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Subject Flexing 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 flexing.

1.1 Principles of Test E-textile specimens are exposed to cyclic flexing 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 Data Recorder A measuring device used to record electrical resistance or electrical continuity.

1.2.4 Flex Distance The distance travelled by the specimens during the flexing durability test, measured as the distance between the initial position of the movable clamp to the final position of the clamp.

1.2.5 Gauge Length The length of the specimen that can be clamped to the machine with minimal tension (without visible extension) across the sample, from the end of one clamp point to the beginning of the second clamp point.

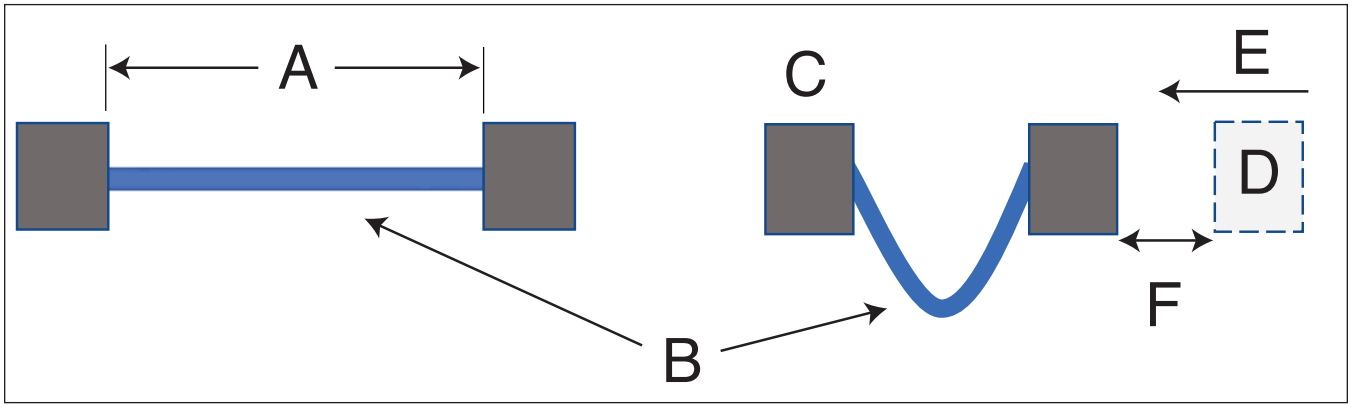

Figure 1 Flex Test of E-textile Specimen (Sample Before Testing (l) – Sample During Testing (r))

Figure key

A – Gauge length (mm)
B – E-textile
C – Fixed clamp
D – Moveable clamp
E – Direction of motion
F – Flex distance (mm)

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.

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 (area between clamps) and are exposed to flexing.
- The specimens **shall** be cut in rectangular shape. The width of the specimens **shall** be defined as W and the testing length or gauge length as L.
- The specimen **shall** be able to clamp onto the flex machine within its dimensions. The specimengauge length (L) **shall** be chosen according to test device dimensions. The total length (l) **shall** be chosen to reflect gauge length and allow for clamping.
- The specimen width (W) **shall** be chosen according to clamp width. Clamp width **shall** be larger or equal to specimen width. The specimen **shall** be able to clamp onto the machine so that the specimen is completely secured along its width without deforming the specimen. Specimen width **shall** be appropriate for the width of critical area(s).

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

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 Flexing Machine The flex machine **shall** be able to perform cyclic rectilinear motion of the specimen with the given number of cycles for the different flex distances.

4.2 Data recorder for functionality testing

5 PROCEDURES

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. 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 maximal flex distance and gauge length to reflect use-case conditions or other target values.

5.4 Conduct test up to the target number of cycles.

1 www.iso.org

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

5.6 After the test is performed, conduct a visual inspection of the 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 (maximum flex distance, gauge length, number of test cycles, other info)
- Cycle count/time intervals for intermediate testing
- Test results (parameter values before, during (if applicable) and after testing); if applicable: plotting of parameter values over time / cycle count) or other types of measurements (e.g., tensile behavior)
- Results of visual inspection before, during (if applicable) and after testing
- Any deviations from the presented methods
- Comments

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