
# ACCEDE 2019
# TAS' Experience with AEC-Q devices in launcher applications

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# Agenda

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# INTRODUCTION: WHY AEC FOR LAUNCHERS

- ARIANE-6: A6-GR-1000000-X-32-ASL Issue 1 EEE Components & Assembly technologies policy
  - Ariane-5 Large Heritage with AEC-Q devices. Field Return: No failures
  - AEC-Q devices meet A6 requirements on Components Reliability Data
  - AEC-Q devices meet A6 requirements on whisker data
  - No Total Ionisation Dose (TID) / Total Non Ionisation Dose (TNID) requirements for launchers but Single Event Effect: avoid non recoverable effects a LETth<35MeV*cm2/mg
  - AEC-Q devices: Constructional Analysis as per ECSS-Q-ST-60-13C, and heavy ions testing as applicable
  - RoHS & REACH required
  - This policy is in line ECSS-Q-ST-60-13c Grade-3 except by ROHS & REACH and lack of TID/NITD
  - EEE Components meeting Araine-6 requirements are classified in TAS Parts Common data Base as Grade-4 to segregate with other Grade-1/Grade-2/Grade-3 COTS as per ECSS-Q-ST-60-13C
- VEGA-C : VG-SG-1-D-0032-SYS Iss.2 Rev.1 VEGA-C Launcher Vehicle EEE components's policy
  - Similar approach as Ariane-6 for the "Industrial procedure".

ARIANE 6

Electrical, Electromechanical and Electronic Components and Assembly Technologies Policy

VECEP PROGRAM

EEE COMPONENT'S POLICY GENERAL SPECIFICATION

# SOME FIGURES FROM ARIANE-6: 70% AEC

- TAS in Belgium Analysis :
  - 4 Equipments: 596 line items (374 passives, 109 connectors, 113 actives). 407 are automotive ; 169 pure commercial ; 14 are PEDs (Plastic Enhanced Devices with Vendor Item Drawing); 6 are HiREL
  - TASiB. 93 Justification documents prepared.
- TASinSpain:
  - 1 Single Equipment: 96 line items (including passive values), 73 types where 43 are AEC-Q, 7 are PEDs (with VID), 22 are pure commercial, and 1 is 883B.
  - 54 Justification Documents prepared by TASiS, 13 reused from those prepared by TASiB.
- Total:
  - 67% components are AEC-Q. 70% including AEC+PED.

# SUPPLIERS. THE KEY DECISION. TRACEABILITY & COUNTERFEIT

- Define 2 or 3 preferred and authorized distributors (DIGI-KEY; MOUSER, FARNELL, ARROW, AVNET…)
- Provide the complete list to distributor for PCN/PDN tracking
- Clarify the needs to distributors:
  - Traceability (Lot Date Code; assembly Lot, wafer Lot)
  - 1-year old Lots
  - Single Lot, Lot homogeneity
  - Appropriate packaging
  - Cannot accept non AEC-Q alternatives, different manufacturer alternative
  - Counterfeit Controls(Visual, Fischerscope, Constructional Analysis / DPA…)
- Problems with suppliers:
  - Lead Times  Very problematic for resistors and capacitors due to worldwide shortage. 2 or 3 sources recommended
  - Difficulties with requirement on single lot, tracebility, etc.. For some distributors
  - Very big minimum buys for some non preferred distributors
  - Export License for PEDs and some high end AEC (ECCN 3A001a.2.c; 5A991b; 3A991b.1a, etc..)

# CONTROL OF PCN/PDN. OBSOLESCENCE & LAST TIME BUY

- Follow-up of PCN/PDN imply a very huge amount of work. Recommended to be centralised by a single company.
- Follow-up of PCN is critical, along with Constructional Analysis and Incoming, for:
  - Changes affecting radiation (die:  mask number, diffusion site, second sources)
  - Changes affecting mounting qualification (assembly construction techniques, materials, assembly site, second sources for materials or assembly)
  - Reliability data
  - Obsolescence, Last Time Buy
  - Export Licernse
  - Countrefeit Controls
- Obsolescence / Last Time Buy :
  - Although product life cycle of AEC-Q products are expected to be much longer than thiose of pure commercial, TASiS experienced 3 LTB in 2 years (2 of them AEC-Q) for `products with End of Life not expected before 2023.

# AEC-Q MANUFACTURERS FEEDBACK: FROM THE VERY BAD TO THE VERY GOOD

- Very big differences in the feedback and support from AEC-Q manufacturers
  - from the VERY BAD: almost no answer, impossible to get reliability data, PPAP (Production Parts Approval Process), info on ESD, support from Constructional Analysis findings, etc..
  - To the VERY GOOD: willing to provide reliability reports PPAP, support for application and failures, etc…

- Recommended :
  - Establish early communication channel with manufacturers
  - Work preferably with manufacturers with better support

# INCOMING OF AEC-Q DEVICES (VISUAL & XRF): NO FAILURES

- 1st LOT INCOMING :
  - Visual Inspection: should follow JESD22-B101C (best standard, ESCC or MIL standard are not appropriate)
  - Fischerscope Inspection on 2 pieces 2 points whatever finish (pure tin, SAC, ENEPIG, etc…):

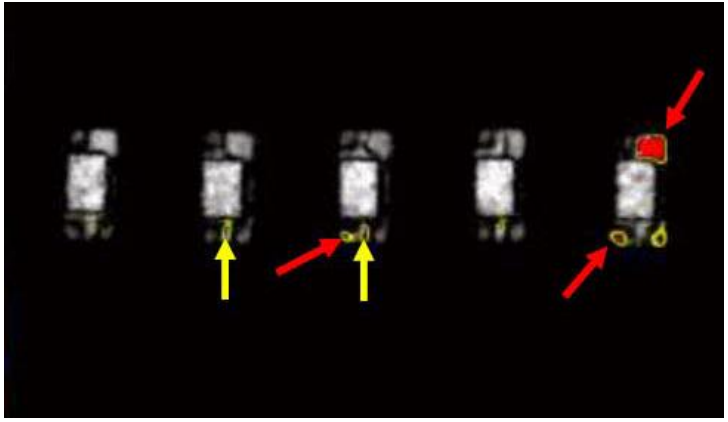
No anomalies seen on AEC-Q devices but on commercial , custom magnetic, etc..

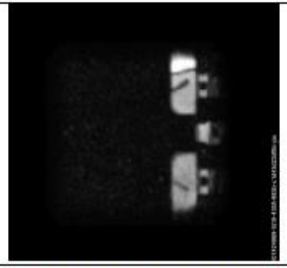
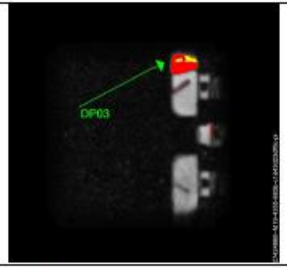
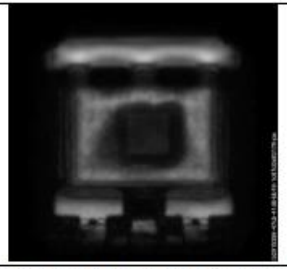
Findings were most cosmetic and in a fraction of per cent of devices: small chip-out, lead frame copper exposed, marks on terminations, etc..

# CONSTRUCTIONAL ANALYSIS: DELAMINATIONS

- Around 200 CA/DPA done. More than 100 on AEC-Q devices. Some more in progress
- Constructional Analysis follows ECSS-Q-ST-60-13C for semiconductors and own TYAS standard for passive. For commercial metal-ceramic cavity RF devices (non hermetic, adhesive sealing) CA as for hirel hermetic excepting RGA
- No anomalies found on AEC-Q devices excepted delaminactions seen in C-SAM inspection
  - Delamination observed on at least 5 constructional analysis (2 of them were AEC-Q).
  - All were classified as minor: very small size confirmed by micro-sections and very good bond pull results when delamination are located under bonding pads
  - Manufacturer feedback: considered them as cosmetic as not affecting AEC reliability testing
  - Manufactyurer feedback: follow J-STD-020E instruction to check for delamination evolution if any:
    - Initial Electricals+Visual+C-SAM
    - Conditioning (thermal cycling, bake, reflow)
    - Final Initial Electricals+Visual+C-SAM, plus measurement of crack/void growth if any.
  - In progress at TASiS
  - Manufacturer feedback: could have less delamination for halogen free package version

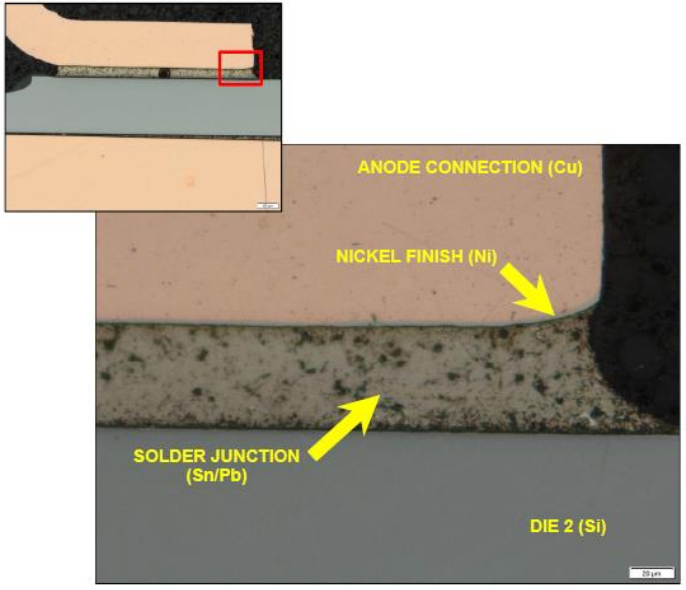
# CONSTRUCTIONAL ANALYSIS: DELAMINATIONS (CONT'D)



| | | |
|---|---|---|
| Circuit Side (focus on lead finger plane) |  |  |
| | The inspection does not show any feature causing rejection in analysed objects.<br>DP03: Partial lead finger delamination. It does not reach the bonding area and therefore it is not a rejection cause. | |
| Non-Circuit Side (focus on lead finger plane) |  |  |
| | The inspection does not reveal any feature related to delamination, cracks or voids in the analysed objects. Coloured areas within the inspection zone (lead fingers) in the phase-inversion image are due to edge effects. This analysis shows parts for which the image acquisition is not optimized (die, pladdle and heat spreader interfaces) and therefore they are not evaluated. | |

# ROHS & REACH: INTERNAL PB SOLDERING

- Observation in CA : Internal Pb95Sn5 soldering not declared in data sheet (which states RoHs & REACH compliance) found in many diodes (5) y in transistors (2) in packages as D2PACK.
- It is allowed by exception 7a of Article 4(1) of RoHS Directive 2002/95/EC mainly for:
  - 5. Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.
  - 7a. - Lead in high melting temperature type solders (i.e. tin-lead solder alloys containing
  - more than 85 % lead),
  - 7d - lead in electronic ceramic parts (e.g. piezoelectronic devices).



# CONCLUSIONS

- No major anomaly found on AEC-Q devices during constructional Analysis (except minor delaminations, or non RoHs internal Pb soldering) or during Incoming.
- Constructional Analysis on each lot has a high added value (lot to lot variability tracking, Counterfeit, PCN, RoHs). Incoming Visual has low added value on 2nd lot.
- Get complete Lot Traceability, single lot, less than 1-year lots could be difficult: work only with preferred distributors.
- Follow-up of PCN/PDN is critical.
- Increase attrition policy. Inert storage recommended.