

ENGINEERING PRACTICE STUDY

PROJECT NUMBER: 5961-2011-091

TITLE: REVIEW OF REQUIREMENTS FOR MIL-STD-750 TEST METHOD 1051

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FINAL REPORT

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ATTCH 1

I. OBJECTIVES: An engineering practice study is being conducted to review and evaluate the requirements of MIL-STD-750, Test Method 1051 (Temperature Cycling) to determine ramp rate(s) which protect DUT(s) from an induced thermal shock. This exercise will also aid the user in determining if performing equipment is acceptable for compliance to a surveillance audit. If consensus indicates that the current requirements are ineffective and/or unachievable, then recommend revising said requirements.

II. BACKGROUND: Recent comments received by DLA have suggested that the current ramp rate requirements of MIL-STD-750, Test Method 1051 are unachievable using currently available temperature chambers. DLA auditors have also recently reported that many currently qualified suppliers are unable to meet the requirements of MIL-STD-750, Test Method 1051. DLA is requesting that custodians, review activities, users, and manufacturers review the requirements of MIL-STD-750, Test Method 1051 to ensure that they are effective and achievable.

III. RESULTS: Final results of this effort along with recommendations and conclusions are documented in attachment 1.

IV. CONCLUSIONS: The noted changes (attachment 1) shall be incorporated in the next revision of MIL-STD-750.

V. RECOMMENDATIONS:

- a) All essential comments must be accepted or resolved through the DLA Land and Maritime spokesmen to the committees generating the drafts of those industry standards.
- b) All suggested comments should be addressed by the industry committees or authors responsible for the draft documents.

ATTACHMENT 1

METHOD 1051.7

TEMPERATURE CYCLING (AIR TO AIR)

1. Purpose. This test method is conducted to determine the resistance of a semiconductor device to extremes of high and low temperatures, and to the effect of alternate exposures to these extremes.

1.1 Terms and definitions.

1.1.1 DUT. The device or individual piece being tested.

1.1.2 Dwell time. The time from introduction of the load to one extreme temperature (hot chamber or cold chamber) until the initiation of the transfer to the other extreme temperature (hot chamber or cold chamber). The total dwell time equals the ramp time plus the soak time.

NOTE: During chamber profiling and characterization, a device temperature sensitive parameter should be used to ensure that for various load conditions, the specified soak time shall be guaranteed.

1.1.3 Load. The devices under test (DUT) and the fixtures holding those DUTs during the test. Maximum load shall be determined by using the worst case load temperature with specific DUT loading. Monolithic loads used to simulate loading may not be appropriate when air circulation is reduced by load configuration. The maximum loading must meet the specified conditions.

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

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

1.1.6 Ramp rate. The time allowed to reach temperature divided by the total time DUTs spend in the chamber.

1.1.7 Ramp time. The time allowed for reaching a given temperature. This timing starts when the load is introduced to the chamber and ends when the load reaches temperature (see table 1051-I).

CAUTION: Due to the ramp capability of test equipment available today, if care is not taken when profiling and characterizing various load conditions or setting up the equipment, thermal shock can be induced. The ramp rate should be controlled as defined in 3.1 or one can create a thermal shock instead of temperature cycling.

1.1.8 Soak time. The elapsed time that occurs after the load has reached temperature (see table 1051-I).

1.1.9 Transfer time. The elapsed time between DUT removal from one temperature extreme and introduction into the other.

1.1.10 Working zone. The volume in the chamber(s) in which the temperature of the load is controlled within the limits specified in table 1051-I.

1.1.11 Worst case load temperature. The worst case load temperature is the temperature of a specific area in the chamber when measured by thermocouples located at the center and at each corner of the load. The worst case load temperature shall be determined at periodic intervals.

2. Apparatus. The chamber(s) used shall be capable of providing and controlling the specified temperatures in the working zone(s) when the chamber is loaded with a maximum load. The thermal capacity and air circulation shall 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. Direct heat conduction to DUTs shall be minimized.

3. Procedure. DUTs 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 the DUT. The use of diffusers is permitted to avoid thermal shock, which is caused by exceeding the ramp rate requirements of 3.1. When special mounting is required, it shall be specified. The DUT shall then be subjected to the specified condition for the specified number of cycles performed continuously. Unless otherwise specified, this test shall be conducted for a minimum of 20 cycles using test condition C. One cycle consists of steps 1 and 2 or the applicable test condition to be counted as a cycle. Completion of the total number of cycles specified for the test may be interrupted for the purpose of test chamber loading or unloading of device lots or as the result of power or equipment failure. However, if for any reason the number of incomplete cycles exceed 10 percent of the total number of cycles specified, one cycle must be added for each incomplete cycle. See figure 1051-1 herein.

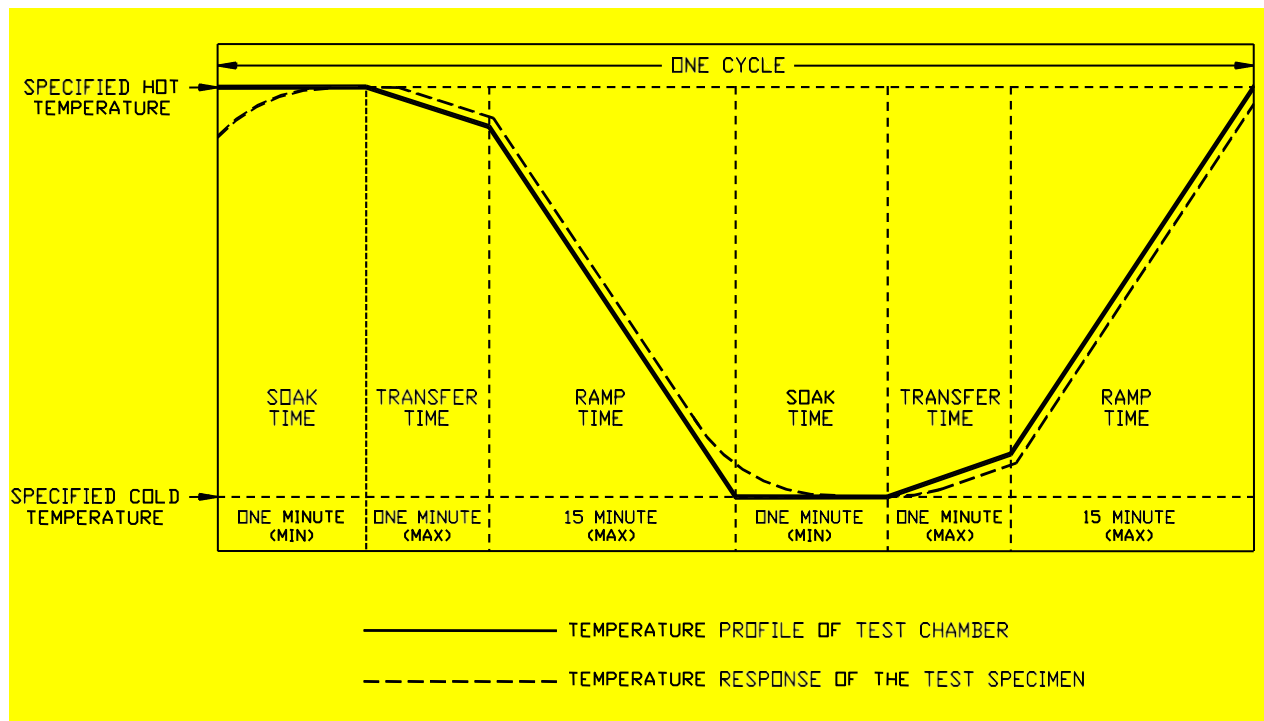


FIGURE 1051-1. Timing diagram showing one cycle.

3.1 Timing. The total transfer time from the hot chamber to the cold chamber or the cold chamber to the hot chamber shall not exceed 1 minute. The load may be transferred after a soak of 1 minute minimum. The soak time shall begin once the worst case load (point which reaches temperature last) has reached the specified temperature. However, the dwell time shall not be less than 10 minutes. The ramp rate for DUT shall operate within the following temperature change rates: 15°C/minute minimum and 50°C/minute maximum independent of load size. However the total ramp time shall not exceed 15 minute. If necessary, the load size shall be increased or decreased to meet the specified temperature change rates.

TABLE 1051-I. Temperature-cycling test conditions.

Step	Dwell time (minutes)	Test condition, temperature, and tolerance (°C)						
		A	B	C	D	E	F	G
1 Cold	≥ 10	-55 +0 / -10	-55 +0 / -10	-55 +0 / -10	-65 +0 / -10	-65 +0 / -10	-65 +0 / -10	-55 +0 / -10
2 Hot	≥ 10	85 +10 / -0	125 +15 / -0	175 +15 / -0	200 +15 / -0	300 +15 / -0	150 +15 / -0	150 +15 / -0

NOTE: Steps 1 and 2 may be interchanged. The load temperature may exceed the + or - zero (0) tolerance during the recovery time. Other tolerances shall not be exceeded.

4. Summary. The following details shall be specified in the applicable performance specification sheet or acquisition document:

- a. Special mounting, if applicable (see 3).
- b. Test condition letter, if other than test condition C herein (see 3).
- c. Number of test cycles, if other than 20 cycles (see 3).
- d. End-point measurements and examinations, (e.g., end-point electrical measurements, seal test method 1071 of this test method standard), or other acceptance criteria.