

Standard Operating Procedure

Assessment of Abrasion Resistance of Insecticide-Treated Nets (ITNs)

1. Scope

This document describes the method for assessing the abrasion resistance of open mesh textile structures such as those used in Insecticide-treated Nets (ITNs). It is an accelerated abrasion test using a light abradant (sandpaper) to evaluate the propensity for hole formation subject to a dry, flat abrasive mechanism.

2. Referenced Documents

The following referenced documents are useful for the application of this document.

ISO 139:2005 Textiles – Standard atmosphere for conditioning and testing.

ISO 12947-1:1998 Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 1: Martindale abrasion testing apparatus.

ISO 12947-2:1998 Textiles – Determination of abrasion resistance of fabrics by the Martindale method – Part 2: Determination of specimen breakdown.

3. Terminology

Open mesh textile: A textile which due to its inherent structure consists of a large number of closely spaced apertures.

Abrasion rub: One revolution of the two outer drives of the Martindale abrasion tester¹.

Inspection interval: Period after a specified number of rubs at which each specimen is visually examined for failure.

Failure: A failure is defined as the breakage of a single filament yarn resulting in a hole of approximately 5 mm.

Face: The technical face of the fabric.

Back: The reverse side of the fabric.

¹ ISO 12947-1:1998 Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 1: Martindale abrasion testing apparatus.

In knitting, the technical face and back of the fabric are determined by the way the fabric is manufactured. Identification of the technical face and back of the fabric can be aided by optical microscopy in order to confirm the loop structure.

4. Summary of Test Method

A circular ITN test specimen mounted in a holder is rubbed against an abradant (sandpaper) of predetermined specification (240 Grit) using a Martindale abrasion tester (as described in ISO 12947-1:1998). The abradant imposes a pressure of 9 kPa on the specimen and traces a Lissajous figure. The specimen is exposed to a number of abrasion rubs, prior to an inspection interval and is inspected for failure. The initial inspection of the specimen is carried out at 10 rubs and subsequently at 25 rubs. After the 25 rubs inspection, the inspection intervals are every 25 rubs, up to 200 rubs. After 200 rubs, the inspection intervals are every 50 rubs, up to a total of 1000 rubs. The test is terminated when yarn breakage occurs in the specimen.

5. Significance and Use

This test is used to assess the abrasion resistance of an ITN that is subjected to a light abrasive action and is designed to reflect conditions that an ITN will be exposed to during normal use. This has particular significance for ITNs, because once yarn breakage occurs, a hole is created that can enable insects to penetrate the structure leading to the potential transmission of diseases such as malaria.

6. Apparatus and Materials

The apparatus required to conduct this test is a Martindale abrasion tester and auxiliary materials, as described in ISO 12947-1:1998.

The abradant required is a 240 Grit sandpaper on a Grade C paper (supplied by Sait Abrasives, Product code: SAITAC AW-C P240).

7. Sampling and Test Specimens

Sampling

Three different ITN samples are required for testing and five specimens per ITN sample are tested. The first four specimens are taken from four different side panels of the ITN, and the fifth specimen is taken from the roof panel as shown in in Figure 1.

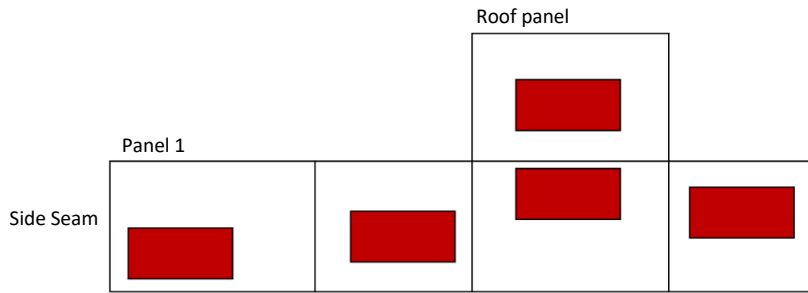


Figure 1 Example of sampling.

Therefore, a total number of 15 specimens is required for the measurements. When taking the specimens for testing it is important to ensure that they do not share wale yarns.

Specimens

The test specimen is a circle of at least 140 mm in diameter.

The test specimen backing fabric is 'standard wool' (as described in ISO 12947-1:1998) with dimensions of 140 mm (+/- 0.5 mm).

The test specimen backing consists of foam (PU foam as described in ISO 12947-1:1998) with dimensions of 140 mm (+/- 0.5 mm).

Abradant (Sandpaper)

The abradant material measures 38 mm in diameter (+/- 0.5 mm).

The abradant backing foam (PU Foam) measures 38 mm in diameter (+/- 0.5 mm).

Specimen mount

In some types of ITN specimen, it may be necessary to use a specimen mount, which is essentially a cut out fabric that is placed in-between the specimen and the mount holder of the Martindale to increase grip and stability of the specimen in the mount. This is made from the standard wool abradant fabric (as described in ISO 12947-1:1998).

The specimen mount is at least 160 mm in diameter with a 125 mm hole in the centre.

8. Conditioning

The atmospheres for preconditioning, conditioning, and testing of specimens are specified in ISO 139:2005.

9. Procedure

1. Mount the specimen on the specimen mount over the top of the auxiliary materials, in the following order:
 1. PU Foam.
 2. Standard wool fabric.
 3. Specimen.
 4. Specimen mount (if required).

It may be necessary to use a specimen mount to prevent it from slipping. A specimen mount is a circular piece of the standard wool fabric with a cut-out centre so that it does not interfere with the area of the specimen being tested. The procedure is illustrated in Figure 2 and Figure 3.

Note: If the structures of the face and back of the fabric are not identical, then an equal number of measurements should be made on both the face and back and reported separately. Accordingly, 15 specimens should be measured on the face, (face side up), and 15 specimens on the back, (back side up).

2. Mount the abrasant in the specimen holder. This should be placed over the PU foam as backing. Do not allow any creasing of the abrasant. Should creasing occur, discard the abrasant and use a new piece. Tips for mounting without creasing:
 - Cut the circular abrasant to size as accurately as possible, too large or too small may lead to creasing.
 - Cut the circular abrasant around its edges approximately every 10 mm, no cut should be longer than 2 mm, as illustrated in Figure 4.

Figures 5-8 illustrate acceptable and unacceptable examples.

3. Set the Martindale abrasion tester up to operate with 9 kPa pressure.
4. Set the Martindale abrasion tester so that it will stop at the relevant inspection intervals of 10 rubs, 25 rubs, then every 25 rubs up to 200 rubs. After 200 rubs, inspection should take place after every 50 rubs, up to a maximum of 1000 rubs.
5. At each inspection interval, inspect the specimen for yarn failure.
6. Once a yarn break is observed, the specimen fails. Remove the abrasant from this specimen and continue testing the other specimens.
7. The test is completed when all specimens have failed.



Figure 2 Order of mounting specimen – Side view.

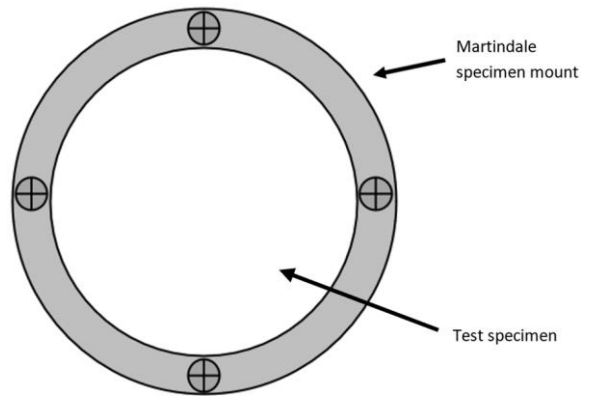


Figure 3 Mounting specimens to prevent slippage– view from above.

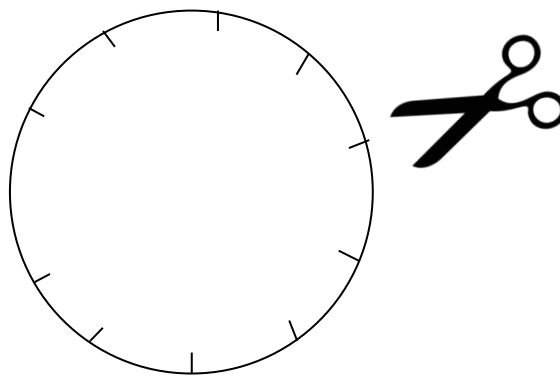


Figure 4 Cutting of the abrasant (sandpaper) around the edges to prevent creasing of the abrasant surface. Make small cuts towards the centre. No cut should be longer than 2 mm.

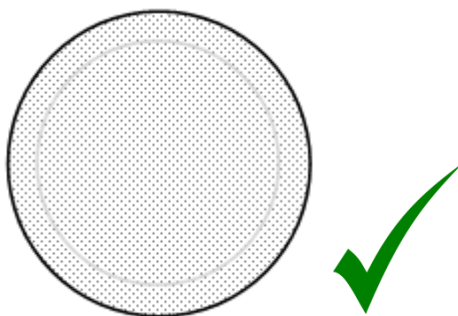


Figure 5 Correct mounting of the abrasant – no creases

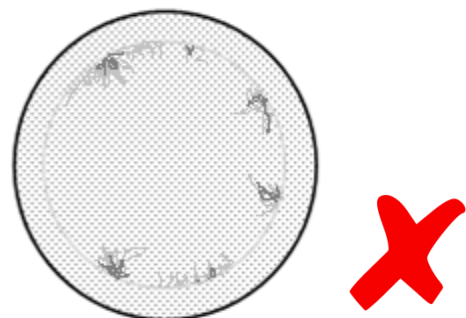


Figure 6 Incorrect mounting of the abrasant. Creases are present in the abrasant surface. Should this occur, discard and use a new piece of abrasant.

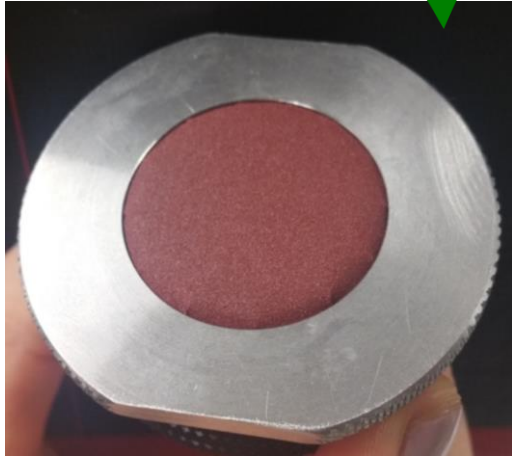


Figure 7 Example of acceptably mounted abrasant. No creases, flat top.



Figure 8 Example of unacceptably mounted abrasant. Creases are visible around the edge leading to an uneven testing surface.

10. Assessment

Results should be recorded in a matrix, an example of which is shown in Table 1.

At each inspection, after each rub interval:

- Record a zero (0) when a yarn break is observed in the specimen (specimen has failed).
- Record a one (1) when no yarn break is observed in the specimen (specimen is intact).

Table 1 Example of test data and interpretation of results.

Specimen Number	Number of Rubs										
	10	25	50	75	100	125	150	175	200	250	300
1	1	1	1	1	1	1	1	0	0	0	0
2	1	1	1	1	1	1	0	0	0	0	0
3	1	1	1	1	1	1	1	1	0	0	0
4	1	1	1	1	1	0	0	0	0	0	0
5	1	1	1	1	1	1	0	0	0	0	0
6	1	1	1	1	1	1	1	1	0	0	0
7	1	1	1	1	1	1	1	0	0	0	0
8	1	1	1	1	1	1	0	0	0	0	0
9	1	1	1	1	1	0	0	0	0	0	0
10	1	1	1	1	1	0	0	0	0	0	0
11	1	1	1	1	1	1	1	1	0	0	0
12	1	1	1	1	1	1	1	0	0	0	0
13	1	1	1	1	1	1	0	0	0	0	0
14	1	1	1	1	1	1	0	0	0	0	0
15	1	1	1	1	1	1	0	0	0	0	0
Intact Specimens	$(15/15)*100 = 100\%$	$(15/15)*100 = 100\%$	$(15/15)*100 = 100\%$	$(15/15)*100 = 100\%$	$(15/15)*100 = 100\%$	$(12/15)*100 = 80\%$	$(6/15)*100 = 40\%$	$(3/15)*100 = 20\%$	$(0/15)*100 = 0\%$	$(0/15)*100 = 0\%$	$(0/15)*100 = 0\%$

The abrasion resistance score is the number of rubs at which $\geq 66.7\%$ of the samples remain intact (5 out of 15). In the example shown in Table 1 the final abrasion resistance score is 125 rubs (80% of specimens are intact).

If the failure of specimens is spread across five or more inspection intervals, then the test should be repeated to determine better accuracy.

11. Test Report

Include in the test report:

- Sample details and identity.
- The date the test is conducted.
- Martindale tester manufacturer and model.
- The test operator.
- The location and laboratory.
- The conditions of testing if outside standard testing conditions outlined in this document.
- The pressure (kPa) at which the test is undertaken.
- The test data matrix as outlined in Section 10 Assessment (Table 1).
- The abrasion resistance score (number of rubs at which $\geq 66.7\%$ of specimens remain intact).