FAILURE ANALYSIS METHODOLOGY

Issue: Solid Tantalum Capacitors are forbidden for certain uses!!
Still, they are used against the rules in many equipments
Result: failures on Ground Testing!!

Why Tantalum Capacitor? : Small, compact and attractive

Possible Utilisation: Filtering, local energy storage

Possible Misuse: Filtering in power supplies
Improper screening test
Project Failure

Investigation
Defined methodology

Outcome

Determine risks and support decision making process

ESA Alerts
Inform Other Projects

Lessons Learned
New Products and Preselection of Technologies

Standardise
ECSS Q60-11 (derating)

ESA tailoring
ESA Future test campaign to update derating

Project Failures
Rosetta
ATV
Galileo
MSM
...

video
Investigation Route: Defined Methodology

TEC-EP (Power Laboratory)
Electrical Characteristic for Utilisation

Capacitor as a Component in a Circuit: Electrical Circuits Engineering

- Exploration of Utilisation Limits
- Definition of Application Domain
- Assessing Performance in Application

TEC-QC (Component Laboratory)
Physical Characteristic

Capacitor as an Electrical Component: Component Engineering

- Component Level Test
- Physical Testing
- Constructional Analysis

Conclusion and Action Plan

25/10/2004
QC Laboratory Analysis

- Electrical Characterisation
- External Visual Inspection
  - Sample Under Analysis
  - Reference Sample
  - Radiographic Inspection
    - IR Analysis and Mapping of Fault Site
    - De-Encapsulation
    - FIB or Micro Section
    - SEM Inspection
EP Power Laboratory Analysis: Electrical Circuits Tests

Capacitors tested: Solid tantalum in chip form e.g. 22μF/35V

Methodology of the Study:

1- Initial Signature of the Capacitors & Capacitors Bank
Leakage current and impedance characteristics
EP Power Laboratory Analysis: Electrical Circuits Tests

*Capacitors tested: Solid tantalum* in chip form e.g. 22μF/35V

**Methodology of the Study:**

1. **Initial Signature of the Capacitors & Capacitors Bank**
   - Leakage current and impedance characteristics

2. **Utilisation Tests as per foreseen test tree**
   - Converter tests: continuous tests, pulsed tests.

3. **Limits Tests as per foreseen test tree**
   - Converter tests until the breakdown occurs.
EP Power Laboratory Analysis: Electrical Circuits Tests

*Capacitors tested: Solid tantalum in chip form e.g. 22uF/35V*

Methodology of the Study:

1- Initial Signature of the Capacitors & Capacitors Bank
   Leakage current and impedance characteristics

2- Utilisation Tests as per foreseen test tree
   Converter tests: continuous tests, pulsed tests.

3- Limits Tests as per foreseen test tree
   Converter tests until the breakdown occurs.

4- Analysis of Tests Results
   Overall conclusions, derivation of application domain,
   input to ECSS-Q-60-11 or derating
Example of Power Laboratory Tests: Current Tests

Continuous Tests
- Max de-rated RMS Current
- Several minutes

Limits Tests
- Max de-rated RMS Current
- Breakdown

Spike Tests
- Dedicated Converter Build to Test the Capacitors

Pulsed Tests
- Max de-rated RMS Current
- Several minutes

Tantalum Capacitor(s) to be Tested

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Work on Tantalum Capacitor is a Three Dimensions Work:

- **Types and Sizes**
  - AVX
  - Firadec
  - CTC21
  - TBJ
  - TPS
  - TAJ

- **Configurations / Uses**
  - Parallel
  - Series-Parallel

- **Manufacturers**