Report EL-2005-05-011 CR

Evaluation of Tin Whisker Growth, FCI Lead Free METRAL® 2000 Header Shields
Rev. B
2006 May 08

PURPOSE:

Lead free METRAL® 2000 header assemblies were tested to assess the growth of whiskers from the matte tin plating on the shielding elements. 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. Evaluation was focused on the portions of the shields that are formed during assembly since these represent conditions of induced stress in the plated material. Whiskers were identified by visual examination of the tin 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 tin plated shields that are formed after plating for interconnection of the shielding elements.

CONCLUSIONS:

No whiskers were observed on the lead free (tin plated) shielding elements of the METRAL® 2000 header assemblies.

SAMPLE DESCRIPTION:

Test sample identity is given in table 1. An example of the connector is depicted in figure 1.

Table 1. Identity of Submitted Samples

Item	Quantity	Description	Part Number	Lot	Shield Plating	Received
1	4	METRAL® 2000 Header	74978-LF	EPR V2430	Sn / Ni	2005 May 10

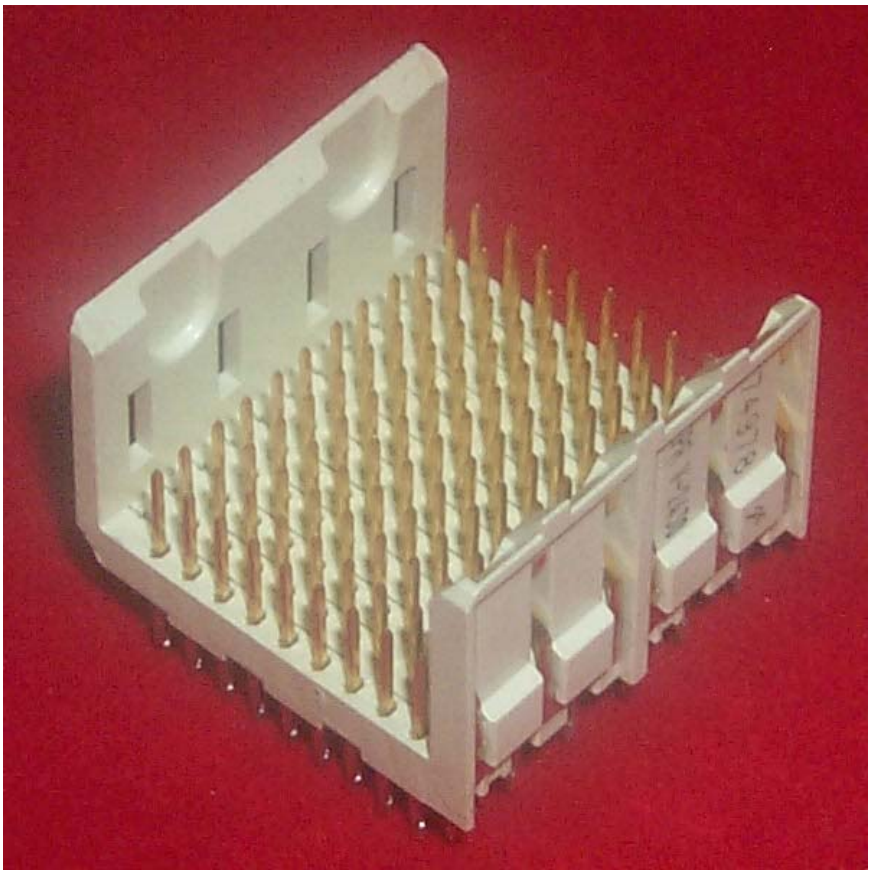

Figure 1. Example of METRAL® 2000 Header Assembly – 3X

The plating on the shield of the lead free header assembly was 0.08 micrometer to 2.54 micrometers of pure matte tin over 1.27 micrometers minimum nickel. Each insert molded leadframe assembly contained six (6) shields, one (1) grounding strip, and nine (9) rows of twelve (12) pins each (108 pins total).

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)

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

		Sequence	
		Group C	Group D
		Humid Heat Aging	Room Temperature Storage
Test Description	Condition	2 Connectors	2 Connectors
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.

Whisker evaluation was focused on the portions of the shields that are subjected to mechanical deformation after plating since these represent conditions of induced stress (which drives whisker formation) in the plated material. These features include areas where the shield is formed into spring members to provide interconnection with the ground strip and grounding pins. The areas of evaluation are delineated in figure 2. Details of the formed features are shown in figures 3 and 4.

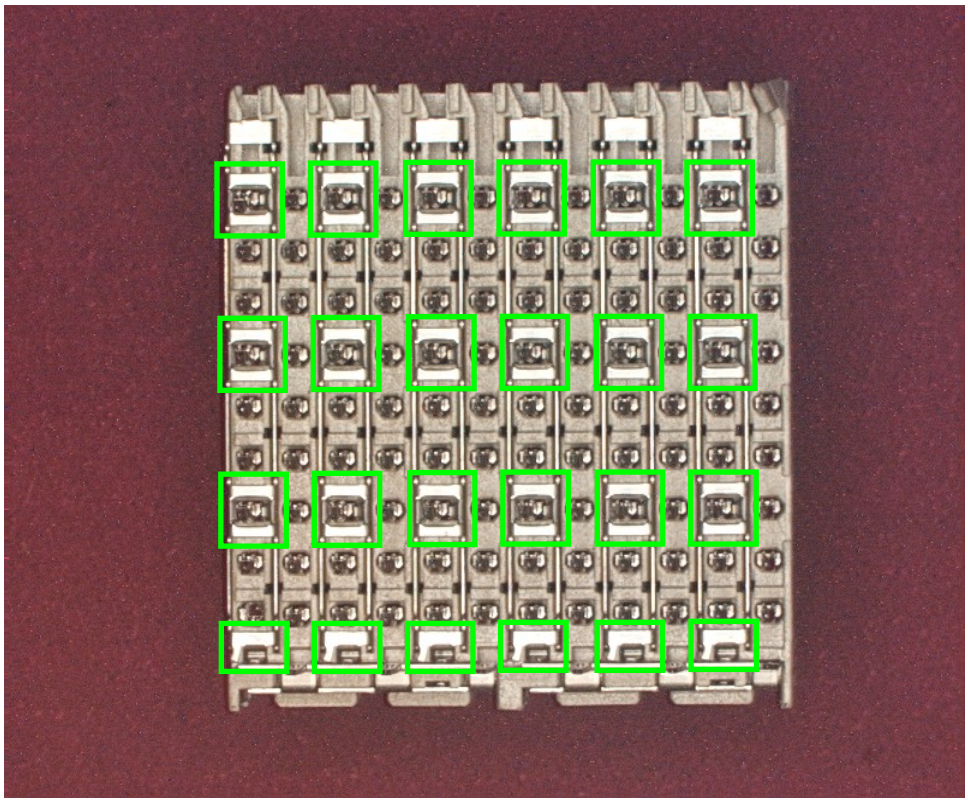

Figure 2. Bottom View of METRAL® 2000 Header Assembly Showing Whisker Evaluation Areas – 3X

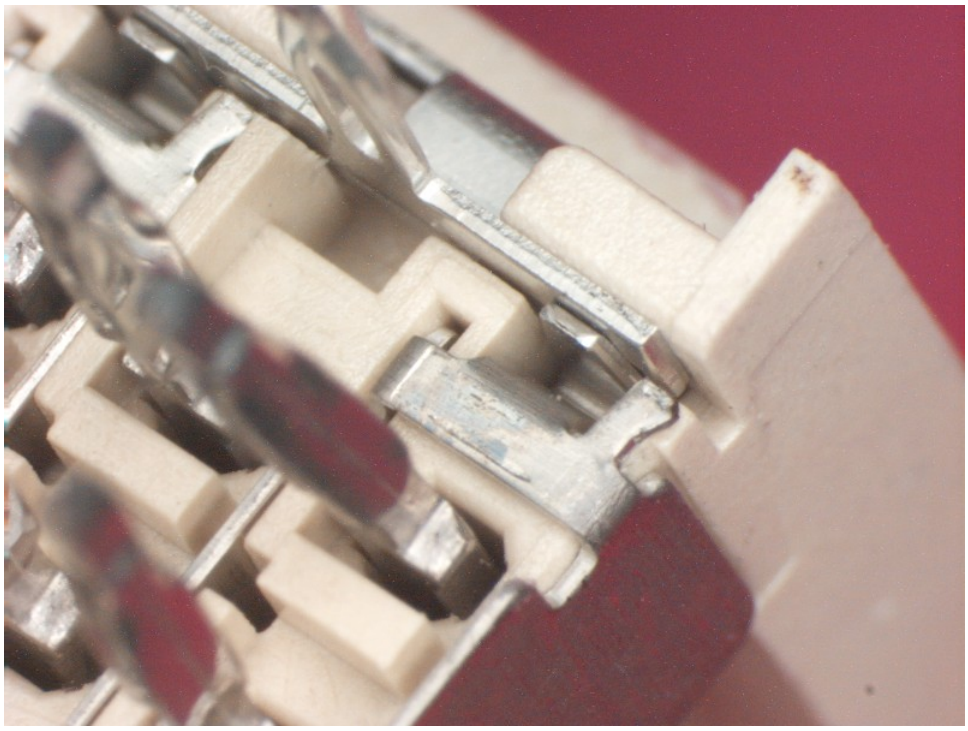

Figure 3. Formed Feature on Shield for Interconnection with Ground Strip of METRAL® 2000 Header – 20X

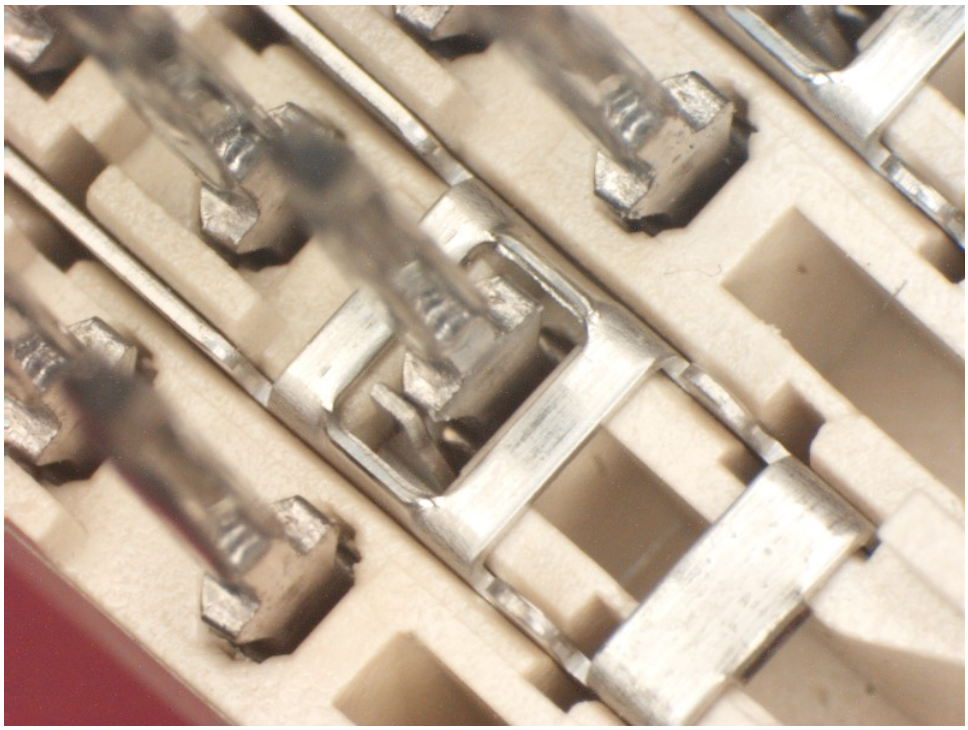

Figure 4. Formed Feature on Shield of METRAL® 2000 Header for Interconnection with Grounding Pin – 20X

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 °C and 85 °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 °C ± 5 °C and 90 % ± 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 °C ± 5 °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 (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	2006 May
Humidity Chamber	Blue M (FR-251B-MP1, SN F1-169)	VG6474	2006 May
Humidity Chamber	Espec (ESX-3CA, SN 015530)	VG7930	2006 Apr

REVISION RECORD

Rev. #	Revision Date	Page(s)	Description
–	2006 Jan 30	All	Original Issue
A	2006 Apr 03	1	Updated Corporate Logo
B	2006 May 08	1	Repositioned Corporate Logo