



DEFENSE LOGISTICS AGENCY

LAND AND MARITIME
POST OFFICE BOX 3990
COLUMBUS, OH 43218-3990

IN REPLY
REFER TO

DLA LAND AND MARITIME-VAC

11 February 2011

MEMORANDUM FOR MILITARY/INDUSTRY DISTRIBUTION

SUBJECT: ENGINEERING PRACTICE STUDY TO REVIEW CONFORMANCE
INSPECTIONS ABILITY TO DETECT WEAKENED WIRE BONDS.
Project Number 5961-2011-027

The initial draft for this subject document, dated 11 February 2011, is now available for viewing and downloading from the DLA Land and Maritime website:

<http://www.dscc.dla.mil/Programs/MilSpec/DocSearch.asp>

The proposal is to add additional tests to Groups C and E in the MIL-PRF-19500 conformance inspection to aid in the detection of weakened wire bonds.

Concurrence or comments are required at this Center within 45 days from the date of this letter. Late comments will be held for the next coordination of the document. Comments from Military departments must be identified as either "Essential" or "Suggested". Essential comments must be justified with supporting data. Military review activities should forward comments to their custodians of this office, as applicable, in sufficient time to allow for consolidating the department reply. Since Navy-EC is the custodian for this document, all Navy review activities should forward their comments directly to this Center.

The point of contact for this document is Mr. Jason Hochstetler, DLA Land and Maritime-VAC, Post Office Box 3990, Columbus, OH 43216-3990. Mr. Hochstetler can also be reached at 614-692-7106/850-7106, or by facsimile 614-692-6939/850-6939, or by e-mail to: Jason.Hochstetler@dla.mil.

/signed/
David Corbett
Acting Chief
Active Devices Team



ENGINEERING PRACTICES STUDY

TITLE: REVIEW MIL-PRF-19500 CONFORMANCE INSPECTION FOR ABILITY TO
DETECT WEAKENED WIRE BONDS

11 February 2011

STUDY PROJECT (SEE ATTACHMENT 1)

PRELIMINARY

Study Conducted by DLA LAND AND MARITIME

Prepared by:

Jason Hochstetler

I. OBJECTIVES: An engineering practice study is being conducted to review the conformance inspection of MIL-PRF-19500 for the ability to find weakened wire bonds. The purpose of this study is to determine if the proposals that were submitted are acceptable.

II. BACKGROUND: The current Group C condition of 6000 cycles for intermittent operating life was added to MIL-PRF-19500 in the mid 1980's and modeled after a users SCD to represent end of life. It was chosen to provide some confidence in wire bond and die attach integrity. In the last revision of MIL-PRF-19500 the destructive bond strength test was added to Group B4, for JANS.

Custodians and review activities have requested adding additional tests to Group C to ensure proper detection of weakened bonds after intermittent operating life. Additionally, it has been proposed to add an end of life characterization test to Group E to verify that the requirements currently in place are adequate.

See attachment 1 for the proposal to Group C and Group E

III. RESULTS: All comments on this study shall be submitted to jason.hochstetler@dla.mil and resulting coordinated changes will provide a basis for updating MIL-PRF-19500 in the next spec action. Comments to this study are to be provided to DLA Land and Maritime within 45 days from the date of this letter.

IV. CONCLUSIONS: The final comments on this study will be published in a final EP study report after all submitted comments have been resolved.

V. RECOMMENDATIONS: DLA Land and Maritime recommends that all military and industry representatives review the proposed changes to the slash sheets and provide comments

TABLE E-VII. Group C periodic inspections (all quality levels) – Continued.

Inspections	MIL-STD-750		Sample plan	Small lot conformance inspection
	Method	Condition		
<u>Subgroup 4</u> Salt atmosphere (corrosion) <u>1/</u>	1041		15 devices c = 0	6 devices c = 0
<u>Subgroup 5</u> Thermal resistance <u>4/</u> Diodes Transistors (bipolar) Transistors (power FETs) Thyristors IGBT GaAs FET	4081 3131 3161 3181 3103 3104	As specified.	15 devices c = 0	6 devices c = 0
<u>Subgroup 6</u> <u>5/ 6/</u> Steady-state operation life Electrical measurements or Intermittent operation life Hermetic seal <u>2/</u> a. Fine b. Gross Electrical measurements Bond strength (wire or clip bonded devices only) or Blocking life <u>8/</u> Electrical measurements	1026 1037 1042 1071 2037 1048	Not required for disc packages. 1,000 hours minimum, bias conditions as specified. <u>7/ 8/</u> Group A, subgroup 2. 6,000 cycles minimum. Condition D, 6,000 cycles minimum. Not required for double plug diodes. Group A, subgroup 2. Condition D. The sample shall include a minimum of three devices and shall include all wire sizes.	22 devices c = 0 11 wires, c = 0	12 devices c = 0 11 wires, c = 0
<u>Subgroup 7</u> Internal gas analysis	1018	To be performed on each structurally identical package family.	3 devices c = 0 <u>9/</u>	3 devices c = 0 <u>9</u>

See footnotes at end of table.

TABLE E-VII. Group C periodic inspections (all quality levels) – Continued.

- 1/ Electrical reject devices, from the same inspection lot, may be used for all subgroups when electrical end-point measurements are not required. Other non-catastrophic rejected devices (i.e., PIND, X-ray) may be utilized for all subgroups. For subgroups with end-point measurements, the devices shall be screened to table E-IV through screen 13.
- 2/ Non-transparent glass encased double plug noncavity axial lead diodes only may use test method 2068 of MIL-STD-750, in lieu of 1071. This test may be performed after electrical measurements.
- 3/ Not applicable to any devices with external and internal pressure contacts (die to electrical contacts), optical coupled isolators, and double plug diodes.
- 4/ Not required when performed in group B.
- 5/ If a given inspection lot undergoing group B inspection has been selected to satisfy group C inspection requirements, the 328 hour or 2,000 cycles life tests **may shall** be continued on test to 1,000 hours or 6,000 cycles, as applicable, in order to satisfy the group C life test requirements. End-point measurements shall be performed on either table E-VIA, group B, subgroup 4, or table E-VIB group B, subgroup 3 (340 hours or 2,000 cycles, as applicable) to satisfy group B (table E-VIA or table E-VIB) lot acceptance or group C, subgroup 6 (1,000 hours or 6,000 cycles, as applicable) to satisfy group B and C lot acceptance.
- 6/ Intermittent operation life shall be performed on all case mounted devices.
- 7/ $T_J = 150^{\circ}\text{C}$ (min) or rated T_J whichever is less (except schottky and power mosfets) for operation life.
- 8/ The sample size may be increased and the test time decreased so long as the devices are stressed for a total of 22,000 device hours minimum, and the actual time of test is at least 340 hours.
- 9/ Internal gas analysis shall be performed on hermetic devices. An engineering evaluation shall be performed if there is a device failure to determine the moisture source (e.g. sealing environment, non hermetic device). The entire lot shall be rescreened in accordance with screen 14 herein (and resubmitted at 6/0.) Corrective action shall be taken as necessary.

TABLE E-IX. Group E inspections (all quality levels)

Inspections	MIL-STD-750		Sample plan
	Method	Condition	
<u>Subgroup 1</u>			45 devices, c = 0 or as specified.
Thermal shock or Temperature cycling	1056 1051	100 cycles or as specified. 500 cycles minimum or as specified. Test condition C or max storage temp, which ever is less.	
Hermetic seal a. Fine leak b. Gross leak	1071	As applicable.	
Electrical measurements		Group A, subgroup 2.	
<u>Subgroup 2</u>			45 devices, c = 0 or as specified.
Intermittent operating life Electrical measurements or Life test Electrical measurements or Steady-state operating life Electrical measurements or Blocking life Electrical measurements	1037 1042 1026 1048	As specified. Group A, subgroup 2. Condition A, B, C, or D. Group A, subgroup 2. As specified. Group A, subgroup 2. As specified. Group A, subgroup 2.	
<u>Subgroup 3</u> Not applicable			
<u>Subgroup 4</u> Thermal impedance curves (as applicable)	N/A	Each supplier shall submit a thermal impedance ($Z_{\theta JX}$) histogram of the entire qualification lot. The histogram data shall be taken prior to the removal of devices that are atypical for thermal impedance. Thermal impedance curves (from $Z_{\theta JX}$ test pulse time to $R_{\theta JX}$ minimum steady-state time) of the best device in the qual lot and the worst device in the qual lot (that meets the supplier proposed screening limit), or from the thermal grouping, shall be submitted. The optimal test conditions and proposed initial thermal impedance screening limit shall be provided in the qualification report. Data indicating how the optimal test conditions were derived for $Z_{\theta JX}$ shall also be submitted. The proposed specification maximum thermal impedance curve shall be submitted. The qualifying activity may approve a different $Z_{\theta JX}$ limit not to exceed the specification's thermal curve for conformance inspection end-point measurements as applicable. The supplier shall support (with applicable data) their $Z_{\theta JX}$ end-point limit proposal when it exceeds the screening $Z_{\theta JX}$ limit. A delta (read and record) $Z_{\theta JX}$ shall be determined by the manufacturer and approved by the qualifying activity for all case mounted devices for conformance inspection (intermittent life test and temperature cycling) end-point measurements. Any exceptions shall be justified to, and approved by, the qualifying activity. Equivalent data, procedures, or SPC plans may be used for part, or all, of the above requirements.	N/A

See footnotes at end of table.

TABLE E-IX. Group E inspections (all quality levels) - Continued.

Inspections	MIL-STD-750		Sample plan
	Method	Condition	
<u>Subgroup 4</u> - continued		The approved thermal impedance conditions and limit for $Z_{\theta JX}$ shall be used by the supplier in screening, and group A subgroup 2. The approved thermal resistance conditions for $R_{\theta JX}$ shall be used by the supplier for conformance inspection. For product families with similar thermal characteristics based on the same physical and thermal die, package, and construction combination (thermal grouping), the supplier may use the same thermal impedance curves.	
<u>Subgroup 5</u> Barometric pressure (reduced) (required only on all devices with rated voltage > 200 V)	1001	As specified.	3 devices, c = 0 or as specified.
<u>Subgroup 6</u> ESD	1020	As required by E.4.2.1.	11 devices, c = 0 or as specified.
<u>Subgroup 7</u> Resistance to soldering heat <u>1/</u> Visual inspection Hermetic seal a. Fine leak b. Gross leak Electrical measurements	2031 1071	See test method 2031 of MIL-STD-750 and H.6 for package family and test conditions. <u>2/</u> As applicable. Group A, subgroup 2.	3 devices, c = 0 or as specified.
<u>Subgroup 8</u> Reverse stability (for bipolar transistors only)	1033	When specified. Condition A for devices > 400 V. Condition B for devices < 400 V.	45 devices, c = 0 or as specified.
<u>Subgroup 9</u> Resistance to glass cracking (glass diodes only)	1057	Condition B. Step stress to destruction by increasing cycles or up to a maximum of 25 cycles. The results shall be available upon request.	45 devices, c = 0 or as specified.
<u>Subgroup 10</u> <u>3/</u> <u>Intermittent operating life</u> <u>Bond strength</u>	<u>1037</u> <u>2037</u>	<u>Step stress to failure. See 2037 of this subgroup for conditions.</u> <u>Condition D, shall be performed after 6000 IOL cycles and every 1000 cycles thereafter. Each bond strength test shall use 3 devices from the remaining sample, and shall include all wires.</u>	<u>45 devices</u>

1/ As an option, the manufacturer may submit data (alternate testing) to the qualifying activity for approval in lieu of performing specific soldering heat test conditions.

2/ After subjection to the test, failure of one or more specified end-point measurements or examinations, evidence of defects or damage to the case, leads, or seals shall be considered a failure. Damage to the marking caused by fixturing or handling during tests shall not be cause for device rejection.

3/ Wire or clip bonded devices only. Data may be used from group E, subgroup 2, and group C for coverage of this subgroup.