

IPC-TM-650 TEST METHODS MANUAL

Number 2.6.29	
Subject Climate Exposure of E-Textiles (Temperature and Moisture)	
Date 02/2025	Revision
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Originating Task Group: 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 various climate conditions.

1.1 Principles of Test The e-textile is exposed to either cyclically changing climate conditions, or to fixed 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 Cycle One complete cycle entails heating from the lowest to the highest temperature at a specified humidity level and cooling back to the lowest temperature. A cycle may be started at any temperature within the range and is considered completed once the starting temperature is reached again after both the highest and lowest temperature. Alternatively, the temperature can be a fixed value and the humidity can be cycled between an upper and lower value.

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

2 APPLICABLE DOCUMENTS

2.1 International Organization for Standardization (ISO)¹

ISO 139 Textiles Standard atmospheres for conditioning and testing

3 TEST SPECIMEN

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 The entire e-textile **shall** be tested.

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).

¹ www.iso.org

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4 APPARATUS AND MATERIALS

4.1 Controlled temperature testing chamber (enclosed environmental chamber) capable of heating and cooling within the target range of temperatures at a specified testing speed. If temperature testing at different humidity levels is required, the chamber should be equipped with humidity controls. The size of the chamber **shall** be large enough to hold at least one specimen.

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 Procedure for Cyclic Temperature Testing

5.2.1 The upper and lower temperature limits and the fixed humidity level **shall** be as agreed between user and supplier (AABUS) to reflect application-specific conditions.

5.2.2 The number of test cycles **shall** be chosen according to the target classification or other requirements.

5.2.3 The specimen(s) is placed in the chamber and exposed to the chosen number of cyclic temperature changes.

5.2.4 Functionality testing **shall** be repeated at previously specified cycles and after the last cycle. If possible, continuous monitoring of the parameters during the exposure is advised.

5.3 Procedure for Cyclic Humidity Testing

5.3.1 The upper and lower humidity limits and the fixed temperature level **shall** be AABUS to reflect application-specific conditions.

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%

5.3.2 The number of test cycles **shall** be chosen according to the target classification or other requirements.

5.3.3 The specimen(s) is placed in the chamber and exposed to the chosen number of cyclic humidity changes.

5.3.4 Functionality testing **shall** be repeated at previously specified cycles and after the last cycle. If possible, continuous monitoring of the parameters during the exposure is advised.

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5.4 Procedure for Prolonged Exposure

5.4.1 For noncyclic testing in the form of prolonged exposure, a fixed temperature and humidity level **shall** be chosen to reflect application-specific conditions (see Table 1, other conditions may be chosen).

5.4.2 The specimen is placed in the chamber and exposed for the chosen target duration at a specific temperature and humidity level.

5.4.3 Functionality testing **shall** be repeated at previously specified time intervals and after the test. If possible, continuous monitoring of the parameters during the exposure is advised.

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
- Description/Specifications of testing equipment
- Testing parameters/specifications if variation is possible (climate conditions, test duration, 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)
- Results of visual inspection before, during (if applicable) and after testing
- Any deviations from the presented methods
- Comments

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