
**Clothing for protection against liquid
chemicals — Determination of the
resistance of protective clothing
materials to penetration by liquids under
pressure**

*Vêtements de protection contre les produits chimiques liquides —
Détermination de la résistance des matériaux des vêtements de
protection à la pénétration des liquides sous pression*



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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.

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 13994 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

This second edition cancels and replaces the first edition (ISO 13994:1998), which has been technically revised.

Introduction

Workers involved in the production, use, and transportation of liquid chemicals can be exposed to numerous compounds capable of causing harm upon contact with the human body. The deleterious effects of these chemicals can range from acute trauma (such as skin irritation and burn) to chronic degenerative disease (such as cancer). Since engineering controls may not eliminate all possible exposures, attention is often placed on reducing the potential for direct skin contact through use of protective clothing that resists permeation, penetration and degradation.

This test method determines the resistance to penetration by liquids under pressure only. It is necessary to use other methods to determine the resistance to permeation and degradation, as well as penetration resistance for liquids not under pressure.

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Clothing for protection against liquid chemicals — Determination of the resistance of protective clothing materials to penetration by liquids under pressure

1 Scope

This International Standard describes a laboratory test method that enables determination of the resistance of materials used in protective clothing to visible penetration under the conditions of continuous liquid contact and pressure, for example clothing that is exposed to repeated splashes of liquid spray under pressure. Protective clothing “pass/fail” determinations are based on visual detection of liquid penetration.

This test method is normally used to evaluate the barrier effectiveness against liquids of materials used for protective clothing and specimens from finished items of protective clothing.

NOTE Finished items of protective clothing include gloves, arm shields, aprons, suits, hoods, boots and the like. The phrase “specimens from finished items” encompasses seamed and other discontinuous regions as well as the usual continuous regions of protective clothing items.

This test method can be used to identify protective clothing materials and constructions that limit exposures to hazardous liquid chemicals under a variety of circumstances. This test method is particularly useful for demonstrating the liquid hold-out capabilities of microporous fabrics.

Significant amounts of hazardous materials can permeate specimens that pass penetration tests. More sensitive analysis of permeation can be carried out using ISO 6529.

Penetration resistance of protective clothing materials using less severe liquid challenges, without pressure, can be carried out using ISO 6530. ISO 6530 uses a relatively low-volume, short-duration liquid challenge which is appropriate for treated porous and other non-film-based or uncoated materials.

This International Standard addresses only the performance of materials or certain material constructions (e.g. seams) used in protective clothing. It does not address the design, overall construction and components, or interfaces of garments or other factors which may affect the overall protection offered by the protective clothing.

It is emphasized that the test method specified in this International Standard does not necessarily simulate conditions that clothing materials are likely to be exposed to in practice. Therefore the use of test data is to be restricted to broad comparative assessment of such materials according to their liquid penetration resistance characteristics.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 2286-3, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 3: Method for determination of thickness*

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

ISO 3801, *Textiles — Woven fabrics — Determination of mass per unit length and mass per unit area*

ISO 5084, *Textiles — Determination of thickness of textiles and textile products*

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 physical properties of a protective clothing material due to contact with chemicals

3.2 penetration
flow of a liquid through closures, porous materials, seams and holes or other imperfections in a protective clothing material on a non-molecular level

3.3 permeation
combined process of molecular diffusion of a chemical through a solid material forming the whole or part of clothing, and its desorption into a specified medium

3.4 protective clothing
apparel used for the purpose of protecting part of the body from contact with a potential hazard

NOTE In this test method, the materials used in protective clothing are evaluated. The potential hazard is contact with liquid chemicals.

3.5 test liquid
individual liquid chemical or a liquid formulation of chemicals that is submitted for test by the method specified in this International Standard

4 Principle

The resistance of a protective clothing material to penetration by a liquid under pressure is determined by subjecting the material to the liquid for a specified time and pressure sequence and observing if visible penetration of the liquid occurs.

In the penetration test apparatus, the clothing material acts as a partition separating the hazardous liquid chemical from the viewing side of the test cell.

Any evidence of liquid penetration constitutes failure. Results are reported as “pass/fail”.

5 Apparatus

5.1 Thickness gage, suitable for measuring thickness to the nearest 0,02 mm, as specified in ISO 2286-3, used to determine the thickness of each protective clothing material specimen tested.

5.2 Penetration test cell, to restrain the specimen during contact with the pressurized test fluid.