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MEMO

Date	13/01/2011	**Ref**	TEC-QT/2011/04/CV
From	Carole Villette	**Visa**	
To	ECSS WG members	**Copy**	M. Nikulainen (TEC-QT), W. Veith (TEC-Q)

Subject: Task Force Mandate regarding the assessment of the reliability of the assembly of critical leadless package per ECSS-Q-ST-70-38C.

Introduction:

It is confirmed that the verification of the assembly of leadless devices such as RM2512, LCC3, etc per ECSS-Q-ST-70-38 often results in unacceptable cracks. The failure is caused by a critical mismatch between the device and the PCB. The aspect ratio of the device is not favourable. In addition additional parameters such as conformal coating may contribute to the failure.

Objective:

To identify the weaknesses and criticalities in the current ECSS-Q-ST-70-38 standard based on user experience. On the basis of the consolidated findings of the Task Force a change request to the standard shall be proposed.

A. Pass/fail criteria definition

The ESA PSS-01-738 Issue 1, dated March 1991 the pass criterion was the absence of cracked solder joint or component damage after 500 thermal cycles when examined under 15X magnification. The microsection was requested only if a crack was identified in order to define the size of the crack.
In 2007 the ECSS-Q-ST-70-38 pass fail criterion was changed to have the assembly microsectioned and is based on the presence of a cracks of less than 25% of a critical area in the solder joint. The size of the acceptable crack has been defined based on the fact that 500 thermal cycles is representative of the end life of the equipment.

Most of the companies, prior to the ECSS-Q-ST-70-38 being applicable, performed the microsection on one device. The quality of the microsection, the reduced

magnification used and the limited number of microsections did allow having the assembly of the RM2512, LCCs approved.
It has been identified that the number of devices (2) assembled on the verification board is limited and that the number of microsection is insufficient as some disparity can be found in between assemblies.

B. Parameters to be addressed

1. Process stability

a. Solder stand off:

By Machine reflow the stand off is provided by the screen thickness (usually 150 micrometers)

By hand the reproducibility is not ensured. Stand off increase can be made.

b. Presence of conformal coating:

The thickness of conformance coating can vary under the device. Indeed the stand off can differ with the copper thickness. Such stand off can vary from one board to the other as boards can be different based on their functionality.
The conformal coating can flow more or less depending on the nature and presence of surrounding devices.

c. Substrate nature

The CTE of the substrate may be different and could influence the results. In addition for certain substrates the CTE in X and Y direction is different and the orientation of the device on the PCB could have an impact on the stress of the solder joints and therefore on the size of the crack.

d. Devices materials and quality

The manufacturer of the devices and therefore the materials shall be assessed as in between manufacturer the materials of the components could be different. This has already been identified for chip capacitors (type 1, 2, X7R, 2C1...)
The Qualification level of the device such as being MIL, ESCC could also results to difference of materials.

2. Design influence

The PCB build up may have some influence:

a. Copper distribution in the PCB (copper plane, symmetry of the PCB,...) may have an influence.

b. Copper thickness on the pads may have an influence due to the ingress of conformal coating in between the device and the PCB.

c. Orientation of the devices: CTE of the PCB can be different between X and Y

d. Pad design: via in pad, pad connected by track,

e. Pad size and position

f. Others

3. Thermal constrain for materials

The presence of adhesive, conformal coating may have a degrading influence on the assembly.
It has been observed that the presence of excessive conformal coating, such as silicone coating, may have a negative impact during the thermal cycling at the extreme temperatures. Such materials are not dedicated to work at such extreme temperature so failure mechanisms could be created during testing when they will not be present during service.
The presence of stiffener could also impact the behaviour during thermal cycling.

C. Critical products

The assembly of the devices such as, R1206, R2010, R2512, LCCs packages (LCC2, LCC3, LCC6, LCC18...), SMD0.5, SMD1 and SMD2 (cracks in the ceramic has been identified) is considered critical. The list shall not be considered exhaustive and may be completed at the completion of the task 1 and 2.

D. Task force mandate

1. Task 1: Identification of the perimeter of the problem.

   Input: experience from the different companies.
   Output: List of "critical assemblies" with its associated failure type, with identification of the component manufacturer and quality level as well as PCB substrate. The number of parts having been microsectionned shall be identified. Photos could be added in the list.

2. Task 2: Identification of the parameters which could lead to failure

   -Conformal coating,
   -pad size and positioning and type (via in pad...)
   -Aspect ratio of the device...
   - component manufacturer and quality level
   - adhesive used and location
   -characterisation of the PCB such as presence or not of copper plane.
   -Nature of the PCB as well as identification of the material (Arlon 35, 85, Nelco...)
   -Thermal cycling parameters (extreme temperature and ramp of the cycles)
   -Environmental tests sequence when the failure has been identified (Cracks in the ceramic, cracks in the solder joints)
   -Stand off height of the solder
   -Type of assembly (VP-HS)

-Was the device already verification tested and considered Approved by the agency and when.

Input: experience from the different companies to be added in the template.

Output: List of parameters to triggered.

3. Task 3: Identification of the testing parameters and their associated constrains

Input: Brainstorming on Electrical monitoring, microsectioning, limited thermal cycling thermal range...Definition of the minimum number of devices to be evaluated (it is proposed to increase the number of devices for critical assembly in order to ensure that the final result is representative.)

Output: Definition of the testing parameters and the required testing capabilities (electrical monitoring needed capabilities, microsection magnification...).

4. Task 4: To identify if the problem is generic and concerns all users

It is proposed to increase the number of devices for critical assembly in order to ensure that the final result is representative.

Input: To have the assembly by automatic machine and HS performed by companies participating in the task force and to test according to the ECSS-Q-ST-70-38 with additional electrical testing.

To determine the effect of the cracks on the electrical properties of the assembly.

To verify the tests having been performed by the component manufacturer during the qualification of the device.

Output: Confirmation of the criticality of the assembly of the devices

5. Task 5: Proposed solution

-Alternative packaging (other size, devices, modification of the aspect ratio...)
-Project limited verification
Request to validate the modified Coffin Manson model
-Others

E. Duration of the task force

The duration of the Task force shall be 6 months.
Task level planning and participation shall be agreed at the task force Kick off meeting.

F. Kick off

Mid of January

G. Task force composition

ECSS-Q-ST-70-38 WG members.

Th. Battault (CNES), P. Allard (Ruag Space Sweden), L. Sollecchia (TAS-L'Aquila), F. Perez Gracia (Ast Crisa), Ph. Cardon (AST-ELancourt), J. Tailhades (AST-Elancourt), J.P. Bessaguet (TAS-Toulouse), J. Barnerias (ESA), C. Villette (ESA),
To be confirmed : B. Strachan (ASTA), S. Nesi (Selex Galileo Firenze).

The members of the task force shall allocate time to participate to the task force exercise.

Lead task force: C. Villette (ESA)

H. Task force reporting

Regular basis reporting shall be made ever two months to the management of the participating organisations.
Final report shall be produced at the end of the mandate in which proposed change request to the ECSS-Q-ST-70-38 shall be addressed.

I. Cost

The cost should be covered by every participant own funding.