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Subject Torsion Durability of E-Textiles	
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Originating Task Group: D-74b E-Textiles Exposure and Durability Test Methods Task Group	

IPC-TM-650
TEST METHODS MANUAL

1 SCOPE

This test method is used for determining the change of one or more functionally relevant parameters in e-textiles as a result of cyclic torsion.

1.1 Principles of Test E-textile specimens are exposed to cyclic torsion up to a given number of cycles while observing a change of one or more relevant functional parameters throughout the cycles or at regular intervals. A specimen of custom size is cut from the e-textile and is cycled at a constant rate.

1.2 Terms and Definitions

1.2.1 Critical Area The areas of e-textiles that have a higher tendency of failure compared to other areas (e.g., joints, connection points, textile electrodes) or that if affected will negatively impact product functionality or the product capability to operate as intended.

1.2.2 Cycle When a sample returns to its original state after single reciprocation.

1.2.3 Cycle Rate The number of cycles per time unit.

1.2.4 Data Recorder A measuring device used to record electrical resistance or electrical continuity.

1.2.6 Torsion angle (α°) The angle a of the specimen at the maximum torsion position along the horizontal axis is set upon the application (see Figure 1).

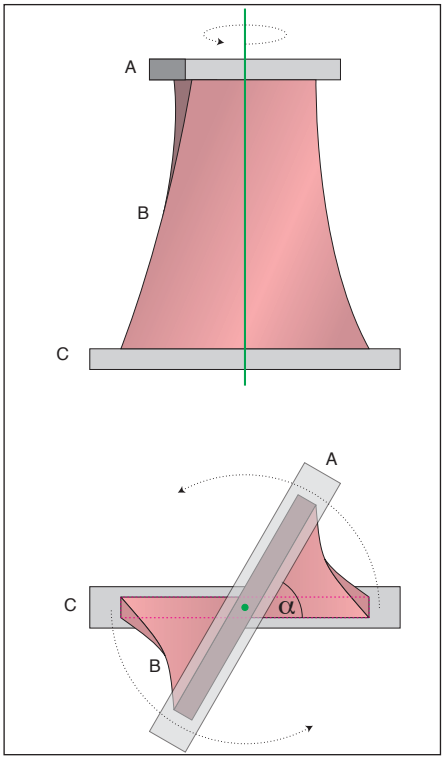

Figure 1 Torsion Angle (α°)

Figure key
A – Twisting specimen grip
B – Specimen under twisting
C – Fixed specimen grip

2 APPLICABLE DOCUMENTS

2.1 International Organization for Standardization (ISO)[1]

ISO 139 Textiles Standard atmospheres for conditioning and testing

3 TEST SPECIMENS

3.1 Specimen Preconditioning All test specimens **shall** be conditioned for ≥ 24 hours according to ISO 139. If other conditions are specified, they should be reported with the test results.

1 www.iso.org

3.2 Specimen Description Specimens **shall** be cut from the e-textile according to the following specifications:

- Specimens **shall** be cut from the e-textile in a way that the critical area(s) are located in the middle of the specimens and are exposed to torsion.
- The specimens **shall** be cut in rectangular shape. The width of the specimens **shall** be defined as W and the testing length as L.
- The specimen size **shall** be L = 200 mm x W = 50 mm. Other specimen sizes **shall** be reported.
- The specimen **shall** be able to clamp onto the torsion machine within its dimensions. Clamp width **shall** be larger or equal to specimen width. The specimen **shall** be able to be clamped onto the machine so that the specimen is completely secured along its width without deforming it.
- The distance d of the critical area(s) from the specimen sides **shall** be at least d = 5 mm to avoid edge effects (see Figure 2).

If applicable, remove insulation from conductive structures at both ends of the specimen for data recorder attachment.

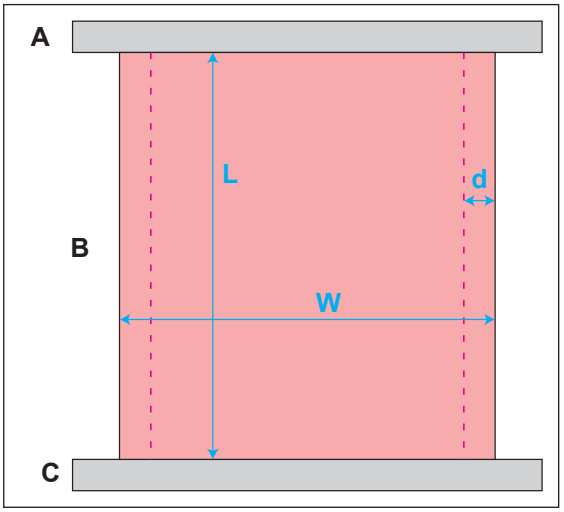

Figure 2 Specimen Length and Width

Figure key

L — Speciman length
W — Speciman width
d — Distance from specimen sides lengthwise and the functional parts
A — Twisting specimen grip
B — Specimen under twisting
C — Fixed specimen grip

Figure note: d is a distance from specimen's sides lengthwise and the functional parts

3.3 Number of Specimens The number of test specimens **shall** be defined to respect the statistical treatment (at least five per affected critical area).

4 APPARATUS AND MATERIAL

4.1 Torsion machine The torsion machine **shall** be able to perform cyclic torsion motion of the specimen with the given number of cycles for the angle α.

The test schematic is shown in Figure 3. An e-textile specimen is anchored to two fixtures on either end of the e-textile specimen. With one fixture stationary, the rotation of the second fixture will twist the e-textile specimen to a certain angle, return it to its original state and then twist it in the opposite direction. Both fixtures can also rotate in opposite directions.

4.2 Data recorder for functionality testing

5 PROCEDURE

5.1 Using the data recorder, measure the initial value of the relevant functional parameter(s). Conduct a visual inspection of the specimen prior to testing.

5.2 The specimen should be clamped in a way that the specimen is free from additional tension and without altering it physically or electrically.

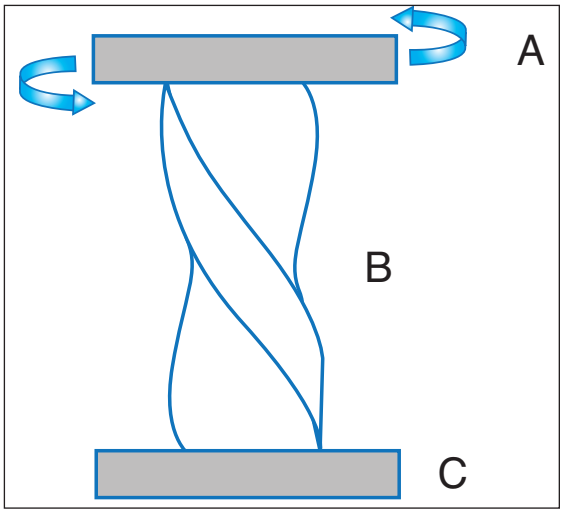

Figure 3 Torsion Test Setup

Figure key

A – Twisting specimen grip
B – Specimen under twisting
C – Fixed specimen grip

The specimen **shall** be clamped evenly and flat against the clamping surfaces. The specimen **shall** be free of wrinkles or folds when mounted into the machine.

5.3 Set the torsion angle α to reflect use case conditions or other target values.

5.4 Conduct the test up to the target number of cycles.

5.5 Continuously or periodically monitor the functional parameter(s) of the specimen.

5.6 After the test is performed, perform a visual inspection of the test specimen.

6 TEST REPORT

The report **shall** contain the following information:

- Date and time of test
- Testing location and name of tester
- Environmental test conditions (if differing from ISO 139)
- Number of test specimens
- Description of test specimens (size, cutting direction (warp/weft (wovens), course/wale (knits)), type of critical area, location of critical area within specimen, etc.)
- Description/Specifications of testing equipment
- Testing parameters/specifications (number of test cycles, torsion angle, other info)
- Cycle count for intermediate testing
- Test results (parameter values before, during (if applicable) and after testing); if applicable: plotting of parameter values over cycle count), other types of measurements
- Results of visual inspection before, during (if applicable) and after testing
- Any deviations from the presented methods
- Comments

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