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Textiles — Determination of resistance to certain insect pests

Textiles — Détermination de la résistance à certains insectes nuisibles

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FOREWORD

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The member body of the following country expressed disapproval of the document on technical grounds :

Switzerland

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Textiles — Determination of resistance to certain insect pests

0 INTRODUCTION

Some methods previously utilized for testing resistance of textiles to insect pests relied solely on loss of mass of the test specimens exposed to larvae as the criterion of damage and this is, of course, the most objective result which can be obtained. However, with pile fabrics, if the larvae cut the roots of the pile or nap, significant loss of pile can sometimes be caused before the larvae die. In this case, the loss in mass of the test specimen may be above the generally acceptable limit although no damage is visible to the naked eye, and the fabric may be accepted as adequately proofed. Conversely, fabrics with a smooth milled surface, and fine knitwear, may have a loss in mass below the acceptable limit, but still show enough damage for them to be assessed as insufficiently proofed. Thus although determinations of mass are recorded in this method, subjective visual observations on the condition of the fabric and larvae play an equal part in the assessment. In most cases the losses in mass will reinforce the visual observations.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for the determination of the resistance of textiles to the larvae of certain insects. It is applicable to all textiles containing animal fibre in any proportion. Information relating to the breeding of the larvae is given in the annex.

2 PRINCIPLE

Conditioned voracity control specimens and test specimens of known mass are placed in contact with selected larvae for 14 days. The loss in mass of all specimens, the extent of the attack on test specimens and the condition of the test larvae are ascertained to assess the resistance of each test specimen.

3 APPARATUS

3.1 Metal containers, the covers of which are pierced with ventilating holes, shallow, large enough to permit the test larvae to remain in contact with, or move away from, the test specimens. A suitable size is 45 mm diameter, 10 mm height.

3.2 Flexible forceps and **camel hair brush** with pesticide-free bristles.

3.3 Weighing bottles, with stoppers.

3.4 Balance capable of determining mass to an accuracy of 0,1 mg.

3.5 Stamp of diameter 40 ± 1,5 mm for punching circular test specimens.

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4 CONDITIONING, REARING AND TESTING ATMOSPHERE

The atmosphere for conditioning, rearing and testing shall have a relative humidity of 65 ± 2 % and a temperature as specified below, depending on the type of insect or pest.

Attagenus piceus *Anthrenus flavipes*	27 ± 1 °C
Tineola bisselliella	24 ± 1 °C
Tinea pellionella	25 ± 1 °C

5 SPECIMENS

5.1 Number

5.1.1 *Test specimens*

Select at random eight test specimens from the sample of material to be tested, at widely spaced intervals. Use four of these as test specimens and four as moisture regain controls.

5.1.2 *Test control specimens*

As it is essential to provide a control on the larval voracity, select eight test control specimens of undyed unproofed woollen material or yarn corresponding to the sample to be tested. Use four of these eight specimens as voracity controls and four as moisture regain controls.

NOTE — A test control specimen should be known to support insect growth and should preferably, but not necessarily, be of the same type of material as the test specimen. A test control specimen is used to check that the test has been done correctly and that the test larvae are viable.

5.2 Form and characteristics

The specimens shall be of the forms and sizes given in table 1.

TABLE 1 — **Form and size of specimens**

Material	Form and size
Woven or knitted fabrics, felts and furs	Disks, 40 mm in diameter
Carpets	Squares approximately 30 mm × 30 mm, with tufts and/or loops along the edges intact
Carpet pile alone	200 mg specimens
Yarn	200 mg specimens, wound into a loose hank in the container

6 TEST INSECTS

6.1 The larva of any of the following test insects may be used as agreed to between the parties interested in the test results :

- *Attagenus piceus* (Oliv.)
  = *Attagenus megatoma* (Fabr.) (beetle)
- *Anthrenus flavipes* (Le Conte)
  = *Anthrenus vorax* (Waterhouse) (beetle)
- *Tineola bisselliella* (Hummel) (moth)
- *Tinea pellionella* (Linn.) (moth)

6.2 Details of breeding of the above larvae are given in the annex. There may be variations in the life cycle due to differences among strains of the same species of insects or the type of rearing medium used, which may call for some deviation in the age of the larvae used for tests. In that case, the deviation should be indicated in the test report. Differences caused by variation in temperature and humidity are largely overcome by use of the standard conditions given in clause 4.

7 PROCEDURE

7.1 Condition all sixteen specimens in the atmosphere specified in clause 4, for 24 h, then determine the mass of each separately in a stoppered weighing bottle (3.3) to an accuracy of 0,1 mg.

7.2 Place each of the specimens of known mass in a separate container (3.1). On to each of the four test specimens and the four voracity control specimens place fifteen larvae of the selected insect or pest.

7.3 Keep the sixteen containers in the dark, in the test atmosphere, for a period of 14 days.

7.4 After this time, remove all larvae, cast skins, excrement and loose fibres from the test specimens and voracity controls by means of pointed forceps and a camel hair brush (3.2). Transfer the test specimens, the voracity controls and the moisture regain controls to small tared weighing bottles (3.3).

7.5 Determine the mass separately of the test specimens, the voracity controls and the moisture regain controls.

7.6 If the mean loss in mass of the four voracity controls (see 8.1) is less than 35 mg, or if any single value is less than 25 mg, or if more than 25 % of the control larvae die or pupate, declare the test invalid.

8 EXPRESSION OF RESULTS

8.1 Method of calculation and formula

Determine the loss in mass, Δm, of each test specimen and voracity control, due to insect feeding, as follows :

$$\Delta m = \frac{m_0 \times m_3}{m_2} - m_1$$

where

m_0 is the mass of the test specimen or voracity control before exposure to larvae;

m_1 is the mass of the test specimen or voracity control after exposure to larvae;

m_2 is the mean initial mass of appropriate moisture regain controls;

m_3 is the mean final mass of appropriate moisture regain controls.

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8.2 Visual assessment of proofness

Examine each test specimen and assess the visible damage using the symbols given in tables 2 and 3.

TABLE 2 — **Estimation of cropping**

Symbol	Cropping : Visible surface damage
1	No detectable damage
2	Very slight visible cropping
3	Moderate cropping
4	Very heavy cropping

TABLE 3 — **Estimation of holes**

Symbol	Estimation of holes
A	No detectable damage
B	Yarn or fibres partially severed
C	A few small holes; yarn or fibres severed
D	Several large holes

8.3 Visual assessment of larval condition

Count and record for each test specimen the number of larvae in each of the following conditions :

a) live;

b) dead;

c) pupating.

8.4 Assessment of resistance

8.4.1 A tested sample of fabric, carpet or yarn shall be considered a borderline case of satisfactory resistance if any of the following applies :

a) visible surface damage and estimation of holes is assessed as attack level 2 B on two of the test disks or squares, or two test lengths of yarn, with the remaining test specimens undamaged;

b) visible surface damage and estimation of holes is assessed as attack level 3 B on any one test disk or square, or one test length of yarn, with the yarn or fibres partially severed at more than one point (indicative of uneven proofer application), with the remaining test specimens undamaged;

c) no surface damage is visible to the naked eye but the mean loss in mass is greater than 15,0 mg or the loss in mass of any one test specimen is greater than 20,0 mg. (This situation occurs not infrequently on carpets, furs and fabrics with a loosely raised rough pile, or thick yarns with a loose hairy surface.)

8.4.2 A tested sample of fabric, carpet or yarn shall be considered satisfactorily resistant if the attack level is assessed as less than that defined as borderline under 8.4.1 a), b) and c).

8.4.3 A tested sample of fabric, carpet or yarn shall be considered inadequately resistant if the attack level is assessed as greater than that defined as borderline under 8.4.1 a), b) and c). If the estimation of holes is assessed as C or D on any one test specimen, the sample falls into this category.

9 TEST REPORT

The test report shall include the following particulars :

a) a statement that the procedure was performed in accordance with this International Standard;

b) type of textile material under test;

c) whether or not the sample has been subjected to laundering or dry cleaning;

d) type of larvae used;

e) larval condition at end of test (see 8.3);

f) mean loss in mass, in milligrams, of the four test specimens (see 8.1);

g) an assessment of visible damage (see 8.2);

h) mean loss in mass, in milligrams, of the four voracity controls (see 8.1);

i) any deviation from the specified test procedure;

j) resistance assessment.

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ANNEX

BREEDING OF LARVAE

A.1 PRINCIPLE

The insect pests are cultured on suitable media for specified times under controlled atmospheric conditions. The cultures are sieved, and the larvae are collected for use in the test.

A.2 INSECTS

The method describes procedures for rearing and maintaining the following insect pests :

- *Attagenus piceus* (Oliv.)
  = *Attagenus megatoma* (Fabr.) (beetle)
- *Anthrenus flavipes* (Le Conte)
  = *Anthrenus vorax* (Waterhouse) (beetle)
- *Tineola bisselliella* (Hummel) (moth)
- *Tinea pellionella* (Linn.) (moth)

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A.3 APPARATUS

A.3.1 Rearing containers – glass jars of suitable shape and volume, provided with fine mesh metal screen or cloth covers.

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A.3.2 Test sieves, of nominal sizes of aperture as follows :

0,180 mm
0,80 mm
1,00 mm
1,25 mm

A.4 MEDIA

Six types of media commonly used to culture textile pests are described.

Medium 1

Fishmeal	70 g
Cornmeal	25 g
Powdered brewer's yeast	5 g

This formulation shall be ground to pass through a 0,80 mm sieve.

Medium 2

Scoured, undyed, wool fabric is treated with a solution of cholesterol in light petroleum (boiling point 60 to 80 °C) to obtain a 1 % deposit of sterol on the fabrics. The solvent is removed by heating and the fabric treated with an aqueous suspension of brewer's yeast to provide, after drying, a 50 to 80 % deposit.

Medium 3

Casein (to pass through a 0,180 mm sieve)	45 g
Casein flour	45 g
Powdered brewer's yeast	9 g
Cholesterol	1 g

Medium 4

Virgin wool, either as chopped fibres or yarn, impregnated with cholesterol and brewer's yeast.

Medium 5

Pure casein	46 g
Glucose	46 g
Brewer's yeast	5 g
Appropriate mixture of mineral salts[1]	2 g
Cholesterol	1 g

The elements shall be finely ground and mixed dry.

Medium 6

All-wool worsted white serge, impregnated with a 5 % dispersion of brewer's yeast in water.

A.5 PROCEDURE

A.5.1 Rearing conditions

Use the conditions of atmospheric temperature and humidity described in clause 4 for rearing the larvae.

1) The mixture of salts referred to as MD No. 185 of Ets NBC, Cleveland, Ohio (U.S.A.), is suitable.

A.5.2 Maintenance of cultures

A.5.2.1 *Attagenus piceus* (Oliv.)

At intervals of 4 months sieve the culture in medium 1. Larvae that pass through a 1,25 mm sieve but are retained by a 1,00 mm sieve will be used for the test. (Sieving in this way should give larvae of 4,5 to 6,5 mg.)

Place the adult beetles and larvae too large for the test in fresh medium. Place the material passing through the 1,25 mm sieve that contains small larvae in a separate container with an equal mass of fresh medium. At the end of the next 4 month period there should be no larvae in these containers small enough to pass through a 1,25 mm sieve. If there are, discard the sievings.

A.5.2.2 *Anthrenus flavipes* (Le Conte)

Fabric pieces (medium 2) are infested with adult beetles. Subsequently add fresh medium as required. After 11 weeks remove excess fabric and sieve the culture as in A.5.2.1. Larvae that are retained by the 1,00 mm sieve will be used for the test. (This should produce larvae of 0,8 to 1,2 mg.)

Mix the unused sievings and large larvae with medium 3. After about 4 to 6 weeks, use the adult beetles that appear on the surface for propagation of the culture.

A.5.2.3 *Tineola bisselliella* (Hummel)

A.5.2.3.1 METHOD 1

Medium 3 is infested with adult insects. After 24 to 26 days pass it through a 1,25 mm sieve. Illuminate the cocoons retained by the sieve from a height of 300 mm with a 100 W lamp.

Larvae suitable for the test, which should be 0,8 to 1,2 mg, emerge and crawl away from the light. Return the unused larvae to the medium for propagation of the culture.

A.5.2.3.2 METHOD 2

This is similar to method 1 but it employs medium 4.

A.5.2.3.3 METHOD 3

This is similar to method 1 but it employs medium 5.

A.5.2.4 *Tinea pellionella* (Linn.)

For starting a culture, daily introduce freshly emerged adults in a glass oviposition container. Every morning, remove eggs by inverting the oviposition jar in a glass dish. Cultures with a known number of eggs (150 to 200) are started in a rearing container feeding medium 5. The eggs hatch out within 5 to 6 days. Each culture thus contains about 150 to 200 larvae which when between 24 and 27 days old will be used as test insects.

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