

IPC-TM-650 TEST METHODS MANUAL

Number 2.6.29.1	
Subject UV Radiation Exposure of E-Textiles	
Date 02/2025	Revision
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Originating Task Group: D-74b E-Textiles Exposure and Durability Test Methods Task Group	

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 exposure to ultraviolet (UV) radiation.

1.1 Principles of Test The e-textile is exposed to UV radiation under specified climate conditions for an extended amount of time while observing a change of one or more relevant functional parameters throughout testing or at regular intervals.

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

1.2.3 Exposure Time Duration of active irradiation.

1.2.4 Irradiance (W/m²) This is the total amount of radiant power incident on a surface per unit area.

1.2.5 Radiant Power (W) This is the total amount of energy emitted by a UV radiation source per unit of time.

1.2.6 Ultraviolet Radiant Exposure (J/m²) This is the cumulative amount of ultraviolet radiation received by a surface over a time interval.

1.2.7 Ultraviolet Radiation Source A radiation source, such as a xenon arc gas lamp, that emits electromagnetic energy across the spectral range of ultraviolet radiation (UVR), which spans from 100 nm to 400 nm. This includes UV sources for UVA, UVB and UVC radiation.

2 APPLICABLE DOCUMENTS

2.1 International Organization for Standardization (ISO)¹

ISO 139 Textiles Standard atmospheres for conditioning and testing

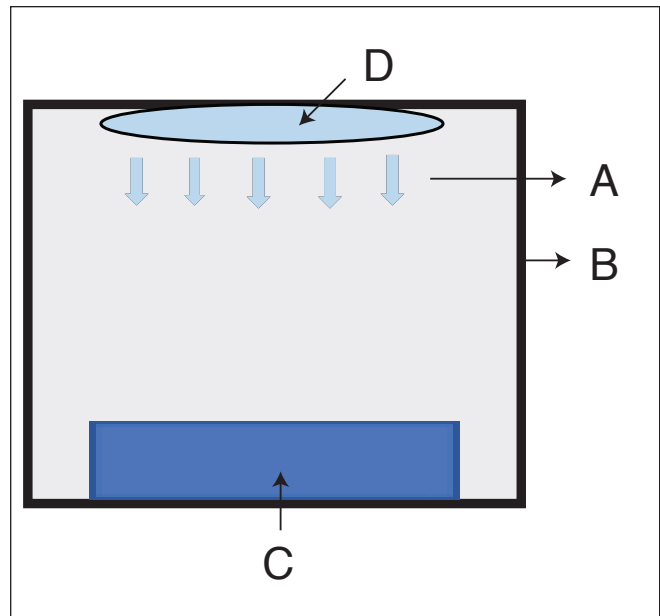


Figure 1 UV Exposure Test of E-Textile Specimen

A – UV radiation B – Environmental chamber
C – E-textile D – UV source

¹ www.iso.org

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3 TEST SPECIMENS

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

3.2 Specimen Description The specimens **shall** be able to fit inside the environmental chamber in a way that the critical area(s) is/are uniformly and actively irradiated by the UV source (see Figure 1). If the whole e-textile specimen is too large to fit into the chamber in this manner, a smaller specimen containing the critical area(s) **shall** be cut from the e-textile.

If applicable, remove insulation from conductive structures 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 / at least five per affected critical area).

4 APPARATUS

4.1 Environmental chamber, which is a controlled testing enclosure with humidity and temperature control mechanisms for simulating various environmental conditions. The chamber **shall** be outfitted with a UV fluorescent lamp (a xenon arc lamp is preferable), a timer and a radiometer (which measures the total radiant power of the UV radiation received by the test specimen) for continuous monitoring.

4.2 Data recorder for functional testing

5 TEST 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 Choose a UV radiation source capable of providing target levels of irradiance and radiant power to achieve target levels of UV radiant exposure. The choice of UV radiation should reflect use case related exposure conditions.

5.3 Choose testing conditions from Table 1 that most closely resemble the use case of the e-textile and set the environmental chamber accordingly. The use of accelerated testing conditions is not recommended, due to the possibility of excessive damages and different materials reacting differently to accelerated conditions.

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Table 1 Environmental Testing Conditions

Environment Classification	Temperature	Relative Humidity (RH)
Ambient Temperature	21 °C, ±5 °C [70 °F, ± 41 °F]	65%, ±10%
Extreme Cold	-20 °C, ±2 °C [-4 °F, ± 36 °F]	—
Cold/Dry	5 °C, ±3 °C [41 °F, ± 38 °F]	25%
Cold/Humid	5° C, ±3 °C [41 °F, ± 38 °F]	85%, ±5%
Warm/Humid	30 °C, ±3 °C [86 °F, ± 38 °F]	90%, ±5%
Tropical	40 °C, ±2 °C [104 °F, ± 36 °F]	90%, ±5%
Hot/Dry	50 °C, ±3 °C [122 °F, ± 38 °F]	25%, ±5%
Desert	60 °C, ±2 °C [140 °F, ± 36 °F]	15%, ±5%

5.4 Specimens **shall** be flatly positioned and free of wrinkles or folds when placed inside the chamber.

5.5 Expose the e-textile specimen to the chosen conditions up to the target exposure time.

5.6 Testing may be paused before the target testing time is reached to do intermediate checks of the functional parameters. If possible, continuous monitoring of the parameters during the exposure is advised.

5.7 After the test is performed, repeat the measurement of the functional parameters.

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 if variation is possible (UV radiation levels and type, climate conditions, test duration, other info)
- 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)
- Results of visual inspection before, during (if applicable) and after testing
- Any deviations from the presented methods
- Comments

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