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Test Method A106-A

Thermal Shock

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THERMAL SHOCK TEST METHOD

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The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document:
Draft PAS	**Report on voting**
47/1458/PAS	47/1491/RVD

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TEST METHOD A106-A
THERMAL SHOCK

(From Council Ballot JCB-94-51 formulated under the cognizance of JC-14.1 Committee on Reliability Test Methods for Packaged Devices)

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TEST METHOD A106-A

THERMAL SHOCK

1. PURPOSE

This test is conducted to determine the resistance of a part to sudden exposure to extreme changes in temperature and to the effect of alternate exposures to these extremes.

1.1 Terms and Definitions

1.1.1 Load

The specimens under test and the fixtures holding those specimens during test. The maximum load shall be the maximum mass of specimens and fixtures that can be placed in the working zone of the bath while maintaining specified temperature and times.

1.1.2 Monitoring Sensor

The temperature sensor that is located and calibrated so as to indicate the same temperature as at the worst-case indicator specimen location. The worst-case indicator specimen location is identified during the periodic characterization of the worst-case load temperature.

1.1.3 Worst-Case Load Temperature

The temperature of a specific specimen as indicated by a thermocouple imbedded in the body and located at the center of the load.

1.1.4 Specimen

The device or individual piece being tested.

1.1.5 Transfer Time

The elapsed time measured from removal of the load from one bath until insertion in the other bath.

1.1.6 Maximum Load

The largest load for which the worst-case load temperature meets the timing requirements (see 3.1).

1.1.7 Dwell Time

The total time the load is immersed in the bath.

2. APPARATUS

The bath(s) used shall be capable of providing and controlling the specified temperatures in the working zone(s) when the bath is loaded with a maximum load. The thermal capacity and liquid circulation must enable the working zone and loads to meet the specified conditions and timing (see 3.1). Worst-case load temperature shall be continually monitored during test by indicators or recorders reading the monitoring sensor(s) . The worst-case load temperature under maximum load conditions and configuration shall be verified as needed to validate bath performance. Perfluorocarbons that meet the physical property requirements of Table II shall be used for conditions B, C, & D.

3. PROCEDURE

Specimens shall be placed in the bath in a position so that the flow of liquid across and around them is substantially unobstructed. The load shall then be subjected to condition C or as otherwise specified of Table I for a duration of 15 cycles. Completion of the total number of cycles specified for the test may be interrupted for the purpose of loading or unloading of device lots or as the result of power or equipment failure. However, if the number of interruptions for any given test exceeds 10 percent of the total number of cycles specified, the test must be restarted from the beginning.

3.1 TIMING

The total transfer time from hot to cold or from cold to hot shall not exceed 10 seconds. The load may be transferred when the worst-case load temperature is within the limits specified in Table 1. However, the dwell time shall not be less than 2 minutes and the load shall reach the specified temperature within 5 minutes.

TABLE I. Thermal Shock temperature tolerances and suggested fluids. 1/

Test Conditions		A	B	C	D
		Tempera-ture	Tempera-ture	Tempera-ture	Tempera-ture
Step 1	Temperature tolerance, °C	85 +10 -0	100 +10 -2	125 +10 -0	150 +10 -0
	Recommended fluid	Water 2/	Perfluoro-carbon 3/	Perfluoro-carbon 3/	Perfluoro-carbon 3/
Step 2	Temperature tolerance, °C	-40 +0 -30	-0 +2 -10	-55 +0 -10	-65 +0 -10
	Recommended fluid	Perfluoro-carbon 3/	Perfluoro-carbon 3/	Perfluoro-carbon 3/	Perfluoro-carbon 3/

1/ Ethylene glycol shall not be used as a thermal shock test fluid.

2/ Water is indicated as an acceptable fluid for this temperature range.

3/ Perfluorocarbons contain no chlorine or hydrogen.

NOTE: Component chemical resistance to the thermal shock liquids should be established prior to running the test.

3.2 MEASUREMENTS

Hermeticity tests, for hermetic devices, visual examination, and electrical measurements that consist of parametric and functional tests, shall be taken as specified in the applicable procurement document.

3.3 **FAILURE CRITERIA**

After subjection to the test, a device shall be defined as a failure if hermeticity, for hermetic devices, cannot be demonstrated, if parametric limits are exceeded, or if device functionality cannot be demonstrated under nominal and worst-case conditions specified in the applicable procurement document. Mechanical damage, such as cracking, chipping, or breaking of the package (as defined in Test Method B101 "External Visual") shall also be considered a failure, provided that such damage was not induced by fixturing or handling.

TABLE II. Physical property requirements of perfluorocarbon fluids. 1/

	Test Condition	B	C	D	ASTM test method
Step 1	Boiling point, °C	>100	>125	>150	D1120
	Density at 25°C gm/ml		>1.6		D941
	Dielectric strength volts/mil		>300		D877
	Residue, microgram/gram		<50		D2109
	Appearance		Clear, colorless liquid		Not applicable
Step 2	Density at 25°C gm/ml		>1.6		D941
	Dielectric strength volts/mil		>300		D877
	Residue, microgram/gram		<50		D2109
	Appearance		Clear, colorless liquid		Not applicable

1/ The perfluorocarbon used shall have a viscosity less than or equal to the thermal shock equipment manufacturer's recommended viscosity at the minimum temperature.

4. SUMMARY

The following details shall be specified in the applicable procurement documents:

(a) Special mounting, if applicable.

(b) Temperature extremes (see Table I), number of cycles, or specific component requirements.

(c) Interim measurement intervals, when required.

(d) Special acceptance criteria for examinations, seal tests (for hermetic packages), and electrical tests.

(e) For qualification testing, sample size and quality level.