GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17874

General Specification for Humid Heat Constant Testing

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard specifies the procedure that verifies the immunity of Rechargeable Energy Storage System (RESS) to elevated humidity that may lead to electrical sneak paths as well as functional and material degradation.

1.2 Applicability. RESS pack, section, and/or module systems, components or materials.

Note: Samples of systems, components or materials released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM department prior to the start of delivery of production level systems, components or materials.

Note: Hybrid controllers, Battery Disconnect Unit (BDU), and other internal electrical/electronic components are also required to meet GMW3172.

1.3 Remarks. This standard describes methods for evaluating RESS systems, components or materials, i.e., Device Under Test (DUT), in their intended subsystem assembly using temperature extremes specified in applicable Battery and/or Cell Manufacturer Specifications and/or DUT Subsystem Technical Specifications (SSTS) or Component Technical Specifications (CTS). The performance measure is determined by the Functional Status Classification (FSC), see Table A1 in Appendix A, Humid Heat Constant is Class A. A Program Specific Technical Specification may include additional program specific requirements that are not referenced in this standard and may supersede any requirements of this standard. In the case of any conflicts between this standard and the Program Specific Technical Specification, the Program Specific Technical Specification takes precedence. See also GMW16390.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

IEC 60068-2-14 ISO 16750-4

2.2 GM Standards/Specifications.

GMW16390

2.3 Additional References.

- Battery and/or Cell Manufacturer Specifications and/or Device Under Test (DUT) Subsystem Technical Specification (SSTS) or Component Technical Specification (CTS)
- Customer Requests and/or Requirements, i.e., Test Request
- Program Specific Technical Specification

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

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3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment. Sized for the RESS to be tested.

3.2.1 Environment Chamber. The chamber shall have the following features:

- Sensing devices for monitoring the temperature and humidity shall be able to be repositioned in the working space. For heat-dissipating specimens, the temperature and humidity near the specimen may be influenced by the effect of heat dissipation from the specimen.
- Condensed water is drained from the chamber and not re-used unless purified.
- No condensed water from the walls and roof of the test chamber can fall on the RESS
- Water utilized to maintain humidity levels has electrical conductivity of not more than 20 µS/cm.
- The RESS shall not be subjected to radiant heat from the chamber conditioning devices.
- Injected moisture, when applicable, is injected remotely from the RESS not directly on it.
- The volume of the test chamber is at least five times the total volume of the RESS under test.
- A RESS mounting device, when used, has minimum influence on the heat and humidity exchanges between RESS and surrounding conditions, unless otherwise specified in Battery and/or Cell Manufacturer Specifications and/or Device Under Test (DUT) Subsystem Technical Specification (SSTS) or Component Technical Specification (CTS).

3.2.2 Voltage and Current Cycler.

3.2.3 Coolant Conditioner. Liquid cooled RESS only.

3.2.4 Fan. Air cooled RESS only.

3.2.5 Data Acquisition System (DAQ). Appropriate equipment is required to acquire and store all necessary data. Data must be recorded using appropriate software for the cycler in use. Data sources will include data measured by the cycler and any external process indicators, i.e., flow meters. There may be additional data sources.

3.3 Test Vehicle/Test Piece. Air or liquid cooled RESS pack, section, and/or module.

3.4 Test Time.

Calendar time:	11 days
Test time:	240 hours
Coordination time:	8 hours

3.5 Test Required Information. All limits imposed by the Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS shall be observed over the course of testing. In the case of any power, current, voltage and temperature conflicts between this standard and the Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS, the Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS take precedence.

3.6 Personnel/Skills. All personnel performing tests must have up to date training in a high voltage training program and be familiar with IEC 60068-2-14 and ISO 16750-4.

3.7 Personal Protection Equipment (PPE). PPE, such as high voltage gloves, face shields, fire extinguishers, etc., shall be in good working order and available in the immediate area used in the execution of the testing.

4 Procedure

4.1 Preparation.

4.1.1 Review the Customer Requests and/or Requirements, i.e., Test Request. **Note:** This is to be provided in writing prior to the start of the test.

4.1.2 Review the applicable Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS conditions for test parameters.

4.1.3 Perform DUT initial inspection as defined by the test requestor.

4.2 Conditions. Cell balancing is to be conducted continuously during Operating Type 3.2. See 4.3 and Table A2 in Appendix A.

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4.2.1 Environmental Conditions. Unless specified otherwise, the environment ranges and tolerances to be used for all testing are as shown in Table 1.

Table 1: Environmental Parameters and Tolerances

Parameter	Range	Tolerance
Chamber Temperature, Generate and Measure	50 °C	± 3 °C
Chamber Humidity, Generate and Measure	60% Relative Humidity (RH)	± 5% RH
Lab Environment Temperature, Measure	25 °C	± 10 °C
Lab Environment Humidity, Measure	10% to 85% RH	± 5% RH
Coolant	40 °C	± 1.5 °C
Maximum Cell Temperature	55 °C	Not applicable
Low Voltage Supply	13.5 V	± 0.1 V

4.2.1.1 Unless specified otherwise by the test requestor, the ambient environment for the DUT should be maintained in accordance with the Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS using the tolerances of Table 1.

4.2.1.2 Unless specified otherwise by the test requestor or defined in the Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS, when changing temperature, i.e., a new test starts or a temperature change occurs within the test, the DUT is required to have environmental conditioning per 4.2.1.2.1 thru 4.2.1.2.4.

4.2.1.2.1 Temperature. Soak until average cell temperature equals the desired test temperature within 3 °C, where delta cell temperature, i.e., Maximum Cell Temperature ($T_{max\ cell}$) – Minimum Cell Temperature ($T_{min\ cell}$) is ≤ 5 °C. See 4.3.

4.2.1.2.2 Humidity. Controlled as specified in 4.3.

4.2.1.2.3 Coolant Conditioner (Liquid Cooled RESS). Coolant conditioning is off.

4.2.1.2.4 Fan (Air Cooled RESS). The fan speed is off.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 General Procedure Notes.

4.3.1.1 Operating Type. Varies: 1.25, 3.1, and 3.2. See Table A2 in Appendix A.

4.3.1.2 Monitoring. Continuous: Cell (thermistor) temperatures, cell voltages, Ambient Temperature, Chamber (T_{amb}), isolation, when maximum cell (thermistor) reaches 25 °C, and any additional data as specified in the Customer Requests and/or Requirements, i.e., Test Request.

4.3.1.3 Criteria. The FSC shall be Class A (Table A1 in Appendix A), the RESS shall be fully functional before, during and after test. Sample data at once per second. Isolation resistance shall be monitored and recorded during the 1 h rest periods as described in 4.3.2. Isolation resistance as measured during the test, may degrade during the test, but shall not exceed minimum isolation resistance values as specified in the Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS. The minimum isolation as measured during the test should be > 1 MΩ. Note any signs of electrolysis or electromigration within the RESS, if present. A cell level Design Review Based on Test Results (DRBTR) inspection and cell tear down (positive middle negative cell in a module) is required.

During the electrical cycling, the RESS shall cycle using durability current profiles based on the Battery and/or Cell Manufacturer Specifications and/or DUT SSTS or CTS operating temperatures and current limits. These limits shall be defined and agreed upon between the RESS Validation and RESS System Engineer (Table A2 in Appendix A).

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