STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard for BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTROTECHNOLOGY

Part 3—BACKGROUND INFORMATION

SECTION 1. TESTS A AND B: COLD AND DRY HEAT TESTS

This standard shall be read in conjunction with AS 1099.1, General, AS 1099.2A, Test A: Cold, and AS 1099.2B, Test B, Dry Heat.

CONTENTS

FOREWORD

The purpose of this standard is to provide guidance for the user of the test methods covering cold tests and dry heat tests, on how to select the correct test method, how to correctly apply the test method and how to correctly interpret the results in terms of background information which is provided in appendices to the document. Test chambers with and without forced air circulation are discussed in Appendix B and Appendix C, while measurement of air velocity is given in Appendix K.

SPECIFICATION

1 SCOPE AND APPLICATION. This Section gives guidance on the performance of Test A, cold and Test B, Dry Heat. It gives reasons for the selection of an appropriate test procedure, describes the design of test equipment and provides test methods for various test parameters.

The performance of components and equipments is influenced and limited by their internal temperatures which depend on the external ambient conditions and on the heat generated within the device itself.

Whenever temperature gradients exist in the system formed by a device and its surroundings, a process of heat transfer will ensue.

The tests cover cold and dry heat testing, with both sudden and gradual change of the temperature, and of non-heat-dissipating and heat-dissipating specimens (the latter with or without artificial cooling).

The use of test chambers with and without forced air circulation is covered as appropriate. A general block diagram of the total procedure is given in Appendix A.

2 REFERENCE AMBIENT CONDITIONS. Unfortunately, the actual ambient conditions in which the device will have to work are normally neither accurately known nor well defined, so that it is not possible to use them as a basis for design, specification or testing.

For these purposes, it is necessary to define conventional reference ambient conditions which may be specified taking into account the following considerations.

3 DEVICES WITHOUT HEAT-DISSIPATION. If the ambient temperature is uniform and constant and there is no generation of heat within the device, heat will flow from the ambient atmosphere into the device if the former is at a higher temperature, and from the device into the ambient atmosphere if the latter is at a lower temperature. This heat transfer will continue until the device has reached in all its parts the temperature of the surrounding atmosphere. From that moment on, the heat transfer ceases and will not start again unless the ambient temperature changes. In this case, the definition of a reference ambient temperature is simple, the only condition being that it shall be uniformly distributed and constant. For the case when the device does not reach the temperature of the surrounding atmosphere, the definition of a reference temperature is more complicated and the conclusions in Clause 4 apply.

4 DEVICES WITH HEAT-DISSIPATION. If heat was generated within the device and there was no heat transfer to the ambient atmosphere, the temperature of the device would rise beyond any limit. It follows that if an ultimate steady temperature is reached, this implies that heat is flowing continuously from the device into the atmosphere whereby the device is always cooled, no matter what the ambient atmosphere is. Only if the ambient temperature rises, a further rise of temperature within the device may occur.

The reference ambient temperature for this case shall obviously be so defined that simple and well reproducible conditions for heat transfer are obtained. Because heat transfer is accomplished by means of three distinct mechanisms, convection, radiation and conduction, well-defined conditions for each of them shall be obtained separately but simultaneously.

If more than one specimen is subjected to one of the dry heat tests in the same chamber, it is necessary to ensure that all specimens are in the same ambient temperature and have identical mounting conditions. It has not, however, been found necessary to differentiate between testing of single specimens and multiple specimens when the cold test is being performed.

5 AMBIENT TEMPERATURE. Users of components and equipment, particularly equipments, require to know the maximum and minimum values of ambient temperature between which the item will operate and these should be specific for the purpose of testing.

Certain difficulties arise here due to the fact that heat transfer is connected with temperature gradients and that therefore the temperature of the medium surrounding the device is necessarily varying in space. Consequently, the ‘ambient temperature’ of the surrounding atmosphere shall be specially defined.

6 SURFACE TEMPERATURES. Considering on the other hand that the principal influence on the performance of the device is its own temperature, for the purposes of monitoring and adjusting test gear it may be convenient to refer to the temperatures at some significant points on the surface or even in the interior of the specimen.

7 MECHANISMS OF HEAT TRANSFER.

7.1 Convection. Heat transfer through convection is a very important part of heat transfer from heat-dissipating specimens exposed to test chamber conditions.

The coefficient of heat transfer from the surface of the test specimen to the ambient air is affected by the velocity of the surrounding air. The higher the air velocity the more efficient is the heat transfer, provided that streamlined flow conditions are maintained. Therefore, for a given ambient air temperature, the surface temperature of the test specimen will vary inversely with the air velocity. This effect is illustrated in Figs B1 and B2 of Appendix B.

In addition to the influence on the surface temperature of the test specimen at any one location, the airflow will also effect the temperature distribution on the surface of the test specimen. This effect is illustrated in Fig. B3.

It is evident from Appendix B that there is no simple relationship between surface temperature and distribution for different air velocities and airflow directions. It is also obvious that if in conformance with actual conditions testing were to be defined with a particular value of air velocity and airflow direction, this would involve problems in the design of chambers.