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Protective gloves for pesticide operators and re-entry workers — Performance requirements

Gant de protection pour les opérateurs manipulant des pesticides et les travailleurs de rentrée — Exigences de performances

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Contents

Page

Foreword

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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 documents 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).

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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 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

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.

Introduction

This document addresses the performance requirements for gloves worn by operators handling liquid pesticide products as well as gloves worn by re-entry workers. It includes requirements for chemical resistant gloves that provide protection to the whole hand as well as gloves used for certain re-entry activities for which partial protection in the palm-side of the hand is sufficient.

This document classifies gloves into two categories: gloves that provide chemical protection to the whole hand and gloves that provide protection only to the fingertips and palm-side of the hand (suitable for certain re-entry tasks). Gloves that provide protection to the whole hand include two performance levels (G1 and G2) and a single performance level (GR) for gloves suitable for certain re-entry tasks. A brief description of the two categories is given below:

Chemical resistant gloves:

Material as well as whole glove testing is required for gloves classified as G1 and G2. In addition to tests conducted for chemical resistant glove, these gloves are also tested with a pesticide surrogate. Since the active ingredient of pesticides is typically a chemical with low vapour pressure and/or low solubility in collection media, EN 16523-1:2015 cannot be used to measure permeation of active ingredient in most pesticide products. Therefore, ISO 19918 is used to measure cumulative permeation with the pesticide surrogate. G1 gloves provide lower level of protection than G2 gloves.

— G1 gloves are suitable when the potential risk is relatively low. These gloves are not suitable for use with concentrated pesticide formulations and/or for scenarios where mechanical risks exist. G1 gloves are typically single use gloves.

— G2 gloves are suitable when the potential risk is higher. These gloves are suitable for use with diluted as well as concentrated pesticides. G2 gloves also meet the minimum mechanical resistance requirements and are therefore suitable for activities that require gloves with minimum mechanical strength.

Chemical resistant gloves with partial protection:

GR gloves provide protection only to the palm-side of the hand for a re-entry worker who is in contact with dry and partially dry pesticide residues that remain on the plant surface after pesticide application. This glove category is suitable only for re-entry activities where it has been determined that protection provided to the fingertips and palm-side of the hand is sufficient. They cannot be used in place of G1 and G2 gloves that protect the whole hand. GR gloves also have mechanical properties that are required for several re-entry tasks. Breathable material in the back of the hand provides comfort.

Registration of pesticide products, such as insecticides, herbicides, and fungicides, involves the assessment of operator and re-entry worker exposures and risks, which determines the need for PPE (including gloves) required for risk mitigation. See Annex A for information on risk assessment and use of PPE (including gloves) for risk mitigation. Protection should correspond to the identified risks in order to avoid a loss of comfort due to overprotection. Actual field trials are used to determine the operator risk while handling concentrates during mixing/loading, and applying diluted pesticides under different scenarios, as well as risks to re-entry workers exposed to dry, partially dry and wet residues. Since protective clothing can be contaminated in various ways, laboratory test methods used in the document rate materials and gloves rather than simulate the various field conditions. Laboratory tests are often accelerated tests and therefore laboratory data cannot be used for direct comparison with field data.

This document is intended for glove manufacturers, pesticide product manufacturers, trainers, regulators, and other individuals or organizations that make decisions regarding PPE for protection against pesticide products.

Protective gloves for pesticide operators and re-entry workers — Performance requirements

1 Scope

This document establishes minimum performance, classification, and labelling requirements for gloves worn by operators and re-entry workers handling pesticide products to protect the hands or hands and forearms against contact with those products. Gloves covered by this document include gloves made with elastomeric and polymeric materials in the areas that provide protection.

This document does not address protection against fumigants.

This document needs to be used in conjunction with ISO 21420.

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 374-1, *Protective gloves against dangerous chemicals and micro-organisms — Part 1: Terminology and performance requirements for chemical risks*

ISO 19918, *Protective clothing — Protection against chemicals — Measurement of cumulative permeation of chemicals with low vapour pressure through materials*

ISO 21420:—[1], *Protective gloves — General requirements and test methods*

ISO 23388:2018, *Protective gloves against mechanical risks*

EN 374-2:2014[2], *Protective gloves against dangerous chemicals and micro-organisms — Part 2: Determination of resistance to penetration*

3 Terms and definitions

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

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

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

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

3.1
active ingredient
component of a pesticide formulation, which is an active substance present in sufficient quantity that relates to an intended phytosanitarian purpose

1) To be published. Stage at the time of publication ISO/FDIS 21420:2019.

2) Once published, EN 374-2:2014 will be replaced with ISO 374-2 which is under preparation. Stage at the time of publication ISO/DIS 374-2:2018.

3.2
decontamination
removal of a contaminant or contaminants from the surface or matrix, or both, of chemical protective materials to the extent necessary for its next intended use

Note 1 to entry: For this document, materials are limited to those used for chemical resistant gloves.

3.3
degradation
deleterious change in one or more mechanical properties of a material due to contact with a chemical or heat

Note 1 to entry: Indications of degradation may include flaking, swelling, disintegration, embrittlement, discoloration, dimensional change, appearance, hardening, softening, etc.

3.4
fumigant
pesticide in the form of gas

3.5
penetration
process by which a chemical moves through porous materials, seams, pinholes, or other imperfections in a material on a non-molecular level

3.6
permeation
process by which a chemical moves through a material on a molecular level, involving

— sorption of the molecules of the chemical into the contacted (outside) surface of a material,

— diffusion of the absorbed molecules in the material, and

— desorption of the molecules from the opposite (inner) surface of the material

3.7
pesticide
substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest or weeds

Note 1 to entry: Pesticides (plant protection products) approved for use in one country may not be approved in another country.

3.8
pesticide operator
person handling pesticides in agricultural settings, green spaces, roadsides, etc.

Note 1 to entry: Handling includes tasks such as mixing, loading, transferring, or applying pesticides; cleaning, adjusting, or repairing the parts of mixing, loading, or application equipment that may contain pesticide residues; assisting with the application of pesticides; and disposing of pesticides or pesticide containers.

Note 2 to entry: Farm, forest, nursery, and greenhouse are examples of agricultural settings.

3.10
re-entry worker
person who can be in contact with a partially or fully dried pesticide product, as part of their work/employment, in an area that has previously been treated

3.11
test chemical
liquid that is used to challenge the specimen of glove material

4 Classification and testing requirements

4.1 General

All gloves complying with this document shall fulfil the requirements of ISO 21420:—, Clauses 4, 5 and 7 with the exception of the minimum glove length. In addition, each type of glove shall be tested and classified by level of performance in accordance with the requirements as stated in Clause 4.

G1 gloves shall pass the penetration test and demonstrate a minimum level of liquid permeation resistance. G1 gloves are not suitable for use with concentrated pesticide formulations and/or for scenarios where mechanical risks exist.

G2 gloves shall pass the penetration test, and the glove material shall meet the liquid permeation requirements. G2 glove is suitable for use with concentrated as well as diluted pesticide formulations and for activities where mechanical risk exists.

GR gloves shall meet the permeation requirements in the palm area as well as mechanical requirements. GR gloves are not suitable for use by pesticide operators or for re-entry tasks for which partial protection to the fingertips and palm-side of the hand is not sufficient.

Table 1 provides a summary of the tests to be conducted for gloves for pesticide operators and re-entry workers. The stringency in the testing requirements to determine protection is higher for G2 gloves. Therefore, any G2 glove necessarily meets G1 requirements.

To be classified in either G1 or G2 or GR, all the applicable requirements shall be satisfied.

Table 1 — Testing requirements for G1, G2, and GR gloves

Subclause	Performance/Design Requirement	Standard; Clause	Requirements		
			G1	G2	GR
4.1	General requirements	ISO 21420	fulfilled	fulfilled	fulfilled
4.2.1	Penetration test	EN 374-2:2014, 7.2 and 7.3	pass	pass	
4.2.2.1	Resistance to permeation	ISO 374-1	≥Type C	≥Type B	≥Level 2 with chemical K
4.2.2.2	Resistance to permeation	ISO 19918	≤10 µg/cm²	≤1 µg/cm²	≤1 µg/cm²
4.2.3.1	Glove length		fulfilled	fulfilled	
4.2.3.2	Coated area				fulfilled
4.2.4	Mechanical requirements	ISO 23388:2018, 6.1		≥Level 2	≥Level 2
		ISO 23388:2018, 6.2		≥Level 1	≥Level 1
		ISO 23388:2018, 6.3		or ≥Level A	or ≥Level A
		ISO 23388:2018, 6.4			≥Level 1
		ISO 23388:2018, 6.5		≥Level 1	≥Level 1

NOTE Once the ISO/EN standards are published, the clauses equivalent to the EN standards stated in the table shall be required.

4.2 Performance requirements

4.2.1 Penetration

Tests shall be performed on three gloves to measure glove integrity in accordance with EN 374-2. All three gloves shall pass both tests. Gloves tested with air can then be used to conduct tests with water.

4.2.2 Permeation

4.2.2.1 Glove materials for G1, G2, and GR shall be conditioned and breakthrough time measured in accordance with ISO 374-1.

Glove materials for G1 shall comply with at least the requirement for Type C.

Glove materials for G2 shall comply with at least the requirement for Type B.

NOTE 1 The test is needed to ensure that G1 and G2 gloves have a minimum resistance to chemicals before assessing it for protection against pesticides.

GR glove materials shall be tested with test chemical K. GR gloves shall comply with at least the minimum requirement of Performance Level 2 (breakthrough time of 30 min) when tested with chemical K.

NOTE 2 Test chemical K (40 % sodium hydroxide) was selected for testing as it is a commonly used water-based test chemical that can differentiate between the different types of glove coating.

4.2.2.2 Glove materials for G1, G2 and GR shall be conditioned and cumulative permeation measured in accordance with ISO 19918. Pesticide surrogate EC-DY (concentrate with 10 % disperse yellow dye) shall be used as the test chemical. Composition and other information for the test chemical is included in Annex B.

When requested, other pesticides representing the workplace can be added. For additional testing the procedure, test methods, and pass criteria shall be the same as that for pesticide surrogate EC-DY. The test chemical shall be the specific pesticide formulation, either concentrated or diluted with water in accordance with the manufacturer's instructions.

NOTE 1 Pesticide formulations are mixtures that, when diluted in water, are often emulsions or suspensions. During the test, agitation in the challenge test cell can be necessary. Selective detection systems can be required to detect the active ingredient.

For G1, G2 and GR glove materials, tests shall be conducted with a diluted formulation for one hour. Water grade 3 (according to ISO 3696) or deionized water shall be used to prepare the diluted solution with 2,5 % EC-DY. In addition, for G2 glove materials, the test shall be conducted with the concentrate for 15 minutes.

NOTE 2 To prepare 100 ml of diluted test chemical, 2,5 ml of EC-DY is made up to 100 ml (0,25 % disperse yellow 26 dye).

NOTE 3 The duration of the test is not based on actual use time since the permeation test is an accelerated test in which the surface of the specimen is in constant contact with the test chemical. Although the duration of the exposure can be for a longer period during field application with the dilute formulation, the entire surface is not in constant contact with the test chemical. In case of accidental spills, the operator needs to remove the glove immediately, and therefore the contact time with the concentrate is much shorter.

Three specimens taken from three gloves shall be tested for each testing condition. For a glove longer or equal to 400 mm, three additional specimens shall be tested from the front or back of the cuff area when testing with the concentrate.

For gloves classified as G1 the maximum cumulative permeation shall be 10 µg/cm^2 disperse yellow 26 dye for all specimens when tested against the diluted surrogate EC-DY.

For gloves classified as G2 the maximum cumulative permeation shall be 1 µg/cm^2 disperse yellow 26 for all specimens when tested against the diluted and concentrate surrogate EC-DY.

For gloves classified as GR the maximum cumulative permeation shall be 1 µg/cm^2 disperse yellow 26 for all specimens when tested against the diluted surrogate EC-DY.

NOTE 4 An accelerated laboratory test is used to classify materials. The maximum limits are not appropriate for use in calculating default protection factors used for exposure mitigation in operator exposure and risk assessment.

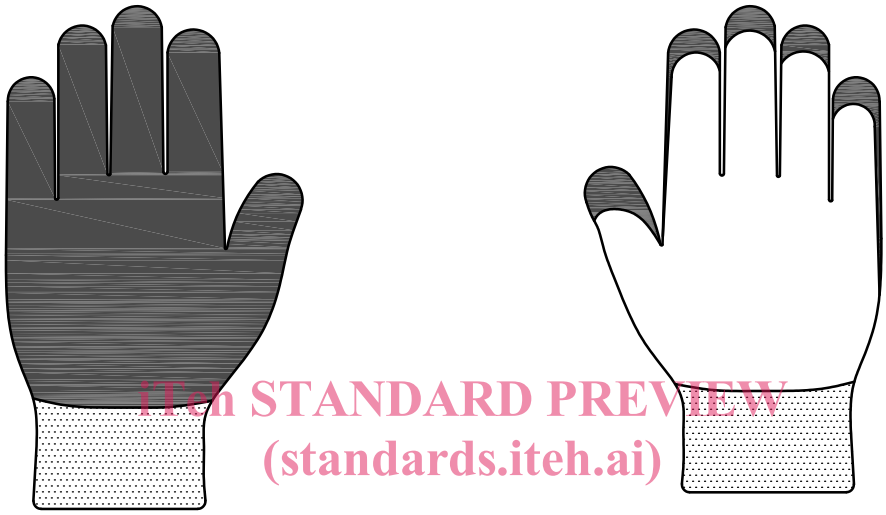
4.2.3 Glove design requirement

For safety reasons, the gloves shall have minimum design requirements.

4.2.3.1 Minimum length shall be 240 mm for G1 and 290 mm for G2 gloves. For G1 gloves with length between 240 mm and 290 mm, a statement in accordance with Clause 7 i) shall be required.

NOTE An overlap of approximately 50 mm between the glove and the garment is included to prevent the possibility of pesticides penetrating between the garment sleeve and the glove [see Clause 7 i)].

4.2.3.2 GR gloves shall have at least the fingertips and palm-side of the hand coated (see Figure 1).



a) Palm-side of the hand **b) Back of the hand**

Figure 1 — Minimum area (coloured grey) to be coated for GR gloves

4.2.4 Mechanical requirements

G2 and GR protective gloves shall fulfil the following minimum mechanical requirements in accordance with ISO 23388:

— Abrasion resistance – Minimum performance level 2 in accordance with 6.1 of ISO 23388:2018.

— Cut resistance – Minimum performance level 1 in accordance with 6.2 or minimum of performance level A in accordance with 6.3 of ISO 23388:2018.

— Tear resistance – Minimum performance level 1 for GR gloves in accordance with 6.4 of ISO 23388:2018.

— Puncture resistance – Minimum performance level 1 in accordance with 6.5 of ISO 23388:2018.

5 Sampling

5.1 Sampling for permeation

Three test specimens shall be taken from the palm area. If the glove is longer or equal to 400 mm and if the cuff is claimed to protect against pesticide risks, three additional test specimens shall be taken with the centre being at 80 mm from the end of the cuff (see Figure 2).