SLOVENSKI STANDARD
SIST EN ISO 13977-1:2026

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Zrak na delovnem mestu - Ocena dermalne izpostavljenosti - 1. del: Okvirno navodilo za oceno dermalne izpostavljenosti (ISO 13977-1:2026)

Workplace air - Assessment of dermal exposure - Part 1: Framework for dermal exposure assessment (ISO 13977-1:2026)

Luft am Arbeitsplatz - Beurteilung der Hautbelastung - Teil 1: Rahmen zur Beurteilung der Hautbelastung (ISO 13977-1:2026)

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13.040.30	Kakovost zraka na delovnem mestu	Workplace atmospheres
13.100	Varnost pri delu. Industrijska higiena	Occupational safety. Industrial hygiene

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EUROPEAN STANDARD

NORME EUROPÉENNE

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EN ISO 13977-1

April 2026

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English Version

Workplace air - Assessment of dermal exposure - Part 1: Framework for dermal exposure assessment (ISO 13977-1:2026)

Air des lieux de travail - Évaluation de l'exposition cutanée - Partie 1: Cadre pour l'évaluation de l'exposition cutanée (ISO 13977-1:2026)

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European foreword

This document (EN ISO 13977-1:2026) has been prepared by Technical Committee ISO/TC 146 "Air quality" in collaboration with Technical Committee CEN/TC 137 “Assessment of workplace exposure to chemical and biological agents” the secretariat of which is held by DIN.

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International Standard

ISO 13977-1

Workplace air — Assessment of dermal exposure —

Part 1: Framework for dermal exposure assessment

Air des lieux de travail — Évaluation de l'exposition cutanée —

Partie 1: Cadre pour l'évaluation de l'exposition cutanée

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Introduction

Dermal exposure assessment explores the dynamic interaction between environmental contaminants and the skin. For thousands of chemicals in the workplace, the contribution of the dermal route to total-body exposure has yet to be determined. Historically, the assessment of occupational exposure has focused on inhalation of chemical agents. However, evidence from studies investigating the exposure pattern for different occupational conditions indicates that dermal contact can serve as the primary route of exposure for many chemical substances.

The penetration and permeation of substances through the skin can cause local and systemic effects, respectively. Substances in contact with the skin can penetrate the stratum corneum to cause local effects (irritation, corrosion or sensitization). Substances can also permeate through the skin reaching systemic circulation leading to systemic effects, using different exposure pathways, namely:

— through sweat glands and hair follicles,

— the intercellular route (around the cells), or

— the intracellular pathway (through the cells).

Observational studies show that the most highly exposed body parts are the hands. However, deposition of airborne aerosols or direct contact with substances can also contaminate other body parts (e.g. forearms, chest and forehead). Location of the exposure is of particular interest, since both the thickness of the stratum corneum and the density of the hair follicles vary substantially between body locations. These are important parameters with regard to potential penetration and local effects through the skin but also for potential permeation and systemic effects. In addition to skin physiology, skin conditions and duration of contact, the actual contact site can also be relevant for potential inadvertent oral exposure due to hand-to-mouth contact[1].

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The development of a conceptual model was a major milestone in assessing dermal exposure[2]. The multicompartment model systematically specifies the transport of contaminant mass from the source of exposure to the surface of the skin. The model consists of six compartments, eight mass transport processes and two barriers, and provides a structure for both qualitatively and quantitatively evaluating dermal exposure. Many control banding tools, dermal exposure modelling tools and measurement methodologies are specified in scientific and grey literature using this basic concept.

No legally binding dermal limit values (DLVs) for dermal exposure are established at the time of the publication of this document. However, derived no effect levels (DNELs)[3] for the dermal route of exposure, threshold limit value–surface limits (TLV–SLs)[4] and skin notations exist for many substances and should be considered in the risk assessment as prescribed in national regulations. For the assessment of, for example, biocides and plant protection products, (internal) reference values are determined. These values, namely the medium and long-term acceptable exposure level (AEL) derived for biocides and the acceptable operator exposure level (AOEL) derived for plant protection products, indicate the maximum acceptable level of a substance in the body, independent of the pathways that lead to the exposure[5]. As a common practice, the whole-body exposure via all relevant routes is assessed, but for many substances and exposure situations, one pathway (dermal, inhalation or ingestion) is typically dominant.

Dermal exposure assessments can be used for various purposes, such as:

— for the evaluation of exposure processes and pathways, in view of the human interface with workplace processes;

— for the evaluation of control measures or interventions for effectiveness of exposure reduction;

— for risk assessment, identifying hazardous agents that exhibit either local effects or systemic health effects;

— for compliance purposes, where results are compared with DLVs, e.g. DNELs, recommendations from scientific committees, TLV-SLs, action levels and in-house limit values;

— for epidemiological studies, requiring estimates of relevant exposure parameters.

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This document is aimed at industrial and occupational hygienists, human exposure scientists, researchers and health and safety professionals to assist recognition, evaluation and control of dermal exposure and its potential consequences.

This document is the basis for future parts of the ISO 13977 series that will elaborate in more detail on the methodologies and approaches that can be applied.

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Workplace air — Assessment of dermal exposure —

Part 1: Framework for dermal exposure assessment

1 Scope

This document specifies a framework introducing the approaches that can be applied to assess the risks linked to dermal exposure to chemical substances in the workplace. This document provides guidance on the different steps to be taken when performing qualitative and quantitative dermal exposure assessments.

This document is not applicable to inhalation, oral, ocular and mucous membranes exposure, biological agents, wet work and mechanical stressors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 18158, *Workplace air — Terminology*

EN 1540, *Workplace exposure — Terminology*

ISO/IEC GUIDE 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995) — Supplement 1: Propagation of distributions using a Monte Carlo method*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18158, EN 1540 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
contaminant layer
compartments that contain a contaminant or chemical agent

Note 1 to entry: The contaminant layer compartment is characterized by a volume of unknown depth.

Note 2 to entry: Compartments include source, air, surface, skin, inner and outer clothing contaminant layers (see Annex A).

3.2
dermal contact volume
volume containing the mass of the chemical agent present on the *dermal exposure surface area* (3.6)

Note 1 to entry: This theoretical term is equivalent to the volume of the *skin contaminant layer (SCL)* (3.14); however, for practical reasons, it is defined by the mass (in g) of all substances present on the SCL.

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3.3
dermal exposure assessment
estimation (qualitative or quantitative) of the magnitude, frequency, duration and extent of exposure to a chemical agent via the dermal route

3.4
dermal exposure loading
dermal exposure mass (3.5) divided by the *dermal exposure surface area* (3.6)

Note 1 to entry: For practical reasons, dermal exposure loading can be expressed as mass of the chemical agent in an exposed part of the *skin contaminant layer (SCL)* (3.14) divided by the surface area of that part, expressed, for example, in milligrams per centimetre squared.

3.5
dermal exposure mass
mass of chemical agent present in the *dermal contact volume* (3.2)

Note 1 to entry: For practical reasons, dermal exposure mass is defined by the amount of the chemical agent present in the *skin contaminant layer (SCL)* (3.14).

3.6
dermal exposure surface area
skin surface area where a chemical agent is present

Note 1 to entry: For practical reasons, the dermal exposure surface is represented by a two-dimensional representation of the *skin contaminant layer (SCL)* (3.14), expressed in centimetres squared.

3.7
dermal hazard assessment
process to identify and characterize the adverse effects of a chemical agent, via the dermal route, based on substance properties that are reflected in hazard statements (H-statements) and similar information

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Note 1 to entry: Effects should be considered adverse only if they affect the viability and normal function of the organism under test.

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3.8
dermal limit value
DLV
level of exposure to the skin that is not expected to result in adverse biological effects

3.9
dermal risk assessment
overall process to identify potential risks based on a *dermal hazard assessment* (3.7) and a *dermal exposure assessment* (3.3)

Note 1 to entry: A risk assessment usually includes risk mitigation, but this is outside the scope of this document.

3.10
local effect
adverse health effect that occurs at the site of contact with a substance

3.11
penetration
process that occurs when a substance enters the skin

3.12
permeation
process that occurs when a substance passes through the skin

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3.13
potential dermal exposure
dermal exposure that can occur on the unprotected skin or clothes

Note 1 to entry: All substance mass that can reach the body without applying any risk management measures (RMMs).

3.14
skin contaminant layer
SCL
compartment on top of the stratum corneum of the human skin formed by sebum lipids, sweat and additional water from transepidermal water loss, also including products from cornification and unshed corneocytes

Note 1 to entry: More information can be found in Annex A.

Note 2 to entry: The SCL compartment is characterized by a volume of unknown depth.

3.15
systemic effect
adverse health effect that occurs in a part of the body distant from the initial point of contact with a substance

3.16
uptake
concentration-driven transport of a chemical agent from the *skin contaminant layer (SCL)* (3.14) into the skin, i.e. crossing the interface between the skin contaminant layer (exposure surface) and the stratum corneum (absorption barrier)

Note 1 to entry: The time-exposure concentration profile for an identified area of the skin contaminant layer over a defined period of time is relevant for uptake.

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4 Schematic overview of the framework for dermal exposure assessment

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The assessment of dermal occupational exposure to chemical agents starts with general substance information gathering, identification of the population at risk, description of the workplace [e.g. use of RMMs] and the identification of similar exposure groups (SEGs) described in Clause 5. This is followed by a qualitative dermal exposure risk assessment based on the classification of the product, substance or agent, as defined in 6.2, and when required by a quantitative assessment when a method and DLV is available as per 6.3. The dermal exposure assessments shall be documented, and periodic reassessments shall be conducted when significant changes occur at the workplace that can affect the dermal exposure and for evaluations where no safe situation can be obtained. An annual interval for reassessment is recommended, whatever the outcome, as defined in Clause 7. Figure 1 provides a schematic overview of the framework for dermal exposure assessment.

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