ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES®

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Number	
2.6.7.2	
Subject	
Thermal Shock, Continutity and Microsection, Printed Board	
Date	Revision
05/04	**B**
Originating Task Group	
Rigid Printed Board Performance Task Group (D-33a)	

IPC-TM-650
TEST METHODS MANUAL

1 Scope This method is to determine the physical endurance of printed boards to sudden changes of temperature. It is designed to expose specimens to a series of high and low temperature excursions to cause physical fatigue.

2 Applicable Documents

IPC-2221 Generic Standard on Printed Board Design

3 Test Specimen Coupon D from IPC-2221 or other suitable test coupon (see 6.1a).

4 Apparatus

4.1 An automatically controlled dual temperature environmental test chamber or other dual chamber apparatus capable of maintaining –65, –55, –40 or 0 °C + 0 –5 °C [–85, –67, –40, +32 °F + 0 –9 °F] in the low temperature chamber and 70, 85, 105, 125, 150 or 170 +5 –0 °C [158, 185, 221, 257, 302 or 338 +9 –0 °F] in the high temperature chamber.

NOTE: The temperature extremes (high and low) that are required is dependent on the base material of the specimen that is to be tested (see 6.1b and the temperatures listed in Table 2). The recovery capacity of the test chambers shall be such that the internal chamber temperature shall reach the specified temperature within two minutes after the specimen(s) have been transferred to the test chamber. Test conditions, if not otherwise stated in the applicable performance specification (see 6.1b), shall meet the requirements of Table 2.

4.2 An electrical resistance meter capable of accuracies of 0.5 milliohm or better with Kelvin (four terminal) type leads. A Kelvin type double bridge or potentiometer of the specified accuracy may also be used.

5 Procedure

5.1 Preparation Wire up test specimen with Kelvin-type leads at the points where measurements will be made.

5.1.1 Operate chamber (or chambers) and allow to stabilize at the high and low temperature required. Clamp or suspend-test specimen in the approximate center of the high temperature chamber. Test specimens shall be placed approximately 13 mm [0.5 in] apart and aligned in a manner to permit maximum heat transfer to test specimen(s).

5.2 Test

5.2.1 Thermal Shock Cycle

5.2.1.1 The test specimens shall be subjected to 100 temperature cycles in accordance with Table 1.

5.2.1.2 Transfer time between chambers shall be less than two minutes. The thermal capacity of the test chamber used

Table 1

	Test Condition A		Test Condition B		Test Condition C	
Step	Temperature °C [°F]	Time (min)[1]	Temperature °C [°F]	Time (min)[1]	Temperature °C [°F]	Time (min)[1]
1	0, +0/5 [32, +0/9]	15	-40, +0/-5 [-40, +0/-9]	15	-55, +0/-5 [-67, +0/-9]	15
2	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0
3	+70, +5/-0 [158, +9/-0]	15	+85, +5/-0 [185, +9/-0]	15	+105, +5/-0 [221, +9/-0]	15
4	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0
	Test Condition D		**Test Condition E**		**Test Condition F**	
Step	**Temperature °C [°F]**	**Time (min)[1]**	**Temperature °C [°F]**	**Time (min)[1]**	**Temperature °C [°F]**	**Time (min)[1]**
1	-55, +0/-5 [-67, +0/-9]	15	-65, +0/-5 [-85, +0/-9]	15	-65, +0/-5 [-85, +0/-9]	15
2	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0
3	+125, +5/-0 [257, +9/-0]	15	+150, +5/-0 [302, +9/-0]	15	+170, +5/-0 [338, +9/-0]	15
4	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0	25, +10/-5 [77, +18/-9]	0

[1] Or until samples reach test temperature.
Tolerance shall be +2 and -0 minutes.

Table 2

BASE MATERIAL TYPE DESIGNATOR			TEST CONDITION
IPC SPECIFICATION		MILITARY[1]	
IPC-4101	IPC-4103	S-13949	A
	/01	GT	B
	/02	GX	B
	/03	GP	B
	/04	GR	B
	/05	GY	B
/20		GE	C
/21		GF	D
/22		GB	D
/24		GF	D
/25		GF	D
/26		GF	D
/28		GF	D
/29		GF	D
/50		AF	D
/53		BI	D
/55		BF	D
/56		BI	D
/97		GF	D
/98		GF	D
/23		GH	E
/30		GI	F
/40		GI	F
/41		GI	F
/42		GI	F
/60		QI	F

[1] MIL-S-13949 is canceled and listed for reference only

shall be such that the ambient temperature shall reach the specified temperature within twp minutes after the test specimen has been transferred to the appropriate chamber.

5.2.1.3 Interconnection resistance measurements shall be taken before the test, during the first cycle at high temperature, and during the last cycle at high temperature.

5.3 Evaluation The maximum change in resistance between the first and 100th cycle shall be evaluated for acceptability to the requirements of the applicable performance specification (see 6.1c). After testing, a minimum of three plated-through holes shall be microsectioned and shall be evaluated for acceptability to the requirements of the applicable performance specifications.

6 Notes

6.1 The following details are to be specified in the applicable performance specification:

a. Test specimen, if other than specified in 3.

b. Test condition, if other than specified in 4.1.

c. Maximum allowable change in resistance.

6.1.1 Unless otherwise specified by the applicable performance specification, the following base material types/ temperature ratings are recommended.