemical protective suits the manufacturers are claiming chemical Type 6 protection as well as Type 4 protection.

For example, a Type 6 suit is classified for penetration against the liquid chemicals 30 % sulphuric acid and 10 % sodium hydroxide. However this does not mean, that in order to be able to be certified also as Type 4 suit, this suit has to achieve permeation Class 1 for at least either sulphuric acid or sodium hydroxide.

The compliance with the "at least permeation Class 1 for one chemical" requirement for a Type 4 suit can well be achieved for a chemical, indicated by the manufacturer, other than 30 % sulphuric acid and 10 % sodium hydroxide.