

INTERNATIONAL STANDARD

ISO 15797

Second edition
2017-12

Textiles — Industrial washing and finishing procedures for testing of workwear

*Textiles — Méthodes de blanchissage et de finition industriels pour les
essais des vêtements de travail*



Reference number
ISO 15797:2017(E)



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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 2, *Cleansing, finishing and water resistance tests*.

This second edition cancels and replaces the first edition (ISO 15797:2002), which has been technically revised. It also incorporates the Technical Corrigendum ISO 15797:2002/Cor. 1:2004.

The main changes compared to the previous edition are as follows:

- in the Scope, the restriction of workwear to cotton, polyester and their blends has been removed, thereby including other fibres, and the accommodation of some PPE garments for which the referenced processes are appropriate has been added;
- [6.5](#) has been added to give examples of antichlor chemicals;
- in [9.2](#), in light of experience, changes have been made to Drying procedure B tunnel and cabinet finishing;
- throughout [Tables 1](#) to [4](#), the headings Cotton and Polyester/cotton have been replaced by Full load and Reduced load, respectively, to facilitate the change in the Scope;
- [Annex A](#) has been revised to include alternative temperature measuring systems.

Introduction

This document enables manufacturers of textiles to test their fabrics and garments for resistance to exacting washing and drying processes used in industrial laundries for care and maintenance purposes.

It is not practical to carry out rigorous testing in an industrial laundry environment and this document, using intermediate stage equipment, allows testing to be done in a more exacting laboratory setting under standardized conditions.

This document is a test method and is not intended as instructions or recommendations on how to wash and dry in an industrial laundry. Nor does it provide specifications on equipment to be used by industrial launderers.

A laundering cycle consists of a washing and a drying/finishing procedure.

Textiles — Industrial washing and finishing procedures for testing of workwear

1 Scope

This document specifies test procedures and equipment which can be used in the evaluation of workwear (including, where appropriate, for some PPE garments) intended to be industrially laundered. They serve as a basis for testing relevant properties such as dimensional stability, colour characteristics, creasing, seam puckering, pilling and visual aspects in general.

This document does not provide instructions and specifications for the procedures and equipment to be used by industrial launderers.

As it is often not practical to reproduce industrial laundry processes (washing and drying/finishing) in a laboratory setting, this document provides an approach using defined intermediate scale equipment and exacting test procedures which can be used for the evaluation of workwear intended to be laundered industrially.

As this document reflects a simulation of real-life industrial laundry conditions, in some cases, testing of the workwear in the actual industrial laundering equipment and processes intended to be used is advisable when finally determining product and process compatibility.

It is not necessary to test using all eight washing procedures nor both drying procedures. A selection is made of the washing and drying procedure(s) that are best suited to the characteristics of the fabric or fabric composition and the intended use.

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

ISO 3071, *Textiles — Determination of pH of aqueous extract*

ISO 3759, *Textiles — Preparation, marking and measuring of fabric specimens and garments in tests for determination of dimensional change*

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:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp/>

3.1

cage

rotating container within which the load is held during the laundering process

Note 1 to entry: The cage is generally fabricated from perforated stainless steel.

3.2

dead volume

volume of water left in the *drum* (3.4), such that the water surface lies at a tangent with the inside of the *cage* (3.1) in the stationary position

3.3

domestic laundering

washing/finishing of textiles according to size and volume needed by a single household

Note 1 to entry: The usual size of the *cage* (3.1) for domestic laundering is approximately 60 l.

3.4

drum

non-rotating container within which the *cage* (3.1) rotates

3.5

load ratio

ratio of the dry load to the net *cage* (3.1) volume

Note 1 to entry: The load ratio is expressed in kilogrammes per litre.

Note 2 to entry: Net cage volume is given by net volume of lifters, back wall and door.

3.6

g-factor

factor defined by the formula

$$0,56 \times \left(\frac{n}{1000} \right)^2 \times d$$

where

n is the number of revolutions per minute (r/min);

d is the cage diameter in millimetres

3.7

industrial laundering

professional laundering of *workwear* (3.9) in greater quantities than *domestic laundering* (3.3)

3.8

liquor ratio

ratio of the dry load to the total amount of water

Note 1 to entry: The liquor ratio is expressed in kilogrammes per litre.

3.9

workwear

garment specifically designed to be worn in the workplace

Note 1 to entry: Its attributes are determined by the reason for its use, the activity in the workplace and the requirement to restore it for reuse.

4 Principle

The specimen (or relevant number of specimens) is washed in a washer/extractor and dried/finished according to one of the specified procedures. If multiple laundering cycles are required, each wash process shall be followed by drying/finishing.

5 Apparatus

5.1 Washer/extractor, with the following characteristics:

- a) front- or side-loading open pocket horizontal rotating drum type;
- b) cage volume: 220 l to 250 l;
- c) diameter of cage: 750 mm to 850 mm;
- d) depth of cage: 400 mm to 600 mm;
- e) ratio (diameter of cage to depth of cage): $1,5 \pm 15 \%$;
- f) dead volume: 10 l to 20 l;
- g) lifting vanes (ribs): three; each having a height 10 % to 12 % of the diameter of cage; base width <100 mm;
- h) heating: direct steam or electric, thermostatically controlled;
- i) g-factors: wash $0,75 \pm 10 \%$; drain $0,75 \pm 10 \%$; interspin 50 to 100; final extraction 250 to 350;
- j) programmable extract speeds;
- k) reversible action, (5 to 10) revolutions in one direction, then reverse;
- l) time rotating at full washing speed to total washing time: 80 %.

5.2 Tumble dryer, with the following characteristics:

- a) air vented batch drying tumbler with a system for detecting the moisture content of the exhaust air to a tolerance of $\pm 5 \%$;
- b) thermostatically controlled heating;
- c) diameter of cage: 900 mm to 1 100 mm;
- d) depth of cage: 630 mm to 1 000 mm;
- e) cage volume: 600 l to 720 l;
- f) g-factor: 0,7 to 1,0;
- g) reversing action: yes;
- h) nominal evaporation rate: 45 l/h $\pm 20 \%$;
- i) radial airstream: yes;
- j) perforated drum: yes.

5.3 Finisher, with the following characteristics:

- a) batch-loaded steam cabinet;
- b) capacity: (8 to 18) pieces/garment;
- c) spray steam pressure: 2 bar to 5 bar (200 kPa to 500 kPa);
- d) specific volume flow (within cabinet): 6 900 m³/m² h to 8 900 m³/m² h;
- e) direction of air flow: top to bottom;

- f) temperature setting: adjustable;
- g) inlet temperature: 160 °C option required;
- h) distance from hanger to hanger: 75 mm ± 10 mm.

5.4 Loading ballast, consisting of clean workwear garments (lab coats, bib and brace, overalls, jackets, trousers and boiler suits) not previously washed more than 100 times and similar to the type of garment and fabric of the specimen (e.g. polyester/cotton or cotton) and the colour (e.g. white, coloured or fluorescent coloured). In cases where the ballast material may have a significant influence on the test result, the entire loading ballast shall consist of the specimen material, e.g. when testing contrasting colours or multicoloured material in textiles.

6 Reagents

6.1 Reference detergents.

The nominal composition of the reference detergents is given in [6.1.1](#) and [6.1.2](#). The reference detergent (with optical brightener) ([6.1.1](#)) can be used except when colour characteristics are being assessed. The reference detergent shall be stored in closed containers in a cool and dry place.

6.1.1 Reference detergent (with optical brightener).

Values in % are based on 100 % raw material (pure).

Nominal percentage composition by weight	Percentage
ABS-Na (C-12 chain)	0,425
Nonionic surfactant (C13/15 7EO or C12/14 7EO)	6,0
Sodium citrate dehydrate	5,0
Hydroxyethane diphosphonic acid Na-salt (HEDP)	1,0
Metasilicate anhydrous	42,3
Polymer (polymaleic acid)	2,0
Foam inhibitor (phosphoric acid ester)	3,0
Sodium carbonate	39,5
Optical brightener	0,3
Remaining water from raw material	0,475
	100,00

Due to the variability which may result from the manufacturing procedure of the detergent or of its ageing, the use is recommended, for comparative measurements, of a reference detergent supplied by one definite manufacturer from a definite production batch and of recent supply. It is recommended to keep the detergent and any bleaching agent separate. It is also recommended to keep small quantities and to use it within a limited time.

6.1.2 Reference detergent (without optical brightener).

Values in % are based on 100 % raw material (pure).

Nominal percentage composition by weight	Percentage
ABS-Na (C-12 chain)	0,425
Nonionic surfactant (C13/15 7EO or C12/14 7EO)	6,0
Sodium citrate dehydrate	5,0
Hydroxyethane diphosphonic acid Na salt (HEDP)	1,0
Metasilicate anhydrous	42,6
Polymer (polymaleic acid)	2,0
Foam inhibitor (phosphoric acid ester)	3,0
Sodium carbonate	39,5
Remaining water from raw material	0,475
	100,00

Due to the variability which may result from the manufacturing procedure of the detergent or of its ageing, the use is recommended, for comparative measurements, of a reference detergent supplied by one definite manufacturer from a definite production batch and of recent supply. It is recommended to keep the detergent and any bleaching agent separate. It is also recommended to keep small quantities and to use it within a limited time.

6.2 Peracetic acid bleach.

The nominal composition of the standard peracetic acid bleach is as follows:

- peracetic acid: 4 % to 5 %;
- hydrogen peroxide: 20 % to 30 %.

Use the agent within 30 days of receipt.

6.3 Chlorine bleach.

The nominal composition of the standard chlorine bleach is as follows:

- 150 g/l active chlorine (NaOCl).

Check the concentration prior to testing.

Use the agent within 30 days of receipt.

6.4 Hydrogen peroxide bleach.

Use one of the following commonly available hydrogen peroxide solutions.

	Solution A	Solution B
Strength expressed as volume/volume	100	130
Strength expressed as mass/volume %	30	40
Strength expressed as mass/mass %	27,5	35

Check the concentration prior to testing.

Use the agent within 30 days of receipt.

6.5 Antichlor.

EXAMPLE Sodium metabisulfite, sodium bisulfite.

6.6 Water, with the following quality:

- a) hardness: ≤ 100 mg/l CaCO_3 ;
- b) pH: 6,0 to 7,5;
- c) content of: Fe $\leq 0,1$ mg/l; Mn $\leq 0,03$ mg/l; Cu $\leq 0,05$ mg/l;
- d) temperature: $15\text{ }^\circ\text{C} \pm 5\text{ }^\circ\text{C}$ (deviations to be reported in the test report).

7 Test specimen(s)

The test specimen shall be either a full garment or a composite sample. This sample shall comprise the component parts of the finished item combined in a representative assembly, particularly with regards to dimensions.

At least three specimens shall be subjected to the washing and drying/finishing procedures specified in this document. The actual number of specimens shall be determined by the purpose for which the material is being tested.

8 Washing procedure

8.1 Select the washing procedure to be used from those given in [Tables 1, 2, 3](#) and [4](#).

8.2 Condition specimens (and ballast) in accordance with ISO 139 (20 °C, 65 % relative humidity) and prepare the samples in accordance with ISO 3759, if appropriate. Determine the mass of the conditioned specimen. Place the test specimens to be washed in the washer/extractor ([5.1](#)) and add sufficient loading ballast ([5.4](#)) to make a load according to the size of the machine and the load ratio. Follow specifications of appropriate wash procedure selected from [Tables 1, 2, 3](#) or [4](#).

8.3 Use water as specified in [6.6](#). Add detergent and additives according to selected washing procedure. Reference detergent with optical brightener ([6.1.1](#)) may be used except when colour characteristics are being assessed.

8.4 Acetic acid can be used in the last rinse process to adjust the pH value of the specimen. If acetic acid is used, it shall be reported together with the pH value of the dried specimen (measured in accordance with ISO 3071). The pH value of the dried test sample (determined in accordance with ISO 3071) shall be in the range of pH 5,5 to 7,0.

8.5 After the final extraction of the washing procedure has been completed, remove the specimens, taking care that they are neither stretched nor distorted. Determine the mass of the washed specimens in order to enable calculation of moisture retention of specimens according to washing procedure. Moisture content retained of the textile shall be:

$$w = \frac{m_1 - m_2}{m_1} \times 100$$

where

w is the moisture retention of the textile, expressed as a percentage of the conditioned mass;

m_1 is the mass of the conditioned textile specimens, in kilogrammes;

m_2 is the mass of the textile specimens after extraction, in kilogrammes.

8.6 Dry the entire load using one of the drying/finishing procedures described in [Clause 9](#).

Table 1 — Washing procedures for white workwear and/or sensitive coloured trimmings — Peracetic acid bleach

		1. Full load^a	2. Reduced load^b
	Load ratio	1:12	1:17
	Agitation during heating, washing and rinsing	Normal	Normal
Washing			
	Liquor ratio	1:4	1:4
	Detergents and additives	4 g/l (see 6.1.1 and 6.1.2) 2 g/l (see 6.2)	4 g/l (see 6.1.1 and 6.1.2) 2 g/l (see 6.2)
	Temperature	75 °C ± 2 °C	75 °C ± 2 °C
	Time ^c	20 min	20 min
	Cool down ^d	No	Yes
	Drain	1 min	1 min
	Interspin	1 min	No
Rinse1			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse2			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse3			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Final extraction (estimated time)	6 min	6 min
	Residual moisture	50 % to 55 %	35 % to 40 %
<p>^a For example, cotton.</p> <p>^b For example, polyester cotton blends.</p> <p>^c Washing time starts when temperature is reached.</p> <p>^d Cool down: top up with cold water for 10 min in order to reduce temperature to 55 °C maximum (no more than 3 °C/min).</p> <p>^e Rinse time is measured when liquor level is reached.</p>			

Table 2 — Washing procedures for white workwear — Chlorine bleach

		1. Full load^a	2. Reduced load^b
	Load ratio	1:12	1:17
	Agitation during heating, washing and rinsing	Normal	Normal
Washing			
	Liquor ratio	1:4	1:4
	Detergents	4 g/l (see 6.1.1 and 6.1.2)	4 g/l (see 6.1.1 and 6.1.2)
	Temperature	85 °C ± 2 °C	75 °C ± 2 °C
	Time ^c	20 min	20 min
	Cool down ^d	No	Yes
	Drain	1 min	1 min
	Interspin	1 min	No
Rinse1			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse2			
	Liquor ratio	1:5	1:5
	Additives (chlorine)	2 g/l (see 6.3)	2 g/l (see 6.3)
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse3			
	Liquor ratio	1:5	1:5
	Additives (antichlor)	1 g/l	1 g/l
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Final extraction (estimated time)	6 min	6 min
	Residual moisture	50 % to 55 %	35 % to 40 %

- a For example, cotton.
- b For example, polyester cotton blends.
- c Washing time starts when temperature is reached.
- d Cool down: top up with cold water for 10 min in order to reduce temperature to 55 °C maximum (no more than 3 °C/min).
- e Rinse time is measured when liquor level is reached.

Table 3 — Washing procedures for white workwear and/or sensitive coloured trimmings — Hydrogen peroxide

		1. Full load^a	2. Reduced load^b
	Load ratio	1:12	1:17
	Agitation during heating, washing and rinsing	Normal	Normal
Washing			
	Liquor ratio	1:4	1:4
	Detergents and additives	4 g/l (see 6.1.1 and 6.1.2) 1 g/l (see 6.4)	4 g/l (see 6.1.1 and 6.1.2) 1 g/l (see 6.4)
	Temperature	85 °C ± 2 °C	85 °C ± 2 °C
	Time ^c	20 min	20 min
	Cool down ^d	No	Yes
	Drain	1 min	1 min
	Interspin	1 min	No
Rinse1			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse2			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse3			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Final extraction (estimated time)	6 min	6 min
	Residual moisture	50 % to 55 %	35 % to 40 %
<p>^a For example, cotton.</p> <p>^b For example, polyester cotton blends.</p> <p>^c Washing time starts when temperature is reached.</p> <p>^d Cool down: top up with cold water for 10 min in order to reduce temperature to 55 °C maximum (no more than 3 °C/min).</p> <p>^e Rinse time is measured when liquor level is reached.</p>			

Table 4 — Washing procedures for coloured workwear

		1. Full load ^a	2. Reduced load ^b
	Load ratio	1:12	1:17
	Agitation during heating, washing and rinsing	Normal	Normal
Washing			
	Liquor ratio	1:4	1:4
	Detergents	5 g/l (see 6.1.1 and 6.1.2)	5 g/l (see 6.1.1 and 6.1.2)
	Temperature	85 °C ± 2 °C	75 °C ± 2 °C
	Time ^c	20 min	20 min
	Cool down ^d	No	Yes
	Drain	1 min	1 min
	Interspin	1 min	No
Rinse1			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse2			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Interspin	1 min	1 min
Rinse3			
	Liquor ratio	1:5	1:5
	Time ^e	3 min	3 min
	Drain	1 min	1 min
	Final extraction (estimated time)	6 min	6 min
	Residual moisture	50 % to 55 %	35 % to 40 %
a	For example, cotton.		
b	For example, polyester cotton blends.		
c	Washing time starts when temperature is reached.		
d	Cool down: top up with cold water for 10 min in order to reduce temperature to 55 °C maximum (no more than 3 °C/min).		
e	Rinse time is measured when liquor level is reached.		

9 Drying procedure

9.1 Procedure A — Tumble drying

Place the entire load (load ratio 1:25 to 1:35) in the tumble dryer (5.2) with the outlet temperature from the drum set not to exceed 90 °C. Operate the dryer until the load is dry, and continue tumbling for 5 min with the heat turned off (cool down). The load is dry when the final moisture content related to the conditioned specimens is 0 ± 3 %. Remove the load immediately.

9.2 Procedure B — Tunnel/cabinet finishing

Place specimens, with appropriate hangers, in the pre-heated steam cabinet (5.3). The steam cabinet shall be operated with full content and with at least one piece of ballast at the ends. The finisher shall be set at 155 °C air temperature and at an operating time of a minimum of 3 min. When the readings of the temperature at the inlet are not automatically measured and shown on the control panel display, the ambient air temperature shall be measured with a temperature measuring system in the upper part of the drying chamber. Spray steam shall be applied for between 1 min and one-third of the total finishing time. The load is dry when the load temperature reaches 135 °C to 140 °C. The temperature of the test specimen shall be measured using a temperature measuring system at a distance of 150 mm to 200 mm from the top edge of the hanger, as specified in Annex A.

A continuous tunnel finisher may be used to provide additional information about the attributes of the specimens. Deviations from the operating conditions in 5.3 shall be reported in Clause 10 e) and 10 k).

10 Test report

The test report shall contain the following information:

- a) the name of the testing authority and report identification;
- b) the date of testing;
- c) a reference to this document, i.e. ISO 15797;
- d) identification and description of the specimens to be tested;
- e) the type of machine according to 5.1, 5.2 and 5.3 and the washing and drying/finishing procedures used;
- f) the total number of washing and drying/finishing procedures conducted on the specimens;
- g) the type and concentration of detergent/optical brightener (6.1) and additives (6.2, 6.3, 6.4) used;
- h) if acetic acid is used in the last rinse, the concentration of acetic acid used and pH value of dried specimens;
- i) the total mass of the specimens and loading ballast and type of loading ballast (5.4);
- j) settings/programmed temperatures for drying;
- k) details of any deviation from the specified procedures.

Annex A (normative)

Additional information for procedure B — Tunnel/cabinet finish

The temperature shall be determined on the surface of the test sample at a distance of 150 mm to 200 mm from the upper edge of the coat hanger (see [Figure A.1](#)).

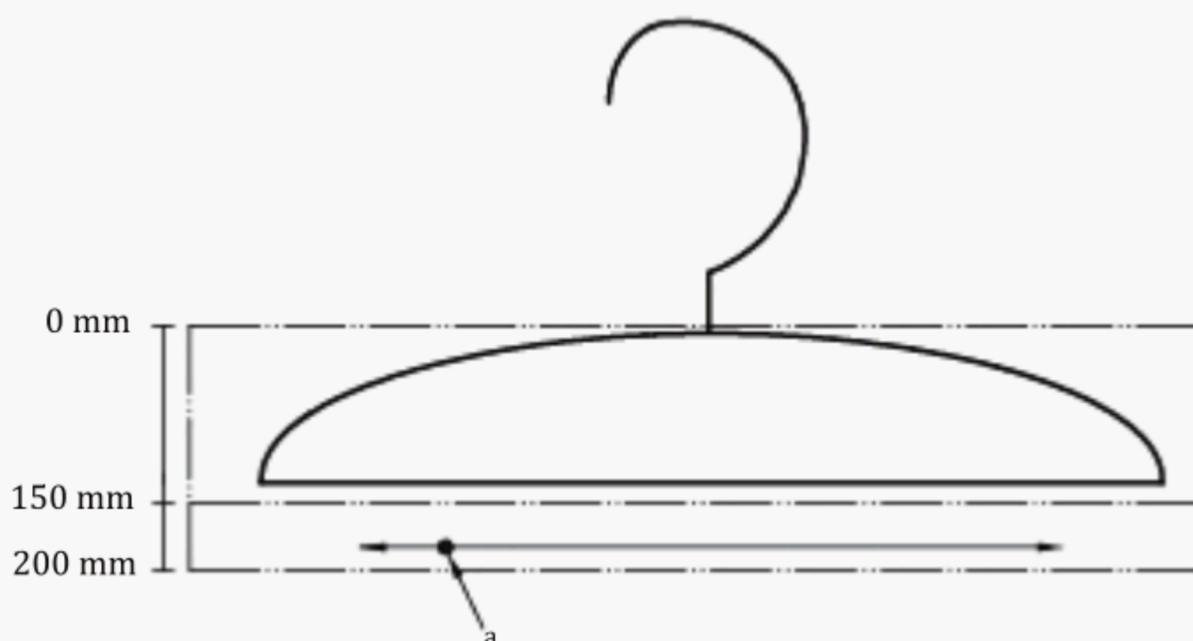
The temperature measuring system shall detect the temperature at the specimen surface. If using a sensor, ensure correct measurements by shielding it from the ambient air stream temperature (see [Figure A.2](#)). Fixing can be made with suitable adhesive tape, two stitches or appropriate clips. The sensor bead shall be placed within the specimen surface in the cool boundary phase (see [Figure A.3](#)).

When temperature strips are used, a calibration cycle per load shall be made to adjust the suitable drying time.

When measuring with infrared sensors, there shall be no obstruction between the test sample and the sensor.

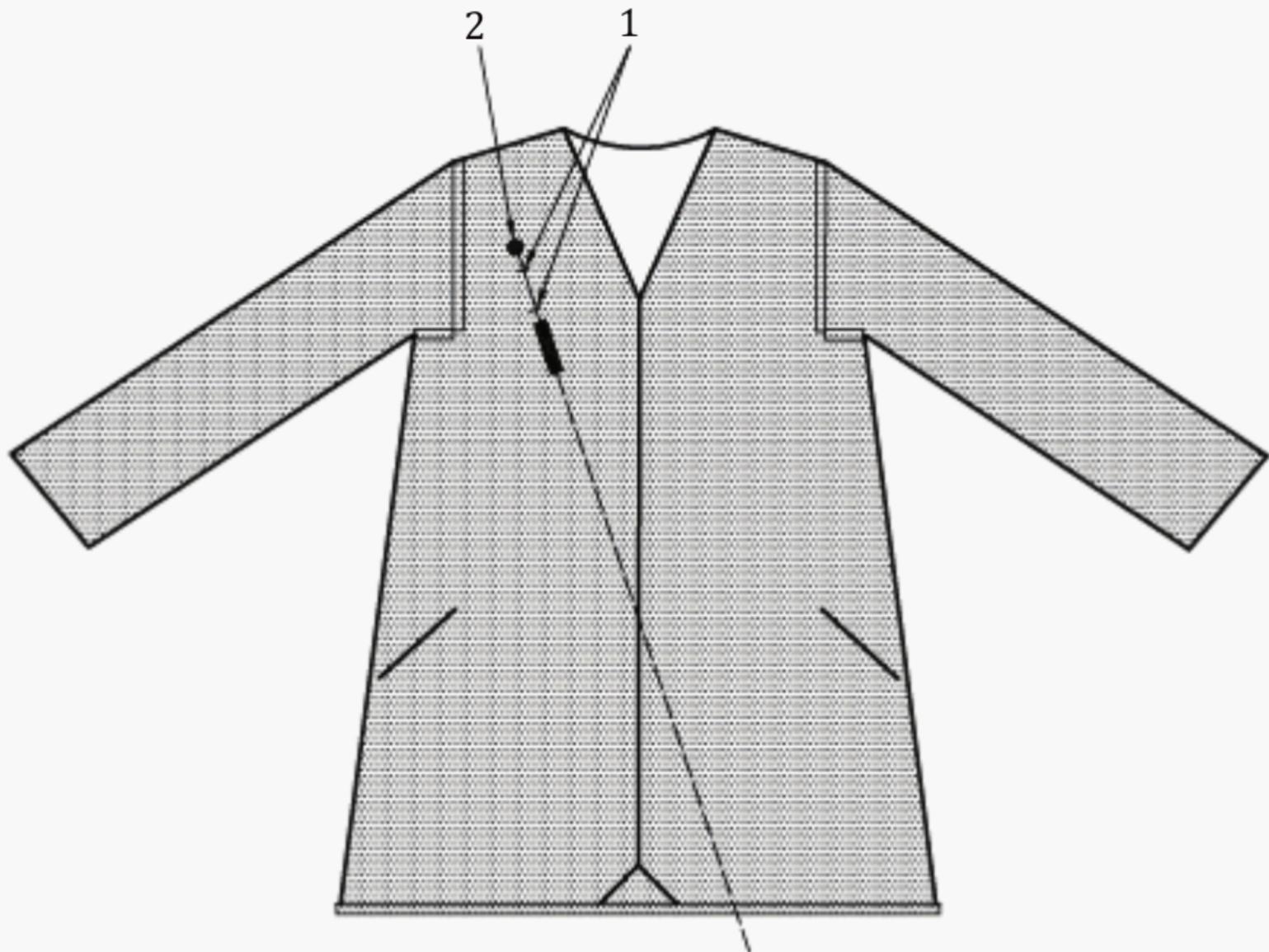
When measuring with temperature detectors or infrared sensors, a cross-check with temperature sensing strips shall be carried out. A calibration of the control units for temperature measurement shall be made.

If certain zones on a specimen are to be tested (e.g. seams), the temperature shall also be determined at these areas.



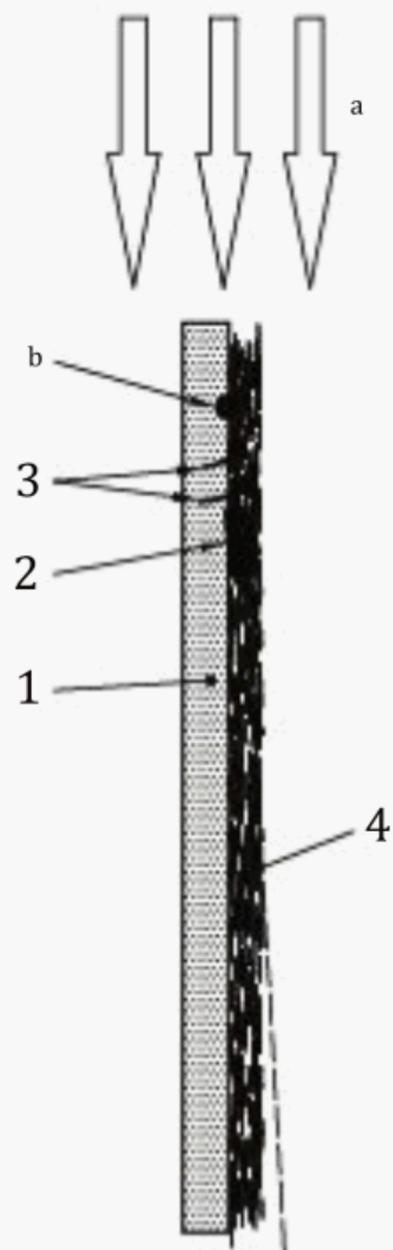
a Temperature measurement.

Figure A.1 — Position of temperature sensor on test specimen

**Key**

- 1 stitches for fixing
- 2 temperature sensor bead

Figure A.2 — Fixing of temperature sensor on test specimen (front view)



Key

- 1 damp test specimen
- 2 stitches for fixing
- 3 connecting plug
- 4 cool boundary phase
- a Hot airstream.
- b Temperature sensor bead.

Figure A.3 — Fixing of temperature sensor on test specimen (side view)

