Teknisk rapport
SIS-ISO/TR 14294:2012

Publicerad/Published: 2012-04-25
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 13.040.30

Arbetsplatsexponering – Mätning av hudexponering – Principer och provtagningsmetoder (ISO/TR 14294:2011, IDT)

Workplace atmospheres – Measurement of dermal exposure – Principles and methods (ISO/TR 14294:2011, IDT)

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This Technical Report is not a Swedish Standard. This document contains the English version of ISO/TR 14294:2011.

Upplysningar om sakinnehållet i detta dokument lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om nationell och internationell standard.

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Dokumentet är framtaget av kommittén för Arbetsplatsluft, SIS/TK 423/AG 3.

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 14294 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres.*

Introduction

Dermal exposure assessment explores the dynamic interaction between environmental contaminants and the skin. Occupational skin diseases and disorders constitute a significant percentage of workplace illnesses; the number and frequency of work-related adverse health effects involving the skin is considerably greater than health effects involving the respiratory system[1]. Occupational skin diseases affect virtually all industry and business sectors and are estimated to cost the European Union 600 million Euros each year, resulting in around 3 million lost working days[2].

For thousands of chemicals in the workplace, the contribution to total-body exposure by the dermal route has yet to be determined. Historically, the assessment of occupational exposure has focused on inhalation of chemical agents; however, toxicological evidence indicates that dermal contact can serve as the primary route of exposure for many chemical substances and that the contribution to total dose, integrated from all exposure routes, should be considered. As occupational inhalation exposure limits are lowered, the dermal contribution on total dose becomes more critical to assess.

In the decade before publication of this Technical Report, scientific research on dermal exposure continued to be published. An important contribution to this field was the development of a conceptual model for dermal exposure (see Annex A)[3]. The model systematically describes the transport of contaminant mass from exposure sources to the surface of the skin and provides a structure for both qualitatively and quantitatively evaluating dermal exposure.

The purpose of this Technical Report is to provide a framework of methodologies, including guidance on application and consistency regarding the measurement of dermal exposures to agents in the workplace.

Workplace atmospheres — Measurement of dermal exposure — Principles and methods

1 Scope

This Technical Report provides general considerations for the assessment of dermal exposure in workplaces. It offers guidance on dermal exposure assessment and the commonly used approaches for measuring dermal exposure[4][5]. An understanding of the advantages and limitations of each approach assists in the selection of the appropriate method(s) to meet the assessment objective. This Technical Report, however, is not intended to provide expert guidance, such as in the case of exposure scenarios or chemical agents.

This Technical Report is intended to assist occupational hygiene practitioners and researchers in developing a dermal exposure assessment strategy in agreement with its intended purpose. More importantly, it promotes adaptation of a consistent approach to assessing dermal exposure, and provides a framework for the assessment and validation of method performance.

This Technical Report describes the requirements against which sampling methods for determining dermal exposure need to be assessed; methodologies and specifications are proposed for the following procedures (not all requirements may be applicable to all methods):

a) sampling efficiency;

b) recovery efficiency;

c) sample stability;

d) capacity;

e) bias, precision, uncertainty;

f) core information;

g) contextual information.

NOTE 1 Core information is descriptive of measuring procedures, including the purpose of the assessment, sampling strategy, and sampling and analytical methods (see Clause 7). Method-specific core information is further refined within Annexes B to F (e.g. B.4.5 specifies the collection substrate, such as the fabric type, thickness, sizes, and backing materials).

NOTE 2 Contextual information is descriptive of the locations in which samples are collected, the exposure situation, the worker(s), the environment and the exposure agent (see Clause 7).

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.

ISO 3534-1:2006, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 3534-2:2006, *Statistics — Vocabulary and symbols — Part 2: Applied statistics*

ISO 15767:2009, *Workplace atmospheres — Controlling and characterizing uncertainty in weighing collected aerosols*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

EN 689:1995, *Workplace atmospheres — Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy*

EN 14902:2005, *Ambient air quality — Standard method for the measurement of Pb, Cd, As, and Ni in the PM10 fraction of suspended particulate matter*

3 Terms and definitions

Definitions of the following terms are obtainable from the references shown in parentheses: bias [ISO/IEC Guide 99:2007]; method detection limit [EN 14902:2005, modified]; precision [ISO 3534-1:2006]; true value [ISO 3534-2:2006]; workplace [EN 689:1995].

Figure 1 illustrates period intervals related to dermal exposure.

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

3.1
agent
any chemical or biological entity on its own or admixed as it occurs in the natural state or as produced by any work activity, whether or not produced intentionally and whether or not placed on the market

[EN 689:1995]

3.2
dermal contact volume
volume containing the mass of the **agent** (3.1) present on the **dermal exposure surface** (3.7)

NOTE This theoretical term is equivalent to the volume of the **skin contaminant layer compartment** (3.14); however, for practical reasons, it is defined by the mass of all substances present in the skin contaminant layer.

3.3
dermal exposure
process of contact between an **agent** (3.1) and human skin at a **dermal exposure surface** (3.7) over an **exposure period** (3.8)

3.4
dermal exposure concentration
concentration of the **agent** (3.1) contained within the **skin contaminant layer compartment** (3.14)

NOTE 1 The dermal exposure concentration is the **dermal exposure mass** (3.6) divided by the **dermal contact volume** (3.2) or the dermal exposure mass divided by the mass contained in the **skin contaminant layer compartment** (3.14).

NOTE 2 The dermal exposure concentration is a theoretical concept. In reality, only the **dermal exposure mass** (3.6) can be estimated via sampling owing to the fact that the **dermal contact volume** (3.2) is unknown. Dermal exposure concentration can be expressed in milligrams per litre or milligrams per kilogram.

3.5
dermal exposure loading
dermal exposure mass (3.6) divided by the **dermal exposure surface** (3.7) area

NOTE For practical reasons, dermal exposure loading can be expressed as mass of **agent** (3.1) in an exposed part of the **skin contaminant layer compartment** (3.14) divided by the surface area of that part, expressed in grams per centimetre squared.

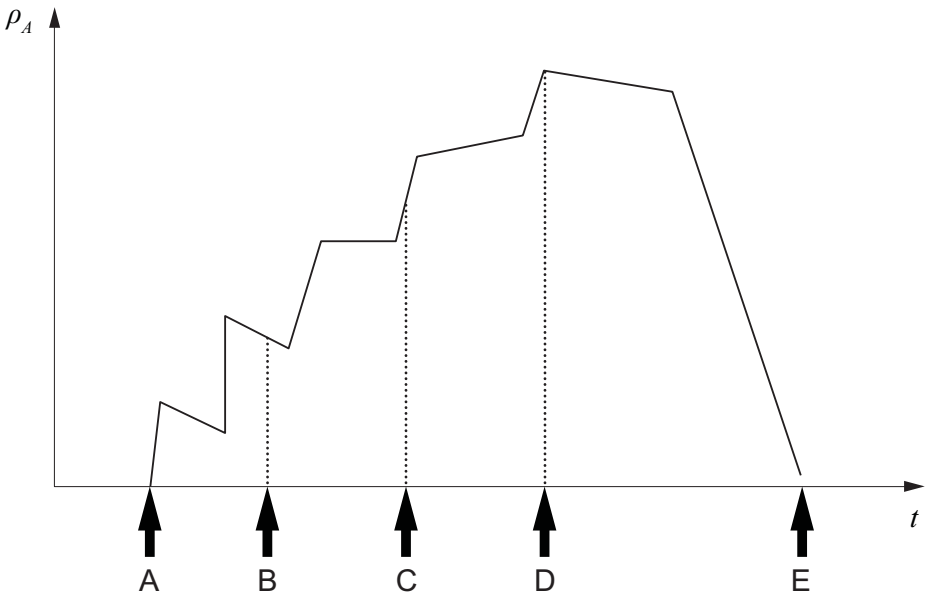
3.6
dermal exposure mass
mass of **agent** (3.1) present in the **dermal contact volume** (3.2)

NOTE For practical reasons, dermal exposure mass is defined by the amount of **agent** (3.1) present in the **skin contaminant layer compartment** (3.14).

3.7
dermal exposure surface
skin surface area where an **agent** (3.1) is present

NOTE For practical reasons, the dermal exposure surface is represented by a two-dimensional representation of the **skin contaminant layer compartment** (3.14), expressed in centimetres squared.

3.8
exposure period
time the **agent** (3.1) is present in the **skin contaminant layer compartment** (3.14)



Key
ρ_A exposure loading
t time

NOTE Figure 1 illustrates relevant period intervals such as sampling period (B-C), **dermal exposure loading** (3.5) or **immission** (3.9) period (A-D), and post-immission period (D-E). Of all these periods, the “sampling period” is arbitrary. Note that these intervals are for illustrative purposes and also that sampling can occur during any interval.

Figure 1 — Illustration of different periods of time, relevant in view of dermal exposure