
Report EL-2005-02-036 CR

Evaluation of Tin Whisker Growth, FCI Lead Free AIRMAX VS® Header Insert Molded Leadframe Assembly
Rev. C
2006 May 08

PURPOSE:

Insert molded leadframe assemblies (IMLAs) from lead free AIRMAX VS® headers were tested to assess the growth of whiskers from the matte tin plating on the terminals. Testing encompassed exposure to two (2) treatment environments: humid heat aging and room temperature storage. Testing was conducted according to FCI specification GS-19-028, which requires thermal shock preconditioning prior to both aging treatments. Whiskers were identified by visual examination of the tin (or tin-lead) plated areas of the IMLA at approximately 100X magnification. Results were evaluated by comparison with the requirement for whisker growth specified in FCI GS-19-028. These results are applicable to all FCI connectors with insert molded leadframe assemblies.

CONCLUSIONS:

No whiskers were observed on the lead free (tin plate) insert molded leadframe assemblies.

SAMPLE DESCRIPTION:

Test sample identity is given in table 1. An example of an insert molded leadframe assembly is illustrated in figure 1.

Table 1. Identity of Submitted Samples

Item	Quantity	Description	Part Number	Lot	PF Plating	Received
1	50	AIRMAX VS® Hdr IMLA A	10016529-103LF	Order 4200	Sn / Ni	2005 Feb 21
2	50	AIRMAX VS® Hdr IMLA B	10016532-103LF	Order 4201	Sn / Ni	2005 Feb 21

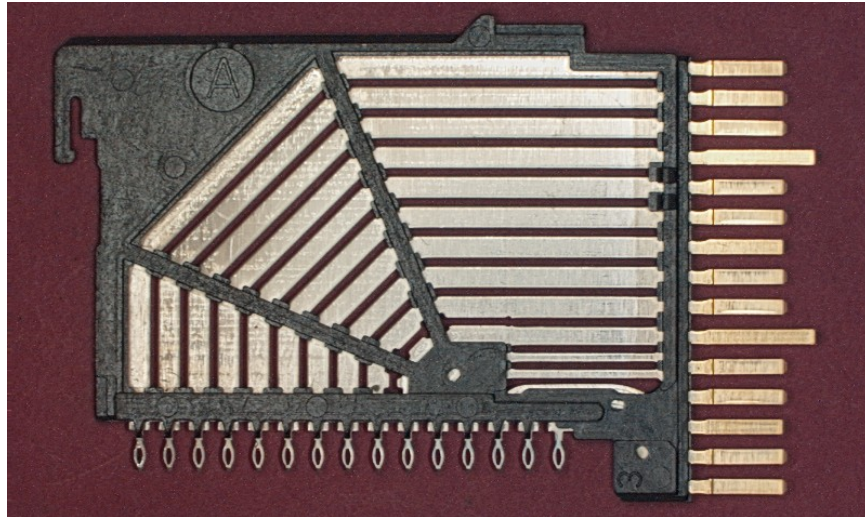


Figure 1. Example of AIRMAX VS® Header IMLA – 3X

The plating on the compliant section of the lead free press fit pins was 0.5 micrometer to 1.5 micrometers of pure matte tin over 0.5 micrometer to 3 micrometers of nickel. The plating on the compliant section of the standard press fit pins was 0.5 micrometer to 1.5 micrometers of tin-lead alloy (92 % nominal mass fraction of tin) over 0.3 micrometer minimum of nickel. Each insert molded leadframe assembly contained fifteen (15) terminals; the connectors contained ten (10) IMLAs: five (5) of each of two (2) types, designated A and B.

Five (5) insert molded leadframe assemblies of each type (A and B) were subjected to each test sequence.

REFERENCE DOCUMENTS:

Pertinent documents are listed in table 3.

Table 3. Reference Documents

Document ID	Title	Rev. Level (Date)
FCI GS-19-028	Test Specification, Test Procedure for Tin Whisker Formation in Lead-free Connector Terminal Finishes	A (2004 Feb 09)
FCI EL-2004-01-032C	Test Summary, Thomas D. Moyer, Designed Experiment to Determine the Reliability of Various Commercial Plating Baths and the Key Factors Affecting Whisker Formation	(2004 Nov 24)
ASTM E766	Standard Practice for Calibrating the Magnification of a Scanning Electron Microscope	98 (2003)

TEST SEQUENCE:

The tests were performed in accordance with the humid heat aging and room temperature storage environments specified in FCI GS-19-028 sections 5.4.1.2 and 5.4.1.3, respectively, after preconditioning by thermal shock exposure per FCI GS-19-028 section 5.2.2. Aging in dry heat (FCI GS-19-028 section 5.4.1.1) was not performed since this environment has previously been shown to be benign with respect to whisker growth (FCI test summary EL-2004-01-032C). The applied test sequence is given in table 4

Table 4. Sequence of Applied Tests by Test Group

Test Description	Condition	Sequence	
		Group C	Group D
		Humid Heat Aging	Room Temperature Storage
		75 Terminals	75 Terminals
Whisker Evaluation	Initial	1	1
Thermal Shock	Preconditioning	2	2
Whisker Evaluation	after T Shock	3	3
Humid Heat Aging	250 hr	4	
Room Temperature Storage	250 hr		4
Whisker Evaluation	at 250 hr	5	5
Humid Heat Aging	+ 480 hr	6	
Room Temperature Storage	+ 480 hr		6
Whisker Evaluation	at 1 Month	7	7
Humid Heat Aging	+ 1 Mo	8	
Room Temperature Storage	+ 1 Mo		8
Whisker Evaluation	at 2 Months	9	9
Humid Heat Aging	+ 1 Mo	10	
Room Temperature Storage	+ 1 Mo		10
Whisker Evaluation	at 3 Months	11	11
Humid Heat Aging	+ 1 Mo	12	
Room Temperature Storage	+ 1 Mo		12
Whisker Evaluation	at 4 Months	13	13
Humid Heat Aging	+ 1 Mo	14	
Room Temperature Storage	+ 1 Mo		14
Whisker Evaluation	at 5 Months	15	15
Humid Heat Aging	+ 1 Mo	16	
Room Temperature Storage	+ 1 Mo		16
Whisker Evaluation	Final (at 6 Mo)	17	17

TEST PROCEDURES:

Whisker Evaluation

The presence of whiskers was evaluated by visual observation using a binocular optical microscope at approximately 100X magnification.

All exposed areas of tin (or tin-lead) plating were examined for whisker growth. This included both sides of the IMLA on the press fit pins and on the terminals exposed within the open framework of the IMLA housing.

Examination for whiskers was conducted initially, after preconditioning, and monthly during the six (6) month environmental treatments; an examination was also conducted after 250 hours of treatment to check for rapid initial whisker growth.

Thermal Shock

The test samples were preconditioned by exposure to repetitive thermal cycling between temperature extremes of $-55\text{ }^{\circ}\text{C}$ and $85\text{ }^{\circ}\text{C}$ in accordance with section 5.2.2 of FCI test specification GS-19-028; 500 cycles of 20 minutes each were applied.

Humid Heat Aging

The test samples were subjected to aging under conditions of humid heat at $52\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and $90\% \pm 5\%$ relative humidity in accordance with section 5.4.1.2 of FCI test specification GS-19-028.

Room Temperature Storage

The test samples were subjected to room temperature storage under ambient conditions ($23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ with humidity uncontrolled) in accordance with section 5.4.1.3 of FCI test specification GS-19-028.

REQUIREMENTS:

The requirement for whisker length was 50 micrometers maximum in accordance with FCI test specification GS-19-028.

TEST RESULTS:

Whisker Evaluation

No whiskers were observed on any of the test samples under any of the applied treatment conditions.

EQUIPMENT:

Item Description	Manufacturer (Model)	Equip. ID #	Cal. Due Date
Microscope	Wild (M7)	G62200	Not Calibrated
Microscope	Wild (M8)	VG7088	Not Calibrated
Microscope	Olympus (SZH)	VG7399	Not Calibrated
Digital Camera	Polaroid (DMC Ie)	VG7555	Not Calibrated
Thermal Shock Chamber	Cincinnati Sub-Zero (Model VTS-1.5-105-105-S/AC)	VG7403	2005 May
Humidity Chamber	Blue M (FR-251B-MP1, SN F1-169)	VG6474	2006 May [†]
Humidity Chamber	Thermotron (Model SE-300-2, SN 31938)	VG7888	2005 May [†]
Humidity Chamber	Espec (PRA-3GP, SN 00119002)	S56130	2005 May [†]
Humidity Chamber	Espec (ESX-3CA, SN 015530)	VG7930	2006 Apr [†]

[†] Multiple chambers were employed for environmental exposure. During each segment of exposure, treatment was accomplished in a chamber with valid calibration throughout that period.

REVISION RECORD

Rev. #	Revision Date	Page(s)	Description
-	2005 Oct 07	All	Original Issue
A	2005 Oct 11	4	Removed erroneous notation “(compliant pins in PWBs)” (3 times)
B	2006 Apr 03	1	Updated Corporate Logo
C	2006 May 08	1	Repositioned Corporate Logo