

Number 2.3.43	
Subject E-Textiles Washing and Drying	
Date 02/2025	Revision
Gage R&R: <input type="checkbox"/> Complete <input checked="" type="checkbox"/> In Progress <input type="checkbox"/> Available <input type="checkbox"/> NO	
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 exposure to domestic washing and drying procedures. The procedures are applicable to e-textiles and e-textiles systems (e.g., e-textiles wearables) which will be exposed to washing and drying procedures.

**1.1 Principles of Test** The e-textile is exposed to (repeated) domestic cleaning procedures (which includes both washing and drying) up to a given number of cycles while monitoring one or more functional relevant parameters after specified cycles.

### 1.2 Terms and Definitions

**1.2.1 Cleaning Cycle** Any hand-washing or machine-washing procedure combined with any of the drying procedures.

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

**1.2.3 Drying Procedures** Based on ISO 6330, any of the following item is a drying procedure:

- Line dry
- Drip line dry
- Flat dry
- Drip flat dry
- Flat press
- Tumble dry

**1.2.4 Hand Washing Procedure** A procedure of manual washing to clean e-textiles that does not use an automated washing device.

**1.2.5 Machine Washing Procedure** A washing procedure representing a domestic machine wash cycle.

## 2 APPLICABLE DOCUMENTS

### 2.1 International Organization for Standardization (ISO)<sup>1</sup>

**ISO 139** Textiles Standard atmospheres for conditioning and testing

**ISO 6330** Textiles Domestic washing and drying procedures for textile testing

<sup>1</sup> www.iso.org

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### 3 TEST SPECIMENS

**3.1 Specimen Preconditioning** All test specimens **shall** be conditioned for  $\geq 24$  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. Any detachable electronics or hardware parts **shall** be removed from the e-textile prior to washing.

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

### 4 APPARATUS AND MATERIALS

**4.1 Washing Machine** Any washing device compliant with ISO 6330, or a domestic washing machine accommodating at least the following washing programs:

- Delicate, Regular and Heavy (for top-loading vertical-axis machines)
- Delicate, Easy Care and Cotton (for front- or top-loading horizontal-axis machines)

**4.2 Detergent** The instructions for detergent **shall** be followed from ISO 6330. Any other detergent used **shall** be reported.

**4.3 Ballast** A ballast is added to the washing procedure to meet the weight (total 2 kg) requirement of each cycle. For different types of ballasts for washing procedures, see ISO 6330. Any other textile-based materials can also be used. The type of ballast used **shall** be indicated in the report.

**4.4 Hand-Washing** Any suitable container with a specified capacity (5 L is the minimum amount for the capacity).

**4.5 Tumble Dryer** Any tumble dryer compliant with ISO 6330 or any domestic dryer capable of providing similar drying programs as standard.

**4.6** Data recorder for functionality testing

### 5 PROCEDURES

#### 5.1 Domestic Washing Machines

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

**5.1.2** Weigh the specimen(s) and add ISO 6330 base load (ballast) items to reach a total load of 2 kg. The weight of the specimen(s) should not exceed 1 kg. Depending on the weight of the specimen, multiple specimens may be washed at the same time.

**5.1.3** ISO 6330 detergent no. 3 without bleach component and activator **shall** be used for machine type A and B. ISO 6330 detergent no. 4 **shall** be used for machine type C. For type C, use 1.33 g per L, for machine type A 20 g per cycle, and for machine type B an adequate amount (see ISO 6330 for guidance). When using a domestic washing machine, choose the detergent for the machine type that resembles the domestic machine used for testing.

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**5.1.4** Put the specimen(s), the base load items and detergent into the washing machine (either ISO 6330 compliant machine or domestic machine). Choose a suitable program provided in the standard. If using a domestic machine, choose a suitable program from the three programs mentioned in 4.1. (For guidance on the suitable program or cycle, see ISO 6330 Annex Z.)

**5.1.5** Remove the specimen(s) after washing without stretching or twisting them. To complete a cleaning cycle, a suitable drying procedure **shall** be followed (see 1.2.3 for drying procedures).

**5.1.6** After one cleaning cycle, a functionality test and visual inspection of the specimen **shall** be conducted after conditioning the specimen for  $\geq 12$  hours according to ISO 139.

Multiple wash cycles may be conducted without intermediate drying and functionality testing/visual assessment. Wash cycles after which measurements are taken **shall** be reported.

**5.1.7** Repeat until the desired cycle number is reached. (See ISO 6330 Annex Y for suitable cycle numbers.)

## **5.2 Handwashing**

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

**5.2.2** Fill the container with water of the intended temperature, for each L of water, add 1.05 g of ISO 6630 detergent no. 3 and stir until dissolved. Add the test specimen. Only one specimen **shall** be tested at the same time.

**5.2.3** Let the specimen(s) soak for five minutes. Gently rub the specimen against itself, gently squeeze it and swish it around for one minute. Repeat both steps.

**5.2.4** Remove the specimen from the suds and gently squeeze out as much water as possible. Discard the suds and refill the container with clean water. Return the specimen to the container.

**5.2.5** Repeat the soaking and washing step with the clean water.

**5.2.6** Carefully wring the specimen to remove as much water as possible

**5.2.7** To complete a cleaning cycle, a suitable drying procedure **shall** be followed (see 1.2.3 for drying procedures).

**5.2.8** After one cleaning cycle, a functionality test and visual inspection of the specimen **shall** be conducted after conditioning the specimen for  $\geq 12$  hours according to ISO 139. Multiple wash cycles may be conducted without intermediate drying and functionality testing/visual assessment. Cycles after which measurements are taken **shall** be reported.

**5.2.9** Repeat until the desired cycle number is reached. (See ISO 6630 Annex Y for suitable cycle numbers.)

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## 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 washing and drying devices and other testing equipment
- Testing parameters/specifications: washing method (including temperature), drying method, number of test cycles
- Cycle count for intermediate testing
- Test results (parameter values before and after testing); if applicable: plotting of parameter values over time / cycle count), or other types of measurements (e.g., tensile behavior)
- Visual Results of visual inspection before, during (if applicable) and after testing
- Any deviations from the presented methods
- Comments

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