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EIA STANDARD

TP-32D

THERMAL SHOCK (TEMPERATURE CYCLING) TEST PROCEDURE FOR ELECTRICAL CONNECTORS AND SOCKETS

EIA/ECA-364-32D

(Revision of EIA-364-32C)

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Electronic Components, Assemblies & Materials Association

THE ELECTRONIC COMPONENTS SECTOR OF THE ELECTRONIC INDUSTRIES ALLIANCE

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Engineering Department
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TEST PROCEDURE No. 32D
THERMAL SHOCK (TEMPERATURE CYCLING) TEST PROCEDURE
FOR
ELECTRICAL CONNECTORS AND SOCKETS

(From EIA Standards Proposal No. 5134, formulated under the cognizance EIA CE-2.0 Committee on National Connector Standards, and previously published in EIA-364-32C.)

1 Introduction

1.1 Scope

This test is conducted for the purpose of determining the resistance of a given electrical connector or socket to exposure at extremes of high and low temperatures and to the shock of alternate exposures to these extremes, simulating the worst probable conditions of storage, transportation and application.

NOTE — This procedure includes the provision for testing at cryogenic temperatures. Cryogenic temperatures should only be used with specimens specifically designed to be compatible with such temperatures.

1.2 Test designation

This test procedure contains 2 test methods, as indicated by the current designations in table 1.

1.2.1 Method A is for air-to-air thermal shock, see table 3.

1.2.2 Method B is for air-to-liquid nitrogen (cryogenic) thermal shock, see table 4.

Table 1 – Test designation

Current designation	Previous designation
Method A, test condition I	Table 2, test condition I
Method A, test condition II	Table 2, test condition II
Method A, test condition III	Table 2, test condition III
Method A, test condition IV	Table 2, test condition IV
Method A, test condition V	Table 2, test condition V
Method A, test condition VI	Table 2, test condition VI
Method A, test condition VII	Table 2, test condition VII
Method A, test condition VIII	Table 2, test condition VIII
Method B, test condition I	Table 3, test condition I
Method B, test condition II	Table 3, test condition II
Method B, test condition III	Table 3, test condition III
Method B, test condition IV	Table 3, test condition IV
Method B, test condition V	Table 3, test condition V
Method B, test condition VI	Table 3, test condition VI

2 Test resources

2.1 Equipment

2.1.1 A thermal shock chamber or two separate chambers (hot and cold) shall be used for the extreme temperature conditions.

2.1.2 When applicable, a dewar large enough to hold a sufficient amount of liquid nitrogen to completely engulf the specimen shall be utilized.

2.1.3 The air temperature of the chamber shall be held at each of the extreme temperatures by means of air circulation and sufficient thermal capacity so that the ambient temperature within the chamber shall reach the specified temperature within 2 minutes after the specimens have been transferred to the appropriate chamber.

2.1.4 When two separate chambers (hot and cold) are used the specimens shall be supported in the test chamber on metal screens or grills having at least 75% open area.

2.1.5 Transfer of the specimens from one chamber to the other or to dewar of liquid nitrogen shall be performed with thermally insulated handling equipment or gloves in order to minimize direct heat conduction.

3 Test specimen

3.1 Description

A test specimen shall consist of a plug, a receptacle, or a mated plug and receptacle, as defined in the referencing document.

3.2 Preparation

3.2.1 The test specimen shall be assembled with contacts, wires and sealing plugs, prior to the test, unless otherwise specified.

3.2.2 The wire lengths shall be of sufficient continuous length to interconnect the test specimen and test equipment, as may be specified for pre- and post-test measurements.

3.2.3 Specimens not normally equipped with an integral coupling device shall be maintained in the simulated mated condition by a suitable fixture. The fixture shall be made as lightweight as possible and of low thermal capacity material, in order to reduce “heat sink” effects that would reduce the severity of thermal shock. For specimen mass determination prior to wiring the specimen; see 4.3.

4 Test procedure

4.1 Mounting

The specimens shall be placed in such a position with respect to the air stream that there is substantially no obstruction to the flow of air across and around each specimen. When special mounting is required, it shall be specified.

4.2 Initial measurements

Specified measurements shall be made prior to the first cycle, and they shall be made at standard ambient conditions.

4.3 Specimen mass determination

The mass of the specimen in table 2 is the total mass of the mated assembly, wire and any fixture attached to the specimen.

Table 2 - Exposure time at temperature extremes

Mass of specimen	Minimum time for steps 1 and 3, hours
28 g (1 oz) and below	½; or ¼ (when specified)
> 28 g (1 oz) to 136 g (0.3 lb) inclusive	½
> 136 g (0.3 lb) to 1.36 kg (3 lb) inclusive	1
> 1.36 kg (3 lb) to 13.6 kg (30 lb) inclusive	2
> 13.6 kg (30 lb) to 136 kg (300 lb) inclusive	4
NOTE — When step one consists of cryogenic immersion of the specimen in liquid nitrogen, as specified in table 4, exposure time shall be as specified in table 2 or the amount of time necessary to obtain thermal stability of the test specimen.	

4.4 Cycling

4.4.1 Subject test specimens to the test method, test condition and test duration as specified in the referencing document.

4.4.2 When a test is not specified in the referencing document, method A, test condition I, test duration A, shall be used as the default.

4.4.3 The first five cycles shall be run continuously. After five cycles, the test may be interrupted after the completion of any full cycle and the specimens allowed to return to room ambient temperature before testing is resumed. One cycle consists of steps 1 through 4 of the applicable test condition.

4.4.4 Specimens shall not be subjected to forced circulating air while being transferred from one chamber to another or to a dewar of liquid nitrogen.

Table 3 – Method A, air-to-air thermal shock test conditions

Step	Test condition I		Test condition II		Test condition III	
	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes
1	+0 -55 -3	See table 2	+0 -65 -5	See table 2	+0 -65 -5	See table 2
2	+10 25 -5	5 max	+10 25 -5	5 max	+10 25 -5	5 max
3	+3 85 -0	See table 2	+3 105 -0	See table 2	+3 125 -0	See table 2
4	+10 25 -5	5 max	+10 25 -5	5 max	+10 25 -5	5 max

Table 3 – Method A, air-to-air thermal shock test conditions (continued)

Step	Test condition IV		Test condition V		Test condition VI	
	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes
1	+0 -65 -5	See table 2	+0 -65 -5	See table 2	+0 -65 -5	See table 1
2	+10 25 -5	5 max	+10 25 -5	5 max	+10 25 -5	5 max
3	+3 150 -0	See table 2	+3 175 -0	See table 2	+5 200 -0	See table 2
4	+10 25 -5	5 max	+10 25 -5	5 max	+10 25 -5	5 max

Table 3 – Method A, air-to-air thermal shock test conditions (continued)

Step	Test condition VII		Test condition VIII	
	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes
1	+0 -55 -5	See table 2	+0 -40 -5	See table 2
2	+10 25 -5	5 max	+10 25 -5	5 max
3	+3 105 -0	See table 2	+3 105 -0	See table 2
4	+10 25 -5	5 max	+10 25 -5	5 max

Table 4 – Method B, air-to-liquid nitrogen (cryogenic) thermal shock test conditions

Step	Test condition I		Test condition II		Test condition III	
	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes
1	+0 -195.8 -5	See table 2	+0 -195.8 -5	See table 2	+0 -195.8 -5	See table 2
2	+10 25 -5	15 max	+10 25 -5	15 max	+10 25 -5	15 max
3	+3 85 -0	See table 2	+3 105 -0	See table 2	+3 125 -0	See table 2
4	+10 25 -5	15 max	+10 25 -5	15 max	+10 25 -5	15 max

Table 4 – Method B, air-to-liquid nitrogen (cryogenic) thermal shock test conditions (continued)

Step	Test condition IV		Test condition V		Test condition VI	
	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes	Temperature, °C	Time, minutes
1	+0 -195.8 -5	See table 2	+0 -195.8 -5	See table 2	+0 -195.8 -5	See table 2
2	+10 25 -5	15 max	+10 25 -5	15 max	+10 25 -5	15 max
3	+3 150 -0	See table 2	+3 175 -0	See table 2	+5 200 -0	See table 2
4	+10 25 -5	15 max	+10 25 -5	15 max	+10 25 -5	15 max

Table 5 – Test durations

Test duration	Number of cycles
A	5
A-1	25
A-2	50
A-3	100
A-4	10

4.5 Final measurements

The specimens shall be returned to thermal stability at standard ambient conditions before the final measurements are made, unless otherwise specified in the referencing document.

4.6 Failures

Effects of thermal shock testing may include, (the referencing document shall specify pass/fail criteria):

4.6.1 Excessive permanent dimensional changes.

4.6.2 Cracking delamination of finishes.

4.6.3 Cracking and crazing of embedding and encapsulating compounds.

4.6.4 Opening of seals and seams.

4.6.5 Leakage of potting materials.

4.6.6 Excessive displacement or rupture of connector shells, inserts, contacts, wire or sealing plugs.

4.6.7 Excessive hardening or softening of resilient dielectric materials.

4.6.8 Fusing or seizure of mating specimen components and contacts.

4.6.9 Change in electrical characteristics.

4.6.10 Changes in mating and unmating characteristics.

5 Details to be specified

The following details shall be specified in the referencing document:

5.1 Number of specimens to be tested

5.2 Test method, test condition and test duration

5.3 Mated or unmated state of test specimens, and assembly of test specimen if other than specified in 3.1 or 3.2

5.4 Wire type and size, if applicable; see 3.2.1

5.5 Number of contacts and sealing plugs, if applicable; see 3.2.1

5.6 Specimen accessories, if applicable

5.7 Special mounting, if required; see 4.1

6 Test documentation

Documentation shall contain the details specified in clause 5, with any exceptions, and the following:

6.1 Title of test

6.2 Specimen description, including fixturing and wiring

6.3 Test equipment used, and date of last and next calibration

6.4 Test and measuring procedure

6.5 Values and observations

6.5.1 Results of visual inspection
6.5.2 Record of chamber temperature and recovery
6.5.3 Initial measurements; see 4.2
6.5.4 Specimen mass; see 4.3
6.5.5 Exposure time at each temperature; see 4.3
6.5.6 Final measurements; see 4.5

6.6 Name of operator and start/finish dates of test

EIA Document Improvement Proposal

If in the review or use of this document, a potential change is made evident for safety, health or technical reasons, please fill in the appropriate information below and mail or FAX to:

Electronic Industries Alliance
Technology Strategy & Standards Department – Publications Office
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Urgency of Change: Immediate: ☐	At next revision: ☐
Problem Area: a. Clause Number and /or Drawing: b. Recommended Changes: c. Reason/Rationale for Recommendation:	
Additional Remarks:	
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Revision History

Revision letter	Project number	Additions, changes and deletions
D	SP-5134	Added paragraph 1.2, 5.2, table 1 and 5. Changed paragraph 4.3, 4.4, and table 2 note. Deleted paragraph 5.7 and 5.8.