BS 7971-6:2016

BSI Standards Publication

Protective clothing and equipment for use in violent situations and in training

Part 6: Gloves – Requirements and test methods

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 10, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 7971 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 August 2016. It was prepared by Subcommittee PH/3/12, *Protective clothing and equipment for use in violent situations and training* under the authority of Technical Committee PH/3, *Protective clothing*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 7971 supersedes BS 7971-6:2003, which is withdrawn.

Information about this document

This part of BS 7971 has been substantially revised in association with the Home Office. The aims of the revision were to amalgamate appropriate content from BS 7971-1, BS 7971-2, BS 7971-7 and BS 7971-6 and to reference the Home Office publication*, Slash resistance standard for UK police (2006)* [N1]. This British Standard contains public sector information licensed under the Open Government Licence v2.0.

This full revision of the standard introduces the following principal changes by addition of clauses covering:

- innocuousness;
- sizing;
- marking;
- user information;
- cleaning;
- modified resistance to chemicals; and
- a high cut resistance test.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Attention is drawn to Regulation (EU) 2016/425 [1)] [1].

[1)] Regulation (EU) 2016/425 replaces Directive 89/686/EEC, which remains in use until April 2018.

Introduction

Gloves used in general duty, specialist operational situations and in training are intended to reduce the risk of injury to a user who might be faced with threats such as various mechanical injuries, heat, flame and the effects of certain liquids, which in some circumstances may also be burning liquids.

Public order gloves in particular are intended to provide protection against specific operational threats and are intended to be worn in conjunction with flame retardant overalls as described in BS 7971-10.

In the selection of suitable gloves, optimum protection has to be balanced with operational requirements in an environment where the option of increasing protection levels as threat escalates might not be viable.

Operational requirements were taken into account during the preparation of this revision. The revision committee made the decision to incorporate different levels of protection for different activities into this single standard, allowing BS 7971-7 to be withdrawn.

Principal changes between this and earlier editions are outlined in the Foreword.

1 Scope

This part of BS 7971 specifies requirements and test methods for two types of gloves, general duty gloves and public order gloves intended to be used for specialist operational activities such as public order situations and public order training.

They are intended to provide protection against different hazards such as mechanical risk, heat and flame and small volumes of certain liquids.

NOTE If the risk assessment of other specialist gloves identifies hazards covered by this standard then in addition to any specific test requirements they might have, elements from this standard can be referenced.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 388:2003, *Protective gloves against mechanical risks*

BS EN 407, *Protective gloves against thermal risks (heat and/or fire)*

BS EN 420, *Protective gloves – General requirements and test methods*

BS EN 659:2003+A1:2008, *Protective gloves for firefighters*

BS EN 13594:2015, *Protective gloves for motorcycle riders – Requirements and test methods*

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

Other publications

[N1] HOME OFFICE SCIENTIFIC DEVELOPMENT BRANCH. *HOSDB Slash resistance standard for UK police (2006).* Publication No. 48/05. St Albans: Home Office, 2006. [2)]

3 Terms and definitions

3.1 general duty
performance of general policing activities such as routine patrol, driving, arrest and restraint, searching of individuals

3.2 liquid trap
design feature in to which liquid could collect

3.3 public order
performance of duties requiring an additional and higher level of protection for certain activities

NOTE Public order activities might include crowd control, major sporting events, demonstrations and violent situations requiring the use of specialist PPE.

3.4 slash
aggressive slicing attack with a short-edged weapon

NOTE For example, a short-edged weapon might be a retractable or folding utility knife.

4 Requirements for all gloves

4.1 Sizing

Gloves shall be available in a range of sizes to fit the user population. Measurement of hand and glove, and indication of hand size shall be in accordance with BS EN 420, except for the minimum length of the gloves which shall be as specified in Table 1.

Table 1 **Minimum length of gloves**

Hand size	General duty	Public order
	mm	mm
6	220	260
7	230	270
8	240	280
9	250	290
10	260	300
11	270	310
12	280	320
13	290	330

NOTE The tolerance for all of these lengths is -0/+5 mm.

[2)] Available from <http://ped-cast.homeoffice.gov.uk/standards//48-05_HOSDB_SLASH_RESISTANCE_STANDARD_FOR_UK_POLICE_(2006).pdf> [last viewed 1 August 2016].

4.2 Innocuousness

The manufacturer shall ensure, by testing or by declaration, that the materials or their derivatives shall not be known to harm the user, i.e. that they shall not be known to contain any toxic, carcinogenic, allergenic or otherwise harmful substances that could be released under foreseeable conditions of use.

4.3 Design and construction

Gloves shall be designed and constructed in such a way as to avoid liquid traps.

4.4 Performance requirements

4.4.1 General requirements (physical)

The minimum performance requirements for abrasion, tear, puncture and cut resistance shall be as specified in Table 2.

Table 2 **Minimum requirements for physical tests**

Test type	Method	Requirement	
		General duty	Public order
Abrasion resistance	BS EN 388:2003, **6.1**	Performance level 2	Performance level 2
Tear resistance	BS EN 388:2003, **6.3**	Performance level 3	Performance level 3
Puncture resistance	BS EN 388:2003, **6.4**	Performance level 2	Performance level 2
Cut resistance	BS EN ISO 13997	2 N	10 N

NOTE These are minimum requirements and higher levels of performance may be specified as necessary.

4.4.2 Protection against chemicals

4.4.2.1 Requirement

After testing in accordance with **4.4.2.2**, there shall be no penetration of liquid through the structure of the glove after 10 min and no more than slight visible damage to the surface, fittings or structure of the glove after 1 h.

4.4.2.2 Chemical resistance testing

4.4.2.2.1 Principle

Whole glove samples are exposed for a short period of time to a limited volume of specific liquids which might be encountered in operational use.

Damage to the materials and structure of the glove including ingress through seams and manufactured structure is assessed following a short and then extended period.

4.4.2.2.2 Method

A single glove sample shall be evaluated per chemical to be applied.

a) Clean the glove with a dry absorbent paper to remove any residue or manufacturing finishes.

b) Store the glove for at least 24 h in an environment at 20 ±2 °C and 65 ±5% rh.

c) Fasten the glove.

d) Fill the glove with absorbent paper as a trace medium for liquid ingress. Ensure the paper is in contact with the back and palm of the hand inside the glove.

e) Prepare a minimum of 50 ml of each of the following test liquids:

1) 50% ISO-octane/50% toluene (petrol substitute);

2) Methyl Isobutyl Ketone (AR grade);

3) 50% ethanol/50% water;

4) 30% aqueous sulfuric acid; and

5) 40% aqueous sodium hydroxide.

f) Place the glove onto a horizontal arm of a retort stand placed above a metal tray of a sufficient size to allow residual liquid to drain from the glove during application.

g) Pour 40 ±4 ml of test liquid evenly across the palm and back of the glove, rotating the glove on the retort stand such that after application it is horizontal with the palm facing down and any spilled volume left in the tray.

NOTE 1 It has been found that using smaller containers each holding 20 ±2 ml of the test liquid, one per palm and back, makes application more consistent.

h) Leave the samples for a period of 10 min ±30 s prior to removal from the retort stand and assess any initial damage.

i) Remove the absorbent paper from inside the glove and, if any liquid penetration is visible as damp patches, note the location of ingress and make a comment on severity of ingress (none/slight/moderate/severe).

j) 1 h ± 2 min after pouring the chemical, carry out a visual inspection of the glove, comparing it to an original (or photographs) and note any damage or visual change (for example, surface marking or damage, damage to stitching or seams, lack of functionality).

NOTE 2 The test sample should be cut open to assess any internal damage.

4.4.3 Ergonomic performance

4.4.3.1 General

Test subjects shall evaluate the position on the hands before, during and after completion of a number of basic activities, also assessing the ease of performing the activities, and discomfort of the gloves.

At least one size of the glove shall be evaluated by two test subjects.

Gloves shall be worn over a long-sleeved undergarment but without any additional clothing being worn on top of the glove.

NOTE 1 For example, flame retardant base layers, or alternatively a long-sleeved T-shirt.

The manufacturer shall provide sizing information.

NOTE 2 The ergonomic activities in this British Standard are designed to replicate a range of basic movements and tasks and eliminate fundamentally inadequate items from use. They are not designed to simulate in-use conditions and are not performed in conjunction with the specific associated PPE intended to be worn in service by the user. It is recommended that a full ergonomic assessment with other PPE or clothing items to be worn in conjunction with the blunt trauma protectors should be conducted by the specifiers/users. See Annex A for rationale.

4.4.3.2 Evaluation method

Select a suitably sized glove using the manufacturer's provided instructions.

Fit and adjust the glove in accordance with the manufacturer's instructions.

Assessment shall be undertaken using the following activities performed once in an order as determined by the test facility.

a) Make a clenched fist.

b) Make a splayed hand.

c) Open and close the front zip of a garment.

NOTE 1 Puller of zip should be a nominal 25 mm long.

d) Remove a pen from a chest pocket and write your name.

e) Lock and unlock handcuffs using a standard manufacturer's key as issued with the handcuffs.

NOTE 2 An example handcuff key is shown in Annex B.

f) After 1 h of wearing, doff and don the gloves five times.

The test subject shall answer all the following questions:

1) Is the supplied information suitable to enable selection of an appropriately sized glove?

2) Were clear instructions given to enable correct fitting and adjustment?

3) Was it possible to complete the activities without restriction?

4) Did the glove remain in place?

5) Was any level of discomfort experienced?

6) Did any fastenings fail?

7) On repeated doffing and donning of the gloves did the lining stay correctly in place within the glove?

4.4.3.3 Test report

The test report shall include the following information:

a) sample details and description;

b) size/s evaluated; and

c) the findings of the test subjects and assessor in response to the questions in **4.4.3.2**.

5 Additional requirements for public order gloves

5.1 Burning behaviour

When tested in accordance with BS EN 407, the burning behaviour of the glove shall conform to a minimum of performance level 4 as specified in BS EN 407. If the material melts it shall not drip. The innermost surface of the glove shall not melt. The seam shall not come apart in the test area after an ignition time of 15 s ±1 s.

5.2 Convective heat resistance

When material from the palm of the glove, and from the back of the glove if applicable, is tested in accordance with BS EN 407, it shall conform to a minimum of performance level 3 as specified in BS EN 407.

5.3 Radiant heat resistance

When material from the palm of the glove, and from the back of the glove, where applicable, is tested in accordance with BS EN 407, it shall conform to a minimum of performance level 2 as specified in BS EN 407.

5.4 Contact heat resistance

When material from the palm of the glove, and from the back of the glove, where applicable, is tested in accordance with BS EN 407, it shall conform to a minimum of performance level 1 as specified in BS EN 407.

5.5 Heat resistance of the lining material

When the lining material which is closest to the skin when the glove is worn is tested in accordance with BS EN 659:2003+A1:2008, **3.11**, the material shall not melt, drip or ignite.

5.6 Impact resistance

Each construction of material from the protective area of the back of the hand and fingers shall be impact tested in accordance with BS EN 13594:2015, **6.9**. Four impacts shall be performed on the fingers and four impacts on the back of the hand with no two impact sites closer than 5 mm. The minimum performance requirements for impact attenuation shall be as specified in Table 3.

Table 3 **Minimum requirements of impact attenuation**

Impact attenuation resistance (knuckle protection/all layers)	Back of fingers	Back of hand
Single result	≤8.0 kN	≤4.0 kN
Mean transmitted force	≤6.0 kN	≤3.0 kN

6 Optional requirements

*COMMENTARY ON **CLAUSE 6***

For certain operational considerations, it would be beneficial to evaluate resistance to penetration by a hypodermic needle. As no British Standard exists for this evaluation at the time of publication, general guidance has been given in Annex C. The inclusion of a formal requirement is intended to be considered during a future revision of this standard.

6.1 Slash resistance

Gloves providing slash resistance shall have the slash resistant pack tested in accordance with *Slash resistance standard for UK police (2006)* [N1], with the following modifications. No penetration shall occur with a force of less than 30 N. The average force from all nine slashes of penetration shall be 40 N or greater. Additionally, any perforation of the material that lasts for more than 1 ms or more than 10 perforations within any 1 ms period shall be classified as a failure.

6.2 Water penetration resistance of gloves

For gloves that contain a waterproof layer, the water penetration resistance of the gloves shall be measured by the manufacturer and the method of test and performance value achieved recorded on the user information.

Gloves providing additional protection to liquids (e.g. rain) shall identify the methods used and performance levels achieved on the user information.

7 Marking

Gloves shall be marked with the following information:

a) size;

b) manufacturer;

c) unique style identification;

d) cleaning instructions;

e) batch number; and

f) end use (i.e. public order or duty).

8 Manufacturer's information to user

Gloves shall be supplied with at least the following information and instructions:

a) the name and full address of the manufacturer and/or their authorized representative;

b) reference to this British Standard, i.e. BS 7971-6, [3)] and type of glove (public order or duty);

c) explanation of any optional requirements;

d) instructions for use:

   1) inspection to be carried out by the wearer before use;

   2) fitting and how to put on and take off the gloves;

   3) instructions for storage;

   4) instructions for cleaning and/or decontamination;

   5) warning about degradation due to inadequate cleaning and/or decontamination;

   6) obsolescence deadline or period of obsolescence;

   7) if appropriate, warnings against problems likely to be encountered (modifications can invalidate compliance); and

   8) guidance on method of disposal.

e) recommendation that a full ergonomic assessment with other PPE or clothing items which are to be worn in conjunction with the gloves is to be conducted by the specifiers/users.

The following warnings shall be given:

1) Gloves should not be expected to provide protection against all chemicals.

2) Gloves should not be expected to provide protection against biological or electrical hazards.

3) Gloves should not be expected to provide protection against prolonged contact with hot surfaces.

NOTE Where gloves provide protection against any of the above, this should be noted on the manufacturer's information to the user and tested accordingly.

[3)] Marking BS 7971-6:2016 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Annex A (informative) Rationale for simplification of ergonomic evaluation

Duty gloves are intended to be worn in conjunction with general operational clothing. Public order gloves for specialist operational situations are intended to be worn under the wrist closure mechanism of public order coveralls, and are required to allow interaction with other items of PPE and operational equipment without the need to be removed in potentially risky situations.

A standard ergonomic evaluation with one specific associated ensemble cannot suitably predict issues that might occur when the gloves are used in conjunction with the variety of other protective items currently available and in use; in addition, in future years any selected standard ensemble might become no longer representative of products in general use.

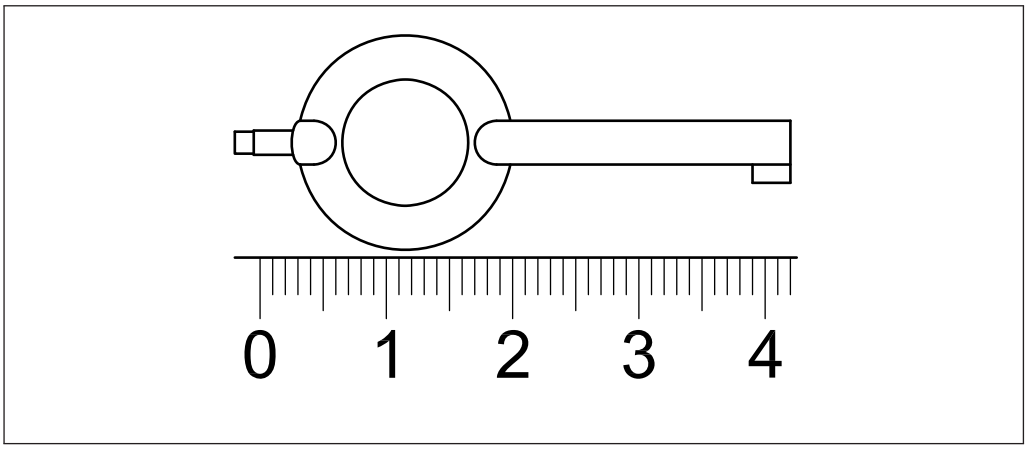
Investigations during the writing of this British Standard also indicated that simple activities would easily identify grossly inadequate products without the need to carry out the full evaluation as outlined in BS 7971-1. The new simplified evaluation was developed in conjunction with experienced users.

In addition to the simplified ergonomic evaluation in this British Standard it is recommended that evaluation of the ensemble by the user or specifiers at the point of purchase is also completed. This would ensure that the gloves would be evaluated in simulated conditions of use by assessors familiar with the specific combination of product with which the gloves are intended to interact with after purchase.

Annex B (informative) Handcuff key

A typical handcuff key, as shown in Figure B.1, is approximately 45 mm long with an area to be gripped of approximately 20 mm by 15 mm.

Figure B.1 **Typical handcuff key**



Annex C (informative)

Resistance to penetration by a hypodermic needle

At the time of publication, there was no British Standard available to use as a basis for testing of resistance of gloves to penetration by the needle of a hypodermic syringe.

To demonstrate resistance to needle penetration, manufacturers currently use alternative methods such as ASTM F2878, a modification of ASTM F1342 or testing using bespoke methods for evaluation of actual gloves.

ASTM F2878 and modifications of ASTM F1342 are both test methods which use an unsupported clamped circle of test material through which a hypodermic needle is pushed. Examples of bespoke methods include ones where simulated fingers are used to test finished gloves and their seams in the construction as would be worn, thus presenting resistance behind the materials of the glove.

All can be performed using actual hypodermic needles, though care should be taken to ensure a repeatable quality of tip. Typically a size 25 gauge needle can be used.

In ASTM F2878 it is noted that materials resistant to fine needles might be less resistant to coarse needles and vice versa, therefore definition of the threat would guide the requirement.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM F1342, *Standard test method for protective clothing material resistance to puncture*

ASTM F2878, *Standard test method for protective clothing material resistance to hypodermic needle puncture*

BS 7971-1, *Protective clothing and equipment for use in violent situations and in training – Part 1: General requirements*

BS 7971-10, *Protective clothing and equipment for use in violent situations and in training – Part 10: Coveralls – Requirements and test methods*

Other publications

[1] EUROPEAN COMMUNITIES. Regulation (EU) 2016/425 of the European Parliament and of the Council of 9 March 2016. Luxembourg: Office for Official Publications of the European Communities, 2016. [4)]

[4)] Regulation (EU) 2016/425 replaces Directive 89/686/EEC, which remains in use until April 2018.

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