
**Textiles — Determination of
deodorant property —**

Part 1:
General principle

*Textiles — Détermination des propriétés de neutralisation d'odeurs —
Partie 1: Principe général*

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 38, *Textiles*.

ISO 17299 consists of the following parts, under the general title *Textiles — Determination of deodorant property*:

- *Part 1: General principle*
- *Part 2: Detector tube method*
- *Part 3: Gas chromatography method*
- *Part 4: Condensation sampling analysis*
- *Part 5: Metal-oxide semiconductor sensors method*

Introduction

Unpleasant odours in daily human life are toilet odour, sweat odour, body odour (nonenal mixture odour), excrement odour, etc. Textile products that reduced these unpleasant odours from ambient air or around the human body were offered in the market by using advanced technology.

However, the evaluation method for such deodorant textiles did not develop as an International Standard. This fact has been making it difficult to evaluate correctly the deodorant property of the textile products for consumers as well as manufactures worldwide.

A current practical method for the evaluation of odour is a human sensory testing method in which a person is directly judged by the human sense of smell if there is an odour or not. This human sensory testing method is difficult to standardize as an objective indicator. Considering this situation, test methods using instruments or ultra-microanalysis testing methods have been developed.

Unpleasant odours are compounds of an infinitesimal quantity of chemicals. ISO 17299 provides a definition for the major component chemicals of odours and specifies the test methods by using several kinds of instruments in which the reduction rate of odour from ambient gas of the textile products is determined.

This part of ISO 17299 describes the general principle of testing methods for the deodorant property of textile products. Actual testing methods are described in ISO 17299-2 to ISO 17299-5.

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Textiles — Determination of deodorant property —

Part 1: General principle

1 Scope

This part of ISO 17299 specifies the general principle of the deodorant textile products and deodorant testing methods for textile products, such as woven fabric, knit, nonwoven, fibres and yarns, braiding products, tapes and slings.

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.

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

3 Terms and definitions

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

3.1 General

3.1.1

unpleasant odour

uncomfortable odour related to the human living environment, such as toilet odour, sweat odour, body odour (nonenal mixture odour), and excrement odour, etc.

3.1.2

major component chemicals of unpleasant odour

chemicals that compose the unpleasant odour in the living environment

Note 1 to entry: These chemicals are as follows:

- toilet odour: ammonia;
- sweat odour: ammonia, acetic acid, and isovaleric acid;
- body odour (nonenal mixture odour): ammonia, acetic acid, isovaleric acid, and nonenal;
- excrement odour: ammonia, acetic acid, hydrogen sulfide, methyl mercaptan, and indole.

Note 2 to entry: Other chemicals might be relevant. The selected chemicals are conceived as representative.

3.1.3

quasi-unpleasant odour

mixed odour produced artificially similar to unpleasant odour

Note 1 to entry: Mixed odours are produced artificially for the purpose of ISO 17299-5. The component chemicals for each odour are defined as follows:

- quasi-sweat odour: ammonia, acetic acid, isovaleric acid;

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- quasi-body odour (nonenal mixture odour): ammonia, acetic acid, isovaleric acid, nonenal;
- quasi-excrement odour: ammonia, acetic acid, hydrogen sulfide, methyl mercaptan, indole.

3.1.4

deodorant textile

textile with the ability to reduce the unpleasant odour in the ambient air around textile products

Note 1 to entry: The unpleasant odour is caused by the chemicals listed in [3.1.2](#) and [3.1.3](#).

3.1.5

deodorant property

ability to reduce the unpleasant odour in ambient air

Note 1 to entry: The unpleasant odour is caused by the chemicals listed in [3.1.2](#) and [3.1.3](#).

3.1.6

deodorant substance

substance able to interact physically or chemically with unpleasant odours

Note 1 to entry: The unpleasant odour are listed in [3.1.2](#) and [3.1.3](#).

Note 2 to entry: Examples of deodorant substances are shown in [Annex A](#).

3.1.7

deodorant processing

process giving a deodorant property to textile products through a production process for application of deodorant substances on the surface or inside of the textile products by a padding and drying process, to be absorbed by a chemical treatment process, to be blended in the polymer by a spinning process, or to be applied using other techniques

3.2 Deodorant testing

3.2.1

evaluation of a deodorant property

measurement of the reduction of chemical concentration in a container with test specimen, comparing to without specimen

Note 1 to entry: The measuring methods of the concentration of odour chemicals are described in [3.2.2](#) to [3.2.6](#).

3.2.2

human sensory testing

judgement of strength of the smell by the human sense of smell

Note 1 to entry: The human sensory testing method is described in [Annex C](#) as an example. Although human sensory testing is not suitable for a standard, the procedure was used to develop the instrument testing method to determine the details of testing conditions.

3.2.3

detector tube method

concentration of odour component chemicals is measured by using the detector tube

Note 1 to entry: The detector tube method is described in ISO 17299-2 which is applied to the test of acetic acid, hydrogen sulphide, and methyl mercaptan.

3.2.4

gas chromatography method

concentration of odour component chemicals is measured by gas chromatography

Note 1 to entry: The gas chromatography (GC) method is described in ISO 17299-3, which is applied to the test of nonenal, indole, isovaleric acid, and the mixture liquid of acetic acid and NaCl.

3.2.5

condensation sampling analysis

odour component chemicals are condensed by the condensation sampling method for each chemical, and then, the appropriate analytical instruments are chosen to obtain the concentration of odour chemicals

Note 1 to entry: The method is described in ISO 17299-4 for the test of indole, methyl mercaptan, hydrogen sulfide, isovaleric acid, and nonenal.

3.2.6

metal-oxide semiconductor sensor method

concentration of quasi-unpleasant odour chemicals are measured by using the metal-oxide semiconductor sensors

Note 1 to entry: This method is described in ISO 17299-5 for the test of quasi-sweat, quasi-body odour (nonenal mixture odour), and quasi-excrement odour.

4 Principle

Concentration of gaseous odour component chemicals of the gas in containers with a specimen denoted as A , and without specimen denoted as B , is measured by using the specified instruments after the designated contacting time. The reduction rate is determined from the chemical concentration with and without specimen as $(B - A)/B \times 100$ %. The test shall be done either with the odour chemical individually or with mixed odour component chemicals as described in each part of ISO 17299.

5 Reagents

Unless otherwise specified, analytical grades have to be used.

5.1 Ammonia water (NH_3), reagent with concentration of 28 % in water.

5.2 Acetic acid (CH_3COOH), reagent with purity of 99,7 %.

5.3 Methyl mercaptan (CH_3SH), standard gas with concentration of 100 $\mu\text{l/l}$ or 1 000 $\mu\text{l/l}$ by nitrogen dilution.

5.4 Hydrogen sulfide (H_2S), standard gas with concentration of 100 $\mu\text{l/l}$ by nitrogen dilution.

5.5 Indole ($\text{C}_8\text{H}_7\text{N}$), reagent.

5.6 Isovaleric acid, solution with purity of 98,0 %.

5.7 2-Nonenal ($\text{C}_9\text{H}_{16}\text{O}$), reagent with purity of 95,0 %.

5.8 Diluent gas, dry air obtained from the mixture cylinder of nitrogen gas and oxygen gas with purity of at least 99,99 %, or nitrogen gas from the nitrogen gas cylinder with a purity of at least 99,99 %.

NOTE Nitrogen gas obtained from a nitrogen cylinder (purity of at least 99,999 9 %) can be used.

5.9 Ethanol, reagent with purity of 99,5 % in water.

6 Materials and apparatus

6.1 Plastic bag, made of vinyl fluoride film, polyester and polyester laminated film, polyvinyl alcohol film, etc. A volume of 1 l, 3 l, 5 l, and 50 l is available depending on the purpose. A plastic or rubber tube is installed to the bag before testing.

6.2 Air pump, capable of drawing air with a flow rate of 0,2 l/min and 5 l/min with the attached flow meter. If the attached flow meter is not available, the integrating flow meter shall be used.

6.3 Integrating flow meter, capable of measuring the gas flow of 500 ml/min or more.

- 6.4 **Hand dryer**, with an electric consumption of 1 kWh to be used to warm up ammonia to 40 °C to 50 °C to evaporate in the 1 l bag.
- 6.5 **Syringe**, made of a glass cylinder with a capacity of 0,5 ml, 100 ml, and 200 ml.
- 6.6 **Micro-syringe**, with a capacity of 10 µl.
- 6.7 **Heat seal**, to seal the opened parts of the plastic bag. The tape can be used with the same sealing capability as an alternative.
- 6.8 **Aspirator**, capable of evacuating all air in the 5 l plastic bag after sealing. A vacuum pump could be used.
- 6.9 **Airtight stopper**.
- 6.10 **Oven**, capable of using at 80 °C
- 6.11 **Parmeator or cylinder**, alternative standard gas generator.

7 Testing environment and sample conditioning

The testing environment shall be kept at a temperature of 20 °C and relative humidity of 65 % in accordance with ISO 139. The samples are conditioned under the same condition for at least 24 h.

NOTE The condition with a temperature of 23 °C and relative humidity of 50 % according to ISO 139 can be used for this test, then record the condition used on the test report.

8 Test procedure

The test procedure will be described in ISO 17299-2 to ISO 17299-5 as follows:

- ISO 17299-2: *Detector tube method*;
- ISO 17299-3: *Gas chromatography method*;
- ISO 17299-4: *Condensation sampling analysis*;
- ISO 17299-5: *Metal-oxide semiconductor sensors method*.

In all parts, the concentration of testing gas without a specimen and with a specimen are denoted as *B* and *A*, respectively.

9 Odour reduction rate

The reduction rate of the concentration is calculated from Formula (1).

$$ORR = \frac{(B - A)}{B} \times 100 \quad (1)$$

where

ORR is the odour reduction rate in percentage;

B is the average of the concentration of testing gas without a specimen;

A is the average of the concentration of testing gas with a specimen.

10 Determination of deodorant property of the textile products

The purpose of this test method is to determine the deodorant property of textile products.

The labelling for the appropriate deodorant property should be presented when the chemical concentration reduction is larger than the values referred to in [Annex E](#) as an example.

11 Test report

The following items are at least recorded in the test report:

- a) a reference to this part of ISO 17299 (i.e. ISO 17299-1) and the test method used;
- b) kind, origin, and designation of the sample (partial specimen, if applicable);
- c) individual odour concentration data, average, and reduction rate;
- d) any deviation from this part of ISO 17299.

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Annex A (informative)

Deodorant substances

A.1 Deodorant substances

Table A.1 shows substances which are supposed to have anti-bacterial property as well as deodorant property.

Table A.1 — Deodorant substances

Category I	Category II	Deodorant substances
1) Inorganic	[Metallic salt]	Molecular sieves, crystalline aluminosilicate silver, or sodium (silver displacement zeolite) Silver/zinc zeolite Silver/zeolite Zirconium phosphate/silver oxide Zirconium phosphate, silver oxide/zinc oxide Titanium phosphate, zinc oxide, and titanium oxide gel compound Compounds of titanium phosphate silver supported gel and zinc oxide Silver supported dioxide silicate Silver oxide, triphosphoric acid ammonium, and sodium phosphate compound Silver chloride Silver Zinc oxide Copper Copper compound Tetra-amine copper ion Glass of phosphoric acid system Hydrophilic amino silicon polymer including metallic oxide
	[Carbon system]	Steam-activated carbon
2) Organic	[Biguanide]	Chlorohexidine gluconate Chlorohexidine gluconate and poroctone olamine Polyhexamethylene biguanide hydrochloride Copolymer of chlorohexidine and 2-propenamide 2-methyl propane sulfonic acid Composition of polyhexamethylene biguanide and zinc oxide
	[Carbanilide]	Triclocarban Composition of triclocarban and nalidixic acid Phenyl amide compound

Table A.1 (continued)

Category I	Category II	Deodorant substances
2) Organic	[Ampholytic surfactant]	Alkyl amide propyl dimethyl β -hydroxyethyl ammonium salt and poly [oxyethylene (dimethylamino) ethylene (dimethylamino) ethylene chloride]
	[Carboxylic acid]	Polymethacrylic acid Compounds of polyacrylate and zinc sulfate Nalidixic acid: 1 ethyl-1, 4-dihydro-7-methyl-4-oxo-1, 8-naphthyridine-3-carboxylic acid
	[Alcohol]	Polyhydric alcohol system compound
	[Quaternary ammonium salt]	Benzalkonium chloride Organic silicone quaternary ammonium salt N-polyoxyalkylene-N, NN-tri-alkylene-ammonium salt Alkyl quaternary ammonium and carboxylate salt Alkyl dimethyl ammonium salt Alkyl dimethyl benzal conium salt Alkyl quaternary ammonium salt N, N, NN-tetra alkyl quaternary ammonium salt Cetyl tri-methyl ammonium chloride Di-alkyl quaternary ammonium salt Tetra-alkyl quaternary ammonium salt Octa-decyl di-methyl ammonium chloride Ammonium chloride di-decyl di-methyl Di-decyl di-methyl ammonium chloride Compounds of quaternary ammonium chloridization of copolymer of phosphoric acid ester monomer 3-(methoxysilyl)-propyl octadecyl dimethyl ammonium chloride N-polyoxyalkylene-NN,-tri-alkylene-ammonium Benzalkonium chloride and polyhydric alcohol system compound Alkyl trimethyl ammonium dibutyl phosphate acid salt Dicyanamide and diethylene triamine and ammonium chloride condensate Dicyandiamide poly-alkylene-poly-amine-ammonium polycondensation body Cation polymer Partial escape acetyl compound of (poly- β -1,4) N-acetyl-D glucosamine and reaction product of hexamethylenebis (3-chloro -2- hydroxypropyl dimethyl ammonium chloride)
	[Phenol]	Alky-lenebis phenol sodium salt Para-chrol-metaxyleneol Bis(2,6 di-t-ptyl-4-methylic phenol) pentaerythritol diphosphate
	[Amino acid]	N-alkyloyl-L -glutamine acid silver copper
[Sulfamide]	N, N-dimethyl-N'-fluoro-dichloro-methylthio-N"-phenylsulf-amide	
[Pyridine]	Bis(2-pyridinethiol-zinc-1-oxide)zinc Bis[1- hydroshiki-2(1) pyridio-thionate (0,S)-T-4] zinc	

Table A.1 (continued)

Category I	Category II	Deodorant substances
2) Organic	[Nitrile]	2, 4, 5, 6 tetra-chloro-isophthalonitrile
	[Polymer]	Acrylonitrile and acrylate copolymerization copper cross-linked Acrylonitrile sulfuration copper complex Acrylamide-diallylamine hydrochloride copolymer Methacrylate copolymerization
	[Others]	Flowable sulfur Lactoferin and lactoferishin
3) Natural organic	[Glucidic]	Chitosan Hydroxy propyl chitosan Chitosan of cross-bridge Chitosan organic acid salt Chitosan fine powder (polyglucosamine) Chitin fibre Chitin
	[Tropolone]	Japanese cypress thiol Japanese cypress oil emulsion Leaf oil Compound of cyclodextrins and leaf oil Leaf oil emulsion
	[Ester]	Undecylenic acid monoglyceride Fatty acid glyceride Fatty acid ester acid (propylene glycol monoester) Glycerine fatty acid ester Methoxypolyethyleneglycolmethacrylate-alkyl phosphoric acid ester Phosphoric acid ester system polymer
	[Terpene]	1,8-cineole (felon herb, eucalyptus, and lemon eucalyptus)
4) Others		Copper Included cellulose textile

Annex B (informative)

Odour components and deodorant

B.1 General

The major component chemicals for odours are given as [Table B.1](#).

Table B.1 — Major component chemicals for odours

Odour component chemicals		Kind of odour				
		Sweat	Body	Excrement	Cigarette	Garbage
Ammonia	NH ₃	m	m	m	m	m
Acetic acid	CH ₃ COOH	m	m	m	m	
Isovaleric acid	CH ₃ (CH ₂) ₃ COOH	m	m			
Nonenal	C ₉ H ₁₆ O		m			
Acetaldehyde	C ₂ H ₄ O				m	
Methyl-mercaptan	CH ₄ S			m		m
Hydrogen sulfide	H ₂ S			m	m	m
Indore	C ₈ H ₇ N			m		
Pyridine	C ₅ H ₅ N				m	
Tri-methylamine	C ₃ H ₉ N					m

m Major component.

B.1.1 Sweat odour

Approximately 99 % of sweat is water, but some fatty acid esters of glycerol come out together from glandulae sudoriferae and stain textiles, then the fatty acid esters are biologically degraded and through a chemical reaction path, acetic acid, ammonia, etc. are formed. Even acetic acid never comes out from the human body directly as sweat.

The selection of chemicals for the test is based on the information above.

B.1.2 Body odour (nonenal mixture odour)

Nonenal was found as a component of body odour (nonenal mixture odour) in 2001.

B.2 Deodorant mechanism and substances

The deodorant mechanism and used substances are summarized in [Table B.2](#).

Table B.2 — Summary of deodorant mechanism and used substances

Deodorant mechanism		Details	Used substances
Chemical reaction	Oxidation-reduction reaction	Chemicals are resolved with the oxidant and reducing agent.	— Hydrogen peroxide — Sodium sulfite
	Addition/condensation reaction	Odour chemicals are removed by addition and the condensation reaction.	— Photocatalytic TiO ₂ — Glyoxal — Methacrylate ester
	Neutralization reaction Ion-exchange reaction	Acidic and basic odour are removed by the neutralization reaction.	— Multivalent carboxylic acid — Multivalent phenol
Physical absorption	Physical absorption	Odour chemicals are absorbed to the surface of porous materials.	— Activated carbon — Zeolite
Sensory deodorant	Masking action	Odours are covered by strong smells.	— Flavor and fragrance — Tree acetic acid
	Offset action	Odours are offset by other odorous chemicals.	— Turpentine — Eucalyptus
Biological deodorant	Enzyme action	Organic odorous chemicals are decomposed by oxidation or microorganism.	— Hydrolase — Yeast

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Annex C (informative)

Human sensory testing method

C.1 General

The human sensory testing method for odour has been used for a long time. This is a method using the human sense of smell as a detector.

However, the testing procedure and the finding from the human sensory testing method could be reflected in a standard using the instrumental devices to test odour.

Therefore, the testing procedure of the human sensory testing method is explained in [Annex C](#) for information.

C.2 Level of odour strength

Designation of the odour strength level into six stages as described below.

- 0: odourless;
- 1: faint odour without knowledge of the kind of odours (odour threshold concentration);
- 2: weak odour with knowledge of the kind of odours (conceivable threshold concentration);
- 3: medium odour, can be easily perceived;
- 4: strong odour;
- 5: very strong odour.

C.3 Testing method

C.3.1 Testing environment

The testing environment should be kept at a temperature of 20 °C and relative humidity of 65 %, or 23 °C and relative humidity of 50 %, in accordance with ISO 139. The condition used should be described in the test report.

C.3.2 Container

Conical flask, 500 ml

C.3.3 Object-odour component chemicals

Ammonia, acetic acid, isovaleric acid, nonenal, hydrogen sulfide, indole, and methyl mercaptan.

Warning — Hydrogen sulfide is a very toxic chemical and is harmful to humans. The test should be performed under strict control and by a trained expert with sufficient knowledge.

C.3.4 Panellist

Six persons or more who should be trained to recognize and quantify the odorant molecules. The odour threshold should be measured for all panelists before testing and the result should be included in the report.

C.3.5 Odour concentration testing procedure

An original odour gas is diluted to 30 times, 100 times, 300 times, 1 000 times, and 3 000 times, for example, and the odour gas is inserted into a conical flask and is tested by panelists.

NOTE The original odour gas concentration of the chemical is detected by an instrument and the concentration of the diluted gas is obtained by calculation, based on the dilution magnification.

C.4 Result

The odour chemical concentration for the odour strength, 3,5 and 2,0 of each odour component chemical, was determined as shown in [Table C.1](#) from the human sensory testing.

Table C.1 — Concentration of the odour component chemical corresponding to human sensory test, relating to odour strength

Odour element chemicals	Odour strength 3,5 concentration µl/l	Dilution ratio to make odour strength 2,0
Ammonia (NH ₃)	105	1/10
Acetic acid (CH ₃ COOH)	1 to 4	1/10
Isovaleric acid (CH ₃) ₂ CHCH ₂ COOH	0,1	1/20
Hydrogen sulfide (H ₂ S)	0,2	1/5
Methyl mercaptan(CH ₃ SH)	1	1/30
Indole (C ₈ H ₇ N)	1,0	1/50
Nonenal (C ₆ H ₁₃ CH = CHCHO)	0,03	1/20

Annex D (informative)

Determination of the testing condition of the instrument testing method

D.1 General

The initial concentration of the odour component chemical for the instrument testing method is considered for evaluating the detector tube method and the gas chromatography method, because the odour concentration for strong/medium odour 3,5 is under $\mu\text{l/l}$ level for some odour chemicals which makes testing difficult.

However, the condensation sampling analysis can be used for the initial concentration directly from the human sensory testing of 3,5 level, because of very high sensitivity.

D.2 Determination of initial concentration for detector tube method (ISO 17299-2) and gas chromatography method (method A of ISO 17299-3)

The initial concentration for the instrument devices was evaluated at several points of concentration and finally determined as in [Table D.1](#), considering the availability of the detector tube and the reproducibility.

The deodorant textile samples are prepared as samples with an odour strength of less than 2,0 by human sensory testing and with non-deodorant treatment control.

The samples were tested using several initial concentrations and finally determined the values shown in [Table D.1](#). The testing results were obtained with a good separation.

Table D.1 — Initial concentration of odour chemicals for testing method

Odour component chemicals	Initial concentration of chemical $\mu\text{l/l}$	Testing method
Ammonia	100	Part 2 Detector tube
Acetic acid	30	Part 2 Detector tube
Isovaleric acid	38	Part 3 A Gas chromatography
Hydrogen sulfide	4	Part 2 Detector tube
Methyl mercaptan	8	Part 2 Detector tube
Indole	33	Part 3 A Gas chromatography
Nonenal	14	Part 3 A Gas chromatography

D.3 Condensation sampling analysis (ISO 17299-4)

The initial odour chemical concentration was selected, referring to the human sensory testing method shown in [Table C.1](#).