International Standard

ISO 13977-1

First edition
2026-04

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

Reference number
ISO 13977-1:2026(en)

© ISO 2026



COPYRIGHT PROTECTED DOCUMENT

© ISO 2026

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Schematic overview of the framework for dermal exposure assessment ... **3**
5 Information gathering ... **5**
5.1 General ... 5
5.2 Substance-related information ... 5
5.3 Population at risk ... 7
5.4 Workplaces, tasks and/or processes at risk and risk management measures in place ... 7
5.5 Identify similar exposure groups ... 8
6 Dermal risk assessment ... **8**
6.1 Dermal hazard assessment ... 8
6.2 Qualitative dermal exposure assessment ... 9
6.2.1 General ... 9
6.2.2 Risk characterization per endpoint and substance ... 9
6.2.3 Availability of a dermal limit value ... 10
6.3 Quantitative dermal exposure assessment ... 10
6.3.1 Modelling dermal exposure ... 10
6.3.2 Measuring dermal exposure ... 11
7 Dermal risk assessment report ... **12**
7.1 General section in the report ... 12
7.2 Qualitative dermal exposure assessment ... 13
7.3 Quantitative dermal exposure assessment ... 13
7.3.1 Modelled dermal exposure assessment ... 13
7.3.2 Measured dermal exposure assessment ... 14
8 Evaluation and periodic reassessment ... **15**
Annex A (informative) **Conceptual model** ... **16**
Annex B (informative) **Local and systemic effects related to dermal exposure** ... **18**
Annex C (informative) **Checklist for visiting workplaces** ... **20**
Annex D (informative) **Kinney and Fine risk assessment method** ... **24**
Annex E (informative) **Models and tools** ... **26**
Annex F (informative) **Measurement of dermal exposure** ... **28**
Bibliography ... **33**

© ISO 2026 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 137, *Assessment of workplace exposure to chemical and biological agents*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 13977 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2026 – All rights reserved

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].

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.

© ISO 2026 – All rights reserved

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.

© ISO 2026 – All rights reserved

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*

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.

© ISO 2026 – All rights reserved