ENGINEERING PRACTICES STUDY

PROJECT NUMBER: 5961-2011-027

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

7 May 2012

STUDY PROJECT (SEE ATTACHMENT 1)

FINAL REPORT

Study Conducted by DLA LAND AND MARITIME

Prepared by:

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I. OBJECTIVES: An engineering practice study was 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 additional Group C 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.

III. RESULTS: The comments received by DLA Land and Maritime have been reviewed and a summary is listed below.

-Group B JANS - add requirement for .008 inch or larger bond wires, do 6,000 cycles instead of 2,000 cycles. An additional end of life test was requested to be added but it was agreed that the 6,000 cycles used in group C, based proposal for B4, has been the accepted normal duration to find failures and that a specific new end of life characterization was not needed. There was also a request for allowing additional bond pull degradation but the existing 6,000 cycles currently required for group C confirms that no additional degradation is needed. It was also agreed to increase the JANS test cycles at this time and evaluate the need to increase cycle times of JANTX and JANTXV devices at a later date.

-Group C6 - added bond pull for the instance when JANS devices are not selected from Group B to satisfy group C requirements. If the Group B test isn't extended, then the bond pull should still be performed as a part of the Group C6 sample.

-Group E - A proposal to add a combination IOL and bond pull characterization test to failure for qualification was determined not needed at this time. The increase of the group B test from 2,000 to 6,000 cycles was agreed to be sufficient based on the existing 6,000 cycle requirement in group C.

IV. CONCLUSIONS: Based on the comments received and input from a JC-13 task group, MIL-PRF-19500 will increase the number of cycles in group B from 2,000 to 6,000 for JANS devices with .008 inch or larger bond wires. In addition, bond pull will be added to group C for those devices which are not selected from group B to satisfy group C requirements.

See attachment 1 for the proposal to group B and group C.

V. RECOMMENDATIONS: DLA Land and Maritime recommends that the accepted proposed changes of this EP Study be incorporated to the MIL-PRF-19500P Amendment1. In addition, an evaluation of the results of these changes should be done to determine the need to also extend the group B cycle times for JANTX and JANTXV devices.

Attachment 1

TABLE E-VIA. Group B inspections for JANS devices - Continued.

Inspections	MIL-STD-750, method	MIL-STD-750, condition	Qualification and large lot conformance inspection sample plan	Small lot conformance inspection
Subgroup 3 - Continued				
Bond strength (wire or clip bonded devices only)	2037	Condition D.	22 wires or 11 devices, c = 0, (whichever requires the smaller number of devices.)	12 wires or 6 devices c=0 (whichever requires the smaller number of devices.)
SEM for applicable designs) 4/	2077			
Die shear (excluding axial leaded devices)	2017		The same number of devices used for bond strength will also be used for die shear (minimum of six die).	
Subgroup 4				
* Intermittent operation life	1037 or 1042	2,000 cycles, Condition D. Devices with .008 inch or larger bond wires, 6,000 cycles.	22 devices, c = 0	12 devices c = 0
Hermetic seal 2/	1071			
a. Fine		Not required for double plug diodes.		
b. Gross				
Electrical measurements		Group A, subgroup 2 and as specified.		
Bond strength (wire or clip bonded devices only) 5/	2037	Condition D. The sample shall include a minimum of three devices and shall include all wire sizes.	11 wires, c = 0	11 wires, c = 0

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

Inspections	MIL-STD-750		Sample plan	Small lot conformance inspection
	Method	Condition		
Subgroup 4 Salt atmosphere (corrosion) 1/	 1041		15 devices c = 0	6 devices c = 0
Subgroup 5 Thermal resistance 4/ 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
Subgroup 6 5/ 6/ Steady-state operation life Electrical measurements or Intermittent operation life Hermetic seal 2/ a. Fine b. Gross Electrical measurements Bond strength 9/ or Blocking life 8/ Electrical measurements	 1026 1037 1042 1071 2037 1048 	Not required for disc packages. 1,000 hours minimum, bias conditions as specified. 7/ 8/ 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, .008 inch or larger wire or clip bonded devices only. The sample shall include a minimum of three devices and shall include all wire sizes. Group A, subgroup 2.	22 devices c = 0 11 wires, c = 0	12 devices c = 0 11 wires, c = 0
Subgroup 7 10/ Internal gas analysis	 1018	 To be performed on each structurally identical package family.	3 devices c = 0	3 devices c = 0

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 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 340 hour or 2,000 cycles life tests may 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°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/ Required for JANS devices with .008 inch or larger bond wires only. Not required when JANS devices from group B bond pull inspection have been selected to satisfy group C inspection requirements.

10/ 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. Subgroup 7 is not required for noncavity double plug devices.