METHOD 1004.7

MOISTURE RESISTANCE

1. PURPOSE. The moisture resistance test is performed for the purpose of evaluating, in an accelerated manner, the resistance of component parts and constituent materials to the deteriorative effects of the high-humidity and heat conditions typical of tropical environments. Most tropical degradation results directly or indirectly from absorption of moisture vapor and films by vulnerable insulating materials, and from surface wetting of metals and insulation. These phenomena produce many types of deterioration, including corrosion of metals; constituents of materials; and detrimental changes in electrical properties. This test differs from the steady-state humidity test and derives its added effectiveness in its employment of temperature cycling, which provides alternate periods of condensation and drying essential to the development of the corrosion processes and, in addition, produces a "breathing" action of moisture into partially sealed containers. Increased effectiveness is also obtained by use of a higher temperature, which intensifies the effects of humidity. The test includes a low-temperature subcycle that acts as an accelerant to reveal otherwise indiscernible evidences of deterioration since stresses caused by freezing moisture tend to widen cracks and fissures. As a result, the deterioration can be detected by the measurement of electrical characteristics (including such tests as voltage breakdown and insulation resistance) or by performance of a test for sealing. Provision is made for the application of a polarizing voltage across insulation to investigate the possibility of electrolysis, which can promote eventual dielectric breakdown. This test also provides for electrical loading of certain components, if desired, in order to determine the resistance of current-carrying components, especially fine wires and contacts, to electrochemical corrosion. Results obtained with this test are reproducible and have been confirmed by investigations of field failures. This test has proved reliable for indicating those parts which are unsuited for tropical field use.

2. APPARATUS. The apparatus used for the moisture resistance test shall include temperature-humidity chambers capable of maintaining the cycles and tolerance described on figure 1004-1 and electrical test equipment capable of performing the measurements in 3.6 and 4.

3. PROCEDURE. Specimens shall be tested in accordance with 3.2 through 3.7 inclusive, and figure 1004-1. Specimens shall be mounted in a manner that will expose them to the test environment.

3.1 Initial conditioning. Unless otherwise specified, prior to mounting specimens for the moisture resistance test, the device leads shall be subjected to a bending stress, initial conditioning in accordance with test condition B_1 of method 2004. Where the specific sample devices being subjected to the moisture resistance test have already been subjected to the required initial conditioning, as part of another test employing the same sample devices, the lead bend need not be repeated.

3.2 Initial measurements. Prior to step 1 of the first cycle, the specified initial measurements shall be made at room ambient conditions, or as specified. When specified, the initial conditioning in a dry oven (see figure 1004-1) shall precede initial measurements and the initial measurements shall be completed within 8 hours after removal from the drying oven.

3.3 Number of cycles. Specimens shall be subjected to 10 continuous cycles, each as shown on figure 1004-1. In the event of no more than one unintentional test interruption (power interruption or equipment failure) prior to the completion of the specified number of cycles (except for the last cycle) the cycle shall be repeated and the test may continue. Unintentional interruptions occurring during the last cycle require a repeat of the cycle plus an additional uninterrupted cycle. Any intentional interruption, or any unintentional interruption of greater than 24 hours requires a complete retest.

3.4 Subcycle of step 7. During at least 5 of the 10 cycles a low temperature subcycle shall be performed. At least 1 hour but not more than 4 hours after step 7 begins, the specimens shall be either removed from the humidity chamber, or the temperature of the chamber shall be reduced, for performance of the subcycle. Specimens during the subcycle shall be conditioned at -10°C +2°C, -5°C, with humidity not controlled, for 3 hours minimum as indicated on figure 1004-1. When a separate cold chamber is not used, care should be taken to assure that the specimens are held at -10°C +2°C, -5°C, for the full period. After the subcycle, the specimens shall be returned to 25°C at 80 percent relative humidity (RH) minimum and kept there until the next cycle begins.

3.5 Applied voltage. During the moisture resistance test as specified on figure 1004-1, when specified (see 4), the device shall be biased in accordance with the specified bias configuration which should be chosen to maximize the voltage differential between chip metallization runs or external terminals, minimize power dissipation and to utilize as many terminals as possible to enhance test results.

3.6 Conditions (see figure 1004-1). The rate of change of temperature in the chamber is unspecified; however, specimens shall not be subject to the radiant heat from the chamber conditioning processes. The circulation of air in the chamber shall be at a minimum cubic rate per minute equivalent to five times the volume of the chamber unless otherwise specified. The steady-state temperature tolerance is ±2°C of the specified temperature at all points within the immediate vicinity of the specimens and at the chamber surfaces. Specimens weighing 25 pounds or less shall be transferred between temperature chambers in less than 2 minutes.

3.7 Final measurements. Following step 6 of the final cycle (or step 7 if the subcycle of 3.3 is performed during the tenth cycle), devices shall be conditioned for 24 hours at room ambient conditions after which either an insulation resistance test in accordance with method 1003, test condition A, or the specified 25°C electrical end-point measurements shall be performed. Electrical measurements may be made during the 24 hour conditioning period. However, any failures resulting from this testing shall be counted, and any retesting of these failures later in the 24 hour period for the purpose of obtaining an acceptable result is prohibited. No other test (e.g., seal) shall be performed during the 24 hour conditioning period. The insulation resistance test or the alternative 25°C electrical end-point measurements shall be completed within 48 hours after removing the devices from the chamber. When the insulation resistance test is performed, the measured resistance shall be no less than 10 megohms and the test shall be recorded and data submitted as part of the end-point data. If the package case is electrically connected to the die substrate by design, the insulation resistance test shall be omitted and the specified 25°C electrical end-point measurements shall be completed within 48 hours after removal of the device from the chamber. A visual examination and any other specified end-point electrical parameter measurements (see 4.c) shall also be performed.

3.8 Failure criteria. No device shall be acceptable that exhibits:

a. Specified markings which are missing in whole or in part, faded, smeared, blurred, shifted, or dislodged to the extent that they are not legible. This examination shall be conducted with normal room lighting and with a magnification of 1X to 3X.

b. Evidence of corrosion over more than 5 percent of the area of the finish or base metal of any package element (i.e., lid, lead, or cap) or any corrosion that completely crosses the element when viewed with a magnification of 10X to 20X.

c. Leads missing, broken, or partially separated.

d. Corrosion formations which bridge between leads or between leads and metal case.

e. Electrical end-point or insulation resistance test failures.

NOTE: The finish shall include the package and entire exposed lead area from meniscus to the lead tip (excluding the sheared off tip itself) and all other exposed metal surfaces.

4. SUMMARY. The following details shall be specified in the applicable acquisition document:

   a. Initial measurements and conditions, if other than room ambient (see 3.1 and 3.2).

   b. Applied voltage, when applicable (see 3.5), and bias configuration, when required. This bias configuration shall be chosen in accordance with the following guidelines:

      (1) Only one supply voltage (V) either positive or negative is required, and an electrical ground (GND) or common terminal. The magnitude of V will be the maximum such that the specified absolute maximum ratings are not exceeded and test conditions are optimized.

      (2) All normally specified voltage terminals and ground leads shall be connected to GND, unless otherwise specified.

      (3) All data inputs, unless otherwise specified, shall be connected to V. The polarity and magnitude of V is chosen to minimize internal power dissipation and current flow into the device. All extender inputs shall be connected to GND, unless otherwise specified.

      (4) All additional leads, e.g., clock, set, reset, outputs, etc., considered individually, shall be connected to V or GND whichever minimizes current flow.

      (5) Leads with no internal connection shall be biased to V or GND whichever is opposite to an adjacent lead.

   c. Final measurements (see 3.7). Final measurements shall include all electrical characteristics and parameters which are specified as end-point electrical parameters.

   d. Number of cycles, if other than 10 (see 3.3).

   e. Conditioning in dry oven before initial measurements, if required (see 3.2).

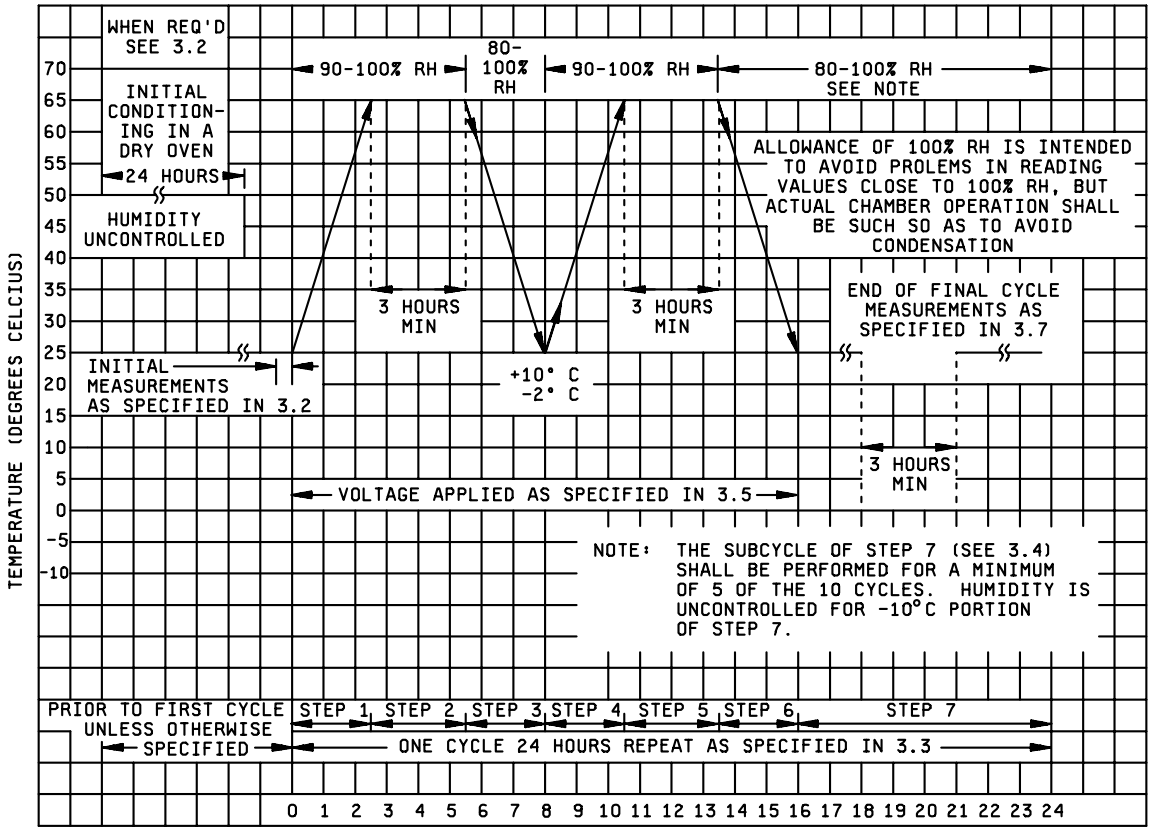

FIGURE 1004-1. Graphical representation of moisture-resistance test.