DRAFT INTERNATIONAL STANDARD ISO/DIS 22613

ISO/TC **94**/SC **13** Secretariat: **SNV**

Voting begins on: **2004-06-18** Voting terminates on: **2004-11-18**

Protective clothing — General test methods and performance requirements for hand-protection

Vêtements de protection — Méthodes d'essai et exigences de performance générales pour gants de protection

ICS 13.340.10

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

Contents

Page

Foreword v
Introduction vi
1 Scope 1
2 Normative references 1
3 Terms and definitions 2
4 Hand protection selection 3
5 General requirements 3
5.1 Glove design and construction — general 3
5.2 Innocuousness of protective gloves 3
5.3 Cleaning 4
5.4 Dexterity 4
5.5 Water vapour transmission and absorption 5
6 Hand protection classification 5
6.1 General 5
6.2 Mechanical protection 5
6.3 Chemical protection 7
6.4 Heat and flame protection 8
6.5 Protection from cold 11
7 Report of testing 12
8 Marking and labelling 12
8.1 General 12
8.2 Package or product labels 13
8.3 Size information 14
8.4 Care information 14
Annex A (informative) Descriptions of test methods used in standard 15
Annex B (informative) Recommended hand protection selection guidelines 19
Annex C (informative) Other factors for consideration 21
C.1 General 21
C.2 Medical (Biological) Hazards 21
C.3 Extreme Temperature Applications 22
C.4 Cleanroom Applications 22
C.5 Hazardous Materials Response Applications 22
C.6 Electrical Hazards 22
C.7 Human Factors 22
C.8 Other Factors 24
Annex D (normative) Test method for detection of soluble chromate and determination of chromium (VI) 25
D.1 Scope 25
D.2 Principle 25
Annex E (normative) Test method for determining gloved finger dexterity 26
E.1 Number and condition of specimens 26
E.2 Apparatus required 26
E.3 Test procedure 26
E.4 Test result 26
Annex F (normative) Test method for determination of water vapour transmission 27

F.1 Introduction 27
F.2 Principle 27
F.3 Apparatus 27
F.4 Specimens 28
F.5 Preparation of specimens 28
F.6 Procedure 29
F.7 Calculation of result 29

Annex G (normative) Test method for determination of water vapour absorption 31
G.1 Specimen 31
G.2 Test apparatus 31
G.3 Test procedure 31
G.4 Result 31

Annex H (normative) Abrasive paper specification 33
H.1 Quality of materials 33
H.2 Abrasive grain 33
H.3 Breaking strength 33
H.4 Overall weight 34

Annex I (normative) Modifications to tear resistance test method 35
I.1 Principle 35
I.2 Equipment 35
I.3 Test specimen 35
I.4 Setting up the test specimen 35
I.5 Test method 36

Annex J (normative) Test method for chemical degradation resistance 37
J.1 Principle 37
J.2 Equipment 37
J.3 Specimens 38
J.4 Conditioning 39
J.5 Specimen Exposure Procedure 39
J.6 Puncture Testing 40
J.7 Expression of Results 40

Annex K (normative) Test method for liquid integrity (leakage) of whole gloves 41
K.1 Principle 41
K.2 Specimens 41
K.3 Test apparatus 41
K.4 Procedure 43
K.5 Pass/fail determination 44

Annex L (normative) Burning behaviour test method modifications 45
L.1 Test modifications 45

Annex M (normative) Test method for determination of heat transfer for convective cold exposures 46
M.1 Principle 46
M.2 Definitions 46
M.3 Apparatus 46

Bibliography 49

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.

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 22613 was prepared by Technical Committee ISO/TC 94, *Personal safety - Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

Introduction

Employers should select and require employees to use appropriate hand protection where there is workplace exposure to hazards such as chemical burns or severe cuts and lacerations. The selection of gloves should be based on the performance and functionality-related characteristics of hand protection relative to the tasks being performed.

This International Standard has been developed to assist employers and users in the appropriate selection of gloves for specific workplace exposures. This International Standard provides or refers to appropriate test methods for specified criteria and provides performance levels for characteristics in relation with hazards or conditions in the workplace.

Test methods and performance levels are established for the following characteristics: Cut resistance, puncture resistance, abrasion resistance, protection from cold, chemical permeation and degradation, detection of holes and heat and flame resistance. An Appendix containing reference information on special considerations such as biological protection, electrical protection and radiation hazards has been included, as well as descriptions of the various test methods used and a section on recommended hand protection selection procedure. It is important to note that every end-use is different, and no test method can fully replicate any of them. In particular, combinations of hazards are not considered in this standard and will affect glove selection. Therefore, there can be no guarantee that a glove which rates highly in any test method will be able to provide adequate protection on the job. Users should contact glove manufacturers for additional information.

Compliance with the requirements states in this International Standard does not give presumption of conformity to any existing national or International regulations regarding protective gloves.

Protective clothing — General test methods and performance requirements for hand-protection

1 Scope

This International Standard addresses the classification and testing of hand protection for specific performance properties related to chemical and industrial applications. Hand protection includes gloves, mittens, partial gloves, or other items covering the hand or a portion of the hand that are intended to provide protection against or resistance to a specific hazard.

The International Standard does not address protection from hazards such as electric shock, ionizing or non-ionizing radiation, radioactive contamination, electrostatic properties in explosive areas, medical applications, or fire fighter applications.

This International Standard provides performance ranges for many different properties based on standardized test methods. Descriptions of the test methods used in this standard are provided in Annex A. Different levels of performance are specified for each property.

The purpose of the International Standard is to provide elements in relation with hazards to help the user select the appropriate hand protection. It also aims to provide manufacturers with a mechanism to classify their products for specific areas of glove performance.

NOTE This International Standard is not intended to establish a singular threshold for the performance of hand protection under all conditions. Manufacturers of hand protection products must determine which properties to test their product against, which are relevant to the intended use of the product. Representations by manufacturers regarding a product's compliance with a particular test criterion does not mean, nor should it be implied, that the product meets any other test selection criteria unless specifically stated.

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 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 4045:1977, Leather – Determination of pH

ISO 4674-1:2003, *Rubber or plastics-coated fabrics – Determination of tear resistance – Part1 : Constant rate of tear methods*

ISO 4675:1990, *Fabrics coated with rubber or plastic – Low temperature bend test*

ISO 5085-1:1989, *Textiles – Determination of thermal resistance – Part 1: Low thermal resistance*

ISO 6529:2001, *Protective clothing – Protection against chemicals – Determination of resistance of materials to permeation by liquids and gases*

ISO 6942:2002, *Protective clothing – Protection against heat and fire – Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat*

ISO 7854:1995, *Rubber- or plastic-coated fabrics – Determination of resistance to damage by flexing*

ISO 9150:1988, *Protective clothing – Determination of behaviour of material on impact of small splashes of molten metal*

ISO 9151:1995, *Protective clothing against heat and flame – Determination of heat transmission on exposure to flame*

ISO 9185:1990, *Protective clothing – Assessment of resistance of materials to molten metal splash*

ISO 12127:1996, *Clothing for protection against heat and flame – Determination of contact heat transmission through protective clothing or constituent materials*

ISO 12947-2:1998, *Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 2 : Determination of specimen Breakdown*

ISO 13688:1998, *Protective clothing – General requirements*

ISO 13996:1999, *Protective clothing – Mechanical properties – Determination of resistance to puncture*

ISO 13997:1999, *Protective clothing – Mechanical properties – Determination of resistance to cutting by sharp objects*

ISO 15025:2000, *Protective clothing – Protection against heat and flame – Method of test for limited flame spread*

ISO 17493:2001, *Clothing and equipment for protection against heat – Test method for convective heat resistance using a hot air circulating oven*

3 Terms and definitions

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

3.1
degradation
deleterious change in one or more properties of a glove due to contact with a chemical or heat

EXAMPLE Rubber gloves may swell, soften and weaken; plastic gloves may shrink, stiffen, harden, and crack when flexed.

3.2
penetration
flow of a chemical through a glove on a non-molecular level through porous materials, seams, and pinholes or other imperfections in the barrier film

3.3
permeation
process by which a chemical moves through a protective clothing material on a molecular level

NOTE Permeation involves (1) sorption of molecules of the chemical into the contacted (outside) surface of a material, (2) diffusion of the sorbed molecules in the material, and (3) desorption of the molecules from the opposite (inside) surface of the material into the collection medium.

3.4
protection (from a stressor)
property that prevents or reduces deleterious effects on the wearer of a glove when stressed

NOTE The distinction between resistance and protection cannot always be clearly drawn. For example, if the stressor is a sharp edge, cut resistance is a property that reduces damage both to the glove and to the wearer.

3.5
resistance
property of a glove that permits it to withstand change when stressed

3.6
sample
material removed from a batch or production lot for testing

3.7
specimen
individual piece or portion to be subjected to testing

4 Hand protection selection

End users should select gloves based on a risk assessment involving the identification of hazards and determination of risk for exposure to those hazards. End users can then determine the relevant performance properties and acceptable levels of performance for those properties.

NOTE No glove can have optimum properties in all respects; the performance requirements can be contradictory. End users are expected to ignore recommendations for performance properties that are not important to them and make compromises as needed among other performance properties.

Recommended guidelines for hand protection selection are provided in Annex B. Annex C provides information on other properties not covered in this standard.

5 General requirements

5.1 Glove design and construction — general

The protective glove shall be designed and manufactured so that in the foreseeable conditions of use for which it is intended, the user can perform the hazard related activity normally whilst enjoying appropriate protection at the highest possible level.

If required, the glove shall be designed as to minimize the time to be put on and / or taken off.

When the glove construction includes seams, the material and strength of the seams shall be such that the overall performance of the glove is not significantly decreased.

5.2 Innocuousness of protective gloves

5.2.1 General

Protective gloves shall be designed and manufactured to provide protection when used to the manufacturer's instructions, without harm to the user when so used.

Glove materials, degradation products, incorporated substances, seams and edges and particularly those parts of the gloves in close contact with the user's hands shall not harm the user's health and hygiene. The manufacturer or its authorized representative shall provide a list of all substances contained in the glove that are known to cause allergies as part of the user information.

5.2.2 Determination of pH value

The pH value for all gloves shall be as close as possible to neutrality. The pH value for leather gloves shall be greater than 3,5 when tested according to ISO 4045:1977. The following amendments shall apply:

— Testing shall be carried out at a temperature of (23 ± 2)°C.

— The test piece shall be cut out from the palm area of the glove. If other parts of the glove are made of different materials, then each material shall be tested separately;

— If gloves are made of more than one layer, all layers shall be tested together;

— A minimum of three specimens shall be tested;

— Clause 8.4 of ISO 4045:1977 does not apply.

5.2.3 Determination of chromium (VI) content

The Chromium (VI) content in leather gloves shall be less than 10 mg/kg when determined as specified in Annex D.

At least two samples shall be taken from different gloves for each leather type.

If the glove is made of different types of leather in direct contact with the skin or not, then the test shall be performed on each type. The highest value shall be considered as the final result.

5.3 Cleaning

All tests required in this standard as well as in the standards for protective gloves shall be performed on unused gloves unless otherwise specified. If care instructions are provided (see 8.4), the relevant tests of the specific standards shall be performed on the gloves, before and after they have been subjected to the maximum recommended number of cleaning cycles.

The levels of performance shall not be negatively affected throughout the recommended number of cycles.

5.4 Dexterity

A glove should allow as much dexterity as possible given its purpose. Dexterity is related to numerous factors e. g. thickness of glove material, its elasticity, its deformability.

If required, finger dexterity shall be tested according to the test method in Annex E.

The performances shall be graded according to Table 1 hereafter.

Table 1 — Levels of performance - finger dexterity test

Level of performance	Smallest diameter of pin fulfilling test conditions
1	11 mm
2	9,5 mm
3	8 mm
4	6,5 mm
5	5 mm

5.5 Water vapour transmission and absorption

5.5.1 Water vapour transmission

Where practicable, protective gloves shall allow water vapour transmission.

If required, gloves shall have a water vapour transmission of at least 5 mg/(cm² × h) when tested according to Annex F.

5.5.2 Water vapour absorption

Where the protection characteristics of the glove inhibits or excludes water vapour transmission, then the glove shall be designed to reduce the effect of perspiration as much as possible.

If required, gloves shall have a water vapour absorption of at least 8 mg/cm² for 8 h when tested according to Annex G.

6 Hand protection classification

6.1 General

Manufacturers may choose the tests applicable to evaluate and classify the performance of their gloves. If the manufacturer elects not to evaluate the glove against a specific property, the manufacturer shall use an “X” is classifying that property. If the manufacturer evaluates the glove against a specific property and it does not meet the lowest performance level, the manufacture shall use a “0” in classifying that property.

When the glove is made of different materials, the glove shall be tested on the different parts from which specimens can be obtained. The lowest level of performance shall be reported when multiple parts of the gloves yield different test results. Alternatively, the various levels of performance shall be given in the information supplied by the manufacturer along with a clear indication of the corresponding part(s) of the glove.

NOTE Performance requirements are only maintained if gloves are new, or kept in good condition.

6.2 Mechanical protection

6.2.1 Cut resistance

When tested in accordance with ISO 13997, the glove’s cut resistance shall be classified against the levels listed in Table 2 using the weight needed to cut through the material with 20 mm of blade travel. Testing shall be performance with all layers in place for each area of the glove that is evaluated.

Table 2 — Classification for cut resistance

Level	Weight needed to cut through material with 20 mm of blade travel (gr)
1	≥ 500
2	≥ 1000
3	≥ 1500
4	≥ 3000

6.2.2 Puncture resistance

When tested in accordance with ISO 13996, the glove's resistance against puncture shall be classified against the levels listed in Table 3 using the puncture force. Testing shall be performance with all layers in place for each area of the glove that is evaluated. No level of performance shall be reported for uncoated textile knits since this gloves do not protect against puncture.

Table 3 — Classification for puncture resistance

Level	**Puncture force** (N)
1	≥ 20
2	≥ 60
3	≥ 100
4	≥ 150

6.2.3 Abrasion resistance

When tested in accordance with ISO 12947-2, the glove's abrasion resistance shall be classified against the levels listed in Table 4 using the number of abrasion cycles to failure. For the purpose of this standard, the pressure on the specimen shall be (9 ± 0,2) kPa and a glass paper abradant meeting the requirements in Annex H shall be used. The end point at which the glove material is determined to fail shall be at the number of abrasion cycles just before the film or coating has a hole abraded through it. Testing shall be performance with all layers in place for each area of the glove that is evaluated. For woven and knit fabrics, the end point shall be when a hole is worn through the glove material(s).

Table 4 — Classification for abrasion resistance

Level	**Abrasion cycles to fail**
1	≥ 100
2	≥ 500
3	≥ 2000
4	≥ 8000

6.2.4 Tear resistance

When tested in accordance with ISO 4674-1, as modified in Annex I, the glove's tear resistance shall be classified against the levels listed in Table 5 using the tear force. Each separable layer of the glove shall be tested.

Table 5 — Classification for tear resistance

Level	**Tear Force** (N)
1	≥ 10
2	≥ 25
3	≥ 50
4	≥ 75

6.3 Chemical protection

6.3.1 Chemical permeation resistance

When tested in accordance with ISO 6529 using a normalization permeation rate of 0,1 mg/cm^2 min, the glove material's chemical permeation resistance shall be classified according to the levels of performance provided in Table 6 for each chemical tested based on the average normalized breakthrough time.

Table 6 — Classification for chemical permeation

Level	**Minimum normalized breakthrough time** (minutes)
1	≥ 10
2	≥ 30
3	≥ 60
4	≥ 480

6.3.2 Chemical degradation resistance

When tested in accordance with Annex J, the glove's chemical degradation resistance shall be classified against the levels listed in Table 7 using the absolute value of the percentage change in puncture resistance (following chemical exposure) for each chemical tested. A level of performance to this property shall only be reported if a minimum puncture force of 5 N is achieved.

NOTE This test is intended to qualify the performance of liquid-proof gloves that are at least 0,3 mm thick.

Table 7 — Classification for degradation

Level	**Percentage change** (%)
1	≤ 80
2	≤ 60
3	≤ 40
4	≤ 20

6.3.3 Liquid integrity

When tested in accordance with Annex K, integrity shall be classified against the levels in Table 8 using the acceptable quality limit achieved based on the type of sampling and inspection level to be achieved. Sample size shall be determined by ISO 2859-1, based on the target acceptable quality level (AQL).

Table 8 — Classification for liquid integrity

Level	**Acceptable quality level**
1	0,65
2	1,5
3	2,5
4	4,0

NOTE This method can be used to assess biological protection.

6.4 Heat and flame protection

6.4.1 Burning behaviour

When tested in accordance with ISO 15025, as modified in Annex L, burning behaviour shall be classified against the levels listed in Table 9 using the afterflame time and afterglow time. In order to be classified at a specific level, the glove material shall meet each of the criteria at that specific level.

Table 9 — Classification for flame resistance

Level	After flame time (s)	After glow time (s)
1	≤ 20	No requirement
2	≤ 10	≤ 120
3	≤ 3	≤ 25
4	≤ 2	≤ 5

The materials shall not drip if the material melts. The seam shall not come apart after an ignition time of 15 s in the test area.

6.4.2 Heat degradation resistance

When tested in accordance with ISO 17493, the glove material's heat degradation resistance shall be classified against the levels listed in Table 10. The classification of the glove shall be at the temperature in which there is no evidence of charring, ignition, melting, dripping, and separation, and there is no dimensional change greater than 5%. Heat degradation resistance testing shall be performed on whole gloves.

Table 10 — Classification for heat degradation resistance

Level	Highest temperature where no charring, ignition, melting, dripping, separation, or dimension change in excess of 5% is observed (°C)
1	100
2	180
3	260
4	340

6.4.3 Heat transfer – contact heat exposure

When tested in accordance with ISO 12127, the glove's heat resistance to contact heat exposures shall be classified against the levels listed in Table 11. Classification of glove performance shall be based on the contact (surface) temperature at which threshold time (t_T) is greater than 15 s. For multi-layered gloves, the test shall be performed simultaneously on all layers. If gloves use different materials or layers on the palm and back side of the glove, each glove side shall be separately tested and classified. The lower result shall be used to give the level of performance when classifying the glove for this property.

Table 11 — Classification for heat transfer – contact heat exposure

Level	Highest contact temperature at which threshold time ≥ 15 s (°C)
1	100
2	250
3	350
4	500

If the glove obtains a performance level of 3 at least, the heat degradation resistance test shall be performed according to 6.4.2. The product shall record at least a level 4 in heat degradation resistance test, otherwise the maximum performance level of 2 shall be reported.

NOTE The threshold time is the time between the start of the contact and the time when the temperature or the calorimeter (sensor) is 10°C above its starting temperature.

6.4.4 Heat transfer – flame exposure

When tested in accordance with ISO 9151, the glove's resistance to heat transfer from flame exposure shall be classified against the levels listed in Table 12. Classification of glove performance shall be based on the Heat Transfer Index (HTI). For multi-layered gloves, the test shall be performed simultaneously on all layers. If gloves use different materials or layers on the palm and back side of the glove, each glove side shall be separately tested and classified. A level of performance shall only be reported if a performance level 3 at least is obtained in burning behaviour (6.4.1).

Table 12 — Classification for heat transfer – flame exposure

Level	Heat transfer index (HTI) (s)
1	≥ 4
2	≥ 7
3	≥ 10
4	≥ 18

6.4.5 Heat transfer – radiant heat exposure

When tested in accordance with ISO 6942, Method B at 20 kW/m^2, the glove's resistance to heat transfer from radiant heat exposures shall be classified against the levels listed in Table 13. Classification of glove performance shall be based on the time for a 24°C temperature rise ($RTHI_{24}$). For multi-layered gloves, the test shall be performed simultaneously on all layers. If gloves use different materials or layers on the palm and back side of the glove, each glove side shall be separately tested and classified. A level of performance in radiant heat shall only be reported if a performance level 3 at least is obtained in burning behaviour (6.4.1).