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Textiles — Domestic laundering procedures for textile fabrics prior to flammability testing

*Textiles — Méthodes de lavage domestique des étoffes en vue des essais
d'inflammabilité*

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ISO 12138:1996(E)**Foreword**

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International Standard ISO 12138 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 2, *Cleansing, finishing and water resistance tests*.

Annex A forms an integral part of this International Standard. Annexes B and C are for information only.

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@isocs.iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

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Introduction

The methods specified in this International Standard provide standardized domestic laundering procedures for use prior to assessing the likely flammability behaviour of textile materials. The methods are based on ISO 6330 but incorporate several additional features which ensure that certain critical parameters are more closely controlled. Alternative procedures for commercial laundering prior to assessing the flammability of textile fabrics are given in ISO 10528.

Because of the wide variety of laundering methods used domestically, it is impossible to specify a standard laundering procedure which will reproduce the effect of laundering under all possible conditions. The methods specified, however, can be used to detect which materials are adversely affected by domestic laundering under conditions which are appropriate for the material being laundered. Such adverse effects are not restricted to textiles which have been treated with flame retardants.

The flammability of textile materials can be affected by a combination of different results:

- shrinkage of the material, causing an increase in mass per unit area;
- abrasion of the material, causing a decrease in mass per unit area;
- removal of finishes;
- chemical modification of the fibre or finish;
- deposition of hard-water salts;
- including application of softeners in the rinse cycle.

The various factors in these test methods are controlled in order to standardize all these effects as far as possible. The essential features specified in the methods are:

- a) water hardness;

A medium water-hardness level is specified in order to ensure that any major effects caused by deposition or chemical modification are detected. Different procedures for preparing this hard water are given, depending on the hardness of the initial water supply.

- b) degree of loading and composition of load;

These factors influence the mechanical action of the washing machine and the deposition results.

c) volumes of liquor used for washing and rinsing;

The liquor:fabric ratio affects the mechanical action and the deposition results. In addition, it is essential to know the volumes of water being used in order to make any necessary adjustments to the water hardness.

d) type and quantity of detergent;

The use of a standard nonphosphate detergent containing sodium perborate and a bleach activator is recommended because of the increasing use of this type of detergent. The detergent used shall be agreed between the interested parties. The detergent can affect the chemical modification of a material or finish by its bleaching action, and also affects the deposition because of the sequestering effect of the nonphosphate builders included in the formulation.

e) wash temperatures;

Four standard wash temperatures are specified so that the appropriate temperature for the material being laundered can be selected.

NOTE — The combination of hard water and high perborate detergent used in this International Standard is not suitable for laundering flame-retardant materials at temperatures above 60 °C.

f) degree of agitation;

The heating period can vary considerably depending on the inlet water temperature and the heating capacity of the washing machine. Reduced agitation is used during filling and heating in order to avoid variations in mechanical action. Normal agitation is specified for the 12-min washing period for washes at 50 °C and 60 °C, but reduced agitation is used during the washing period for 30 °C and 40 °C washes.

g) rinsing procedure;

A standard rinsing procedure is specified, as rinsing can have considerable influence on the deposition of hard-water salts. Fabric softeners added to the rinse are not used in this method.

h) washing machine.

The methods as presented allow the use of two different types of washing machine. As far as possible the same laundering conditions have been specified for each type of machine. The degree of loading is 60 g per litre of drum volume, and the detergent quantity is 20 g per kilogram of wash load. For horizontal drum machines (Type A), the liquor:fabric ratio is 5,0:1,0 for washing and 9,0:1,0 for rinsing.

The mechanical action and the liquor:fabric ratio (20:1) used in the vertical drum machine (Type B) are different from those used in the Type A machines. Experience indicates that testing with this type of machine is equally effective in detecting finish removal, although mechanical effects and deposition results may be different.

Textiles — Domestic laundering procedures for textile fabrics prior to flammability testing

1 Scope

This International Standard specifies methods for repeated domestic laundering at selected wash temperatures prior to assessing flammability behaviour of textile materials. The washing machines and procedures specified are based on those given in ISO 6330, but specific requirements are provided for water hardness and volumes, detergent type and quantity, machine loading and degree of agitation.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6330:1984, *Textiles — Domestic washing and drying procedures for textile testing*.

3 Apparatus and reagents

3.1 Washing machine, automatic, of type A1, A2 or B as specified in ISO 6330 and as agreed between the interested parties.

3.2 Water, having a hardness of 160 mg/litre \pm 40 mg/litre, expressed as calcium carbonate, obtained by one of three methods:

- a) using a water supply having an initial hardness within the range 120 mg/litre to 200 mg/litre
- b) using a water supply having an initial hardness greater than 200 mg/litre and then diluted by the procedure given in A.1 with the appropriate amount of water of hardness less than 120 mg/litre;
- c) using a water supply having an initial hardness of less than 120 mg/litre and then artificially hardened by the procedure given in A.2 before addition to the washing machine.

3.3 Ballast, consisting of rectangular pieces in single layers of either woven 100 % bleached cotton or 100 % polyester. Each piece shall measure at least 350 mm \times 500 mm and shall be hemmed along the cut edges to prevent unravelling.

3.4 Low-foaming detergent, with perborate.

The detergent used shall be agreed upon between the interested parties.

For example, the ECE or IEC nonphosphate TAED reference detergents as specified in annex B may be used. All detergent quantities given in this International Standard are for the complete detergent with perborate.

3.5 Iron or press, capable of being used at a temperature setting appropriate for the material being tested.

4 Composition of the load

The test specimens shall be of sufficient size for subsequent flammability testing. The total dry mass of the load shall be as calculated in 5.2.

Either:

a) at least half the load shall consist of material under test or material of similar fibre type, the remainder consisting of polyester ballast (see 3.3)

or

b) when testing cotton materials, cotton ballast as specified in 3.3 shall be used to make up at least half the load.

5 Preliminary calculations

5.1 Drum volume

If it is not specified, calculate the volume V_1 , expressed in litres to the nearest litre, of the rotating drum, ignoring any space occupied by lifters or agitator, using the equation

$$V_1 = lr^2\pi \times 10^{-6}$$

where

l is the length or height of drum, in millimetres;

r is the radius of drum, in millimetres.

5.2 Test load

The degree of loading shall be (60 ± 4) g of load per litre of drum volume. Calculate the total dry mass m_1 , expressed in kilograms to the nearest 0,1 kg, of the test load, using the equation

$$m_1 = (0,060 \pm 0,004) V_1$$

5.3 Detergent quantity

Calculate the mass m_2 , expressed in grams to the nearest 0,5 g, of detergent to be added, using the equation

$$m_2 = (1,2 \pm 0,06) V_1$$

5.4 Low dip level

Determine the volume of water V_2 , expressed in litres to the nearest 0,5 litre, required to fill the Type A machine to the low dip level (L) with no load present and with a stationary drum, using the equation

$$V_2 = (0,30 \pm 0,02) V_1$$

5.5 High dip level

Determine the volume of water V_3 , expressed in litres to the nearest 0,5 litre, required to fill the machine to the high dip level (H) with no load present and with a stationary drum, using the equation

$$\text{for Type A machines:} \quad V_3 = (0,54 \pm 0,04) V_1$$

or

$$\text{for Type B machines:} \quad V_3 = (1,20 \pm 0,07) V_1$$

NOTE — For some machines the dip levels are preset. Other machines require the dip levels to be adjusted to give the required volumes (see annex C).

6 Washing procedures for Type A machines

6.1 Load the Type A machine (3.1) with a load of mass m_1 as calculated in 5.2 and of the specified composition (see clause 4). Start the machine with reduced agitation and fill with cold hard water (3.2) at a temperature of (15 ± 5) °C to the low dip level (L), at the time adding the mass m_2 of detergent (3.4) as calculated in 5.3.

6.2 Heat the water in the machine with reduced agitation to the appropriate temperature selected from table 1 and as specified in the washing instructions for the material under test. Run the machine for $(12 \pm 0,5)$ min at that temperature with corresponding agitation as specified in table 1. Drain.

Table 1 — Washing procedures for horizontal drum machines (Type A)

Wash temperature °C	Agitation	Centrifuge min
30 ± 3	Reduced	$3 \pm 0,5$
40 ± 3	Reduced	$3 \pm 0,5$
50 ± 3	Normal	$6 \pm 0,5$
60 ± 3	Normal	$6 \pm 0,5$

6.3 Fill the machine with cold hard water (3.2) to the high dip level (H). Run for $(3 \pm 0,5)$ min, then drain. Repeat three times to give a total of four rinses in all. Centrifuge for the time specified in table 1.

6.4 Unless otherwise specified between the interested parties, repeat the washing, rinsing and centrifuging cycle 11 times, making a total of 12 complete cycles.

NOTE — If the number of wash cycles specified cannot be completed without interruption, the load may be left wet for a maximum of 18 h after centrifuging.

6.5 Dry the specimens in accordance with one of the drying procedures given in ISO 6330 and press them (see 3.5) at a suitable temperature to remove creases.

If, according to the washing instructions, the test material should not be centrifuged or pressed, omit these stages and indicate this fact in the test report [see 8 e)].

7 Washing procedures for Type B machines

7.1 Load the Type B machine (3.1) with a load of mass m_1 as calculated in 5.2 and of the specified composition (see clause 4). Fill with warm hard water (3.2) at the specified washing temperature (see table 2 and washing instructions for the material under test) to the high dip level (H), at the same time adding the mass m_2 of detergent (3.4) as calculated in 5.3.

Table 2 — Washing procedures for agitator-type machines (Type B)

Temperature (°C)		Agitation	Centrifuge
Wash	Rinse		
30 ± 3	30 ± 3	Reduced	Gentle
40 ± 3	40 ± 3	Reduced	Gentle
50 ± 3	40 ± 3	Normal	Normal
60 ± 3	40 ± 3	Normal	Normal

7.2 Start the machine with normal agitation. Run the machine for $(12 \pm 0,5)$ min at the temperature and corresponding agitation specified in table 2. Drain.

7.3 Allow the machine to go through its normal rinsing and centrifuging procedure using warm hard water (3.2) and filling to the high dip level (H). The rinse water temperature and the final centrifuging cycle shall be as specified in table 2.

7.4 Unless otherwise specified between the interested parties, repeat the washing, rinsing and centrifuging cycle 11 times, making a total of 12 complete cycles.

NOTE — If the number of wash cycles specified cannot be completed without interruption, the load may be left wet for a maximum of 18 h after centrifuging.

7.5 Dry the specimens in accordance with one of the drying procedures given in ISO 6330 and press them (see 3.5) at a suitable temperature to remove creases.

If according to the washing instructions, the test material should not be centrifuged or pressed, omit these stages and indicate this fact in the test report [see 8 e)].

8 Test report

The test report on the flammability of materials tested after washing by these procedures shall contain the following statement:

“Tested after washing in accordance with ISO 12138”, as well as

- a) the type of washing machine used and its drum volume;
- b) the type of detergent used;
- c) the washing temperature used;
- d) the drying procedure used;
- e) any deviation from the procedures specified.

Annex A (normative)

Preparation of artificial hard water

A.1 Reducing the hardness of the supply water

Where the supply water has an initial hardness n , expressed in milligrams per litre, which is greater than 200, adjust it to 160 mg/litre by the following method.

For every litre of water of initial hardness n , add V_4 litres of water of hardness p , expressed in milligrams per litre, where

$$p < 160$$

$$V_4 = \frac{n - 160}{160 - p}$$

to obtain $(1 + V_4)$ litres of water of hardness 160 mg/litre.

A.2 Increasing the hardness of the supply water

Where the supply water has an initial hardness n , expressed in milligrams per litre, which is less than 120, adjust it to 160 mg/litre by the following method.

A.2.1 Prepare solution A containing $43,8(160 - n)$ mg calcium chloride hexahydrate per litre of supply water of hardness n .

A.2.2 Prepare solution B containing $33,6(160 - n)$ mg sodium hydrogencarbonate per litre of supply water of hardness n .

A.2.3 For every litre of artificial hard water required, take 500 ml of supply water of hardness n . Add 50 ml of solution A (A.2.1) and mix well. Add 50 ml of solution B (A.2.2) and mix well. Add a further 400 ml of supply water of hardness n to make a total volume of 1 litre.

The artificial hard water is preferably prepared before addition to the washing machine. Where it is necessary to add solutions A and B directly into the washing machine, it is essential to thoroughly disperse each solution before adding the detergent.

Annex B (informative)

Composition of the detergent

As the names and compositions of reference detergents are constantly changing, it is not possible to specify the use of a fixed detergent. A recommended detergent is the ECE or IEC TAED reference detergent. This is a zeolite-built detergent, which for these procedures is preferable to the previous phosphate-built ECE or IEC reference detergents specified in ISO 6330:1984, Annex B. Alternative detergents may be agreed upon between the interested parties.

The TAED reference detergent is supplied as three separate components which are mixed in the following mass fractions immediately before use:

Spray-dried powder with enzyme prills	77,0 %
Sodium perborate tetrahydrate	20,0 %
Bleach activator, tetraacetylenediamine	3,0 %

Due to the variability of the manufacturing process and to ageing, the composition of the spray-dried powder may vary.

A typical composition of the ECE spray-dried powder is:

Component	Nominal composition (as mass fraction)
Alkylbenzene sulfonate	7,5
C ₁₂₋₁₈ alcohol + 7 ethylene oxide	4,0
Soap (65 % C ₁₂₋₁₈ , 35 % C ₂₀₋₂₂)	2,8
Sodium aluminium silicate (zeolite 4A)	25,0
Sodium carbonate	10,0
Sodium salt of acrylic/maleic acid copolymer	4,0
Sodium silicate (SiO ₂ :Na ₂ O = 3,3:1)	3,0
Carboxymethylcellulose	1,0
Sodium ethylenediamine tetraacetate	0,2
Sodium sulfate	9,4
Water	9,6
Protease enzyme prills	0,5

NOTES

- 1 The IEC TAED detergent contains 0,2 % of stilbene-type optical whitener with the quantity of sodium sulfate reduced to 9,2 %.
- 2 Details of the availability of TAED reference detergents can be obtained from the Secretariat of ISO/TC 38.

Annex C (informative)

Parameters for typical washing machines

Type	A1	A2	B
Typical machine	Wascator ¹⁾ model 71	Miele ¹⁾	Kenmore ¹⁾
Drum volume, V_1 (litres)	70	45	59
Load, m_1 (kg)	$4,2 \pm 0,3$	$2,7 \pm 0,2$	$3,5 \pm 0,2$
Detergent, m_2 (g)	84 ± 5	54 ± 3	71 ± 4
Low dip volume, V_2 (litres)	$21,0 \pm 1,5$	$13,5 \pm 1,0$	Not applicable
High dip volume, V_3 (litres)	$38,0 \pm 3,0$	$24,5 \pm 2,0$	$71,0 \pm 4,0$
NOTE — The fixed levels I and II on the Miele machine and settings of 10 cm and 20 cm on the Wascator model 71 machines should give the required volumes. For Type B machines, the dip levels are preset and are much higher than for Type A machines.			
1) Wascator, Miele and Kenmore are examples of commercially available washing machines. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the products named. Equivalent products may be used if they can be shown to lead to the same results.			

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