STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTROTECHNOLOGY

Part 2—TESTS

TEST Z/AD: COMPOSITE TEMPERATURE/HUMIDITY CYCLIC TEST

This test shall be read in conjunction with AS 1099.1, General, AS 1099.2A, Test A: Cold, and AS 1099.2D, Test D: Accelerated Damp Heat.

FOREWORD

The purpose of this standard test is to provide a composite test procedure, primarily for electronic or electrical components, for the determination in an accelerated manner of the resistance of the specimens to the destructive effects of high temperature, high humidity and cold. This test procedure should not be considered as being interchangeable with, or an alternative to, either steady state or other cyclic damp heat tests, but the choice of test procedure should be made with due regard to the characteristics of the test specimens and the particular failure mechanism associated with the specimen.

This test differs from other cyclic damp heat tests in that it derives its increased severity from—

(a) a greater number of temperature variations or 'pumping' actions in a given time;

(b) a greater cyclic temperature range;

(c) a higher cyclic rate of change of temperature; and

(d) the inclusion of a number of excursions to sub-zero temperatures.

The accelerated breathing and the effect of the freezing of trapped water in cracks and fissures are the essential features of this composite test.

It is emphasized however that the freezing effect will occur only if the fissure dimensions are large enough to allow the penetration of a coherent mass of water, as is normally the case in fissures between seals and metal assemblies or between seals and wire terminations.

The degree of condensation will depend mainly upon the thermal time constant of the surface of the test specimens and may be negligible for very small specimens but copious for large specimens.

Similarly, the breathing effect will be more apparent on specimens which contain relatively large air-filled or gas-filled voids but again the severity of the test will depend to some extent on the thermal characteristics of the specimen.

For the reasons given above, it is recommended that this test procedure be limited to the case when the construction of the specimens suggests a 'breathing' type of damp heat test combined with icing and where the thermal characteristics are compatible with the rates of temperature, etc, of this Test Z/AD.

For solid type specimens, e.g. plastics-encapsulated, where there may be small hairline cracks or porous material, the absorption or diffusion mechanisms will predominate and a steady damp heat such as the test of AS 1099.2C is preferred for investigating these effects.

For larger specimens such as equipment or when it is essential for components to ensure thermal stability during the various phases of the cycle the test of AS 1099.2Db, should be employed, although due to the reduced number of cycles in a given period the degree of acceleration may not be so great. In this case, AS 1099.2Db should normally form part of a sequence such as that defined in Clause 1.6 of AS 1099.1.

As in other damp heat tests, a polarizing voltage or electrical loading may be applied to the specimens. In the case of electrical loading, the loading should be such

that the temperature rise of the specimens does not unduly affect the chamber conditions.

From the above, it is therefore evident that Test Z/AD should not be considered to be interchangeable with, or an alternative to, either steady state or other cyclic damp heat tests, but the choice of test procedure should be made with due regard for the physical and thermal characteristics of the test specimens and the types of failure mechanisms which are significant for each particular case.

TEST

1 SCOPE AND OBJECT. This standard method sets out a test procedure, the object of which is to provide a composite test, primarily intended for components, to determine in an accelerated manner the resistance of specimens to the destructive effects of high temperature/humidity and cold conditions.

The test employs temperature cycling at highrelative humidity and will produce a 'breathing' action of moisture into partially sealed containers.

The test includes exposure to low temperatures to determine the effects of periodic icing.

2 TEST APPARATUS.

2.1 Description. The exposure to moisture, followed by cold, may be performed either in one chamber or in two separate chambers.

2.2 Humidity Chamber. The chamber for the exposure to moisture shall be so constructed that the following requirements are met:

(a) The temperature can be varied between 25 ± 2°C and 65 ± 2°C in a period of between 1.5 h and 2.5 h for both rising and falling temperatures.

(b) The relative humidity can be maintained at 93 ± 3 percent during the periods of constant or rising temperature and between 80 percent and 96 percent relative humidity during the falling temperature periods.

(c) Care shall be taken to ensure that the conditions prevailing at any point in the working space are uniform and are as similar as possible to those prevailing in the immediate vicinity of suitably located temperature and humidity sensing devices.

The air in the chamber shall therefore be continuously stirred at a rate necessary to maintain the specified conditions of temperature and humidity.

(d) The specimens under test shall not be subjected to radiant heat from the chamber conditioning processes.

(e) Water used for the maintenance of chamber humidity shall have a resistivity of not less than 500 Ω.m.

Condensed water is continuously drained from the chamber and not used again until it has been repurified.

Precautions shall be taken to ensure that no condensed water from the walls and roof of the test chamber can fall on the specimens.

2.3 Cold Chamber. The chamber for exposure to cold shall be so constructed that the following requirements are met:

(a) The temperature can be maintained at - 10 ± 2°C.

(b) Care shall be taken to ensure that the conditions prevailing at any point in the working space are uniform and are as similar as possible to those prevailing in the immediate vicinity of suitably located temperature-sensing devices.

The air in the chamber shall therefore be continuously stirred.

Care shall be taken that the thermal capacity of the specimen under test does not appreciably influence conditions within the chamber.

2.4 Dual-purpose Chamber. The humidity chamber may be used for exposure to cold in which case it shall meet the requirements of Clause 2.2 and in addition shall be so constructed that the following requirements are met:

(a) The temperature can be lowered from 25 ± 2°C to –10 ± 2°C in a period of not more than 30 min.

(b) The specimen can be held at a temperature of 10 ± 2°C for a period of 3 h.

(c) The temperature can be raised from –10 ± 2°C to 25 ± 2°C in a period of not more than 90 min.

3 SEVERITIES. The number of 24-hour cycles shall be 10, unless otherwise specified. If other than 10, the relevant specification shall define the number and the position of the cold cycles in the sequence.

4 TESTING PROCEDURE.

4.1 Preconditioning. Unless otherwise specified, the specimens, in the unpacked, switched off, 'ready-for-use' state, shall be subject to the conditions for 'assisted drying' specified in Clause 1.4.5 of AS 1099.1, i.e. 55 ± 2°C with a relative humidity not exceeding 20 percent, for a period of 24 h prior to the first cycle of the damp heat test. Fig. 1 provides the information in graphical form.

The specimens shall then be allowed to attain thermal stability at standard atmospheric conditions for testing or as otherwise specified before the initial measurements are made.

4.2 Initial Measurements. The specimens shall be visually inspected and electrically and mechanically checked as required by the relevant specification. The results shall be recorded.

4.3 Conditioning.

4.3.1 *General.* The specimens shall be introduced into the humidity chamber, in the unpacked, switched of, 'ready-for-use' state, and mounted in the normal orientation, if this is known, or as otherwise specified and shall be subject to 10 temperature/humidity cycles, each of 24 h duration.

During any five of the first nine of the above cycles after exposure to the humidity sub-cycle (a-f in Fig. 2A), the specimens shall be subjected to cold.