



# EEE COMPONENTS LONG TERM STORAGE

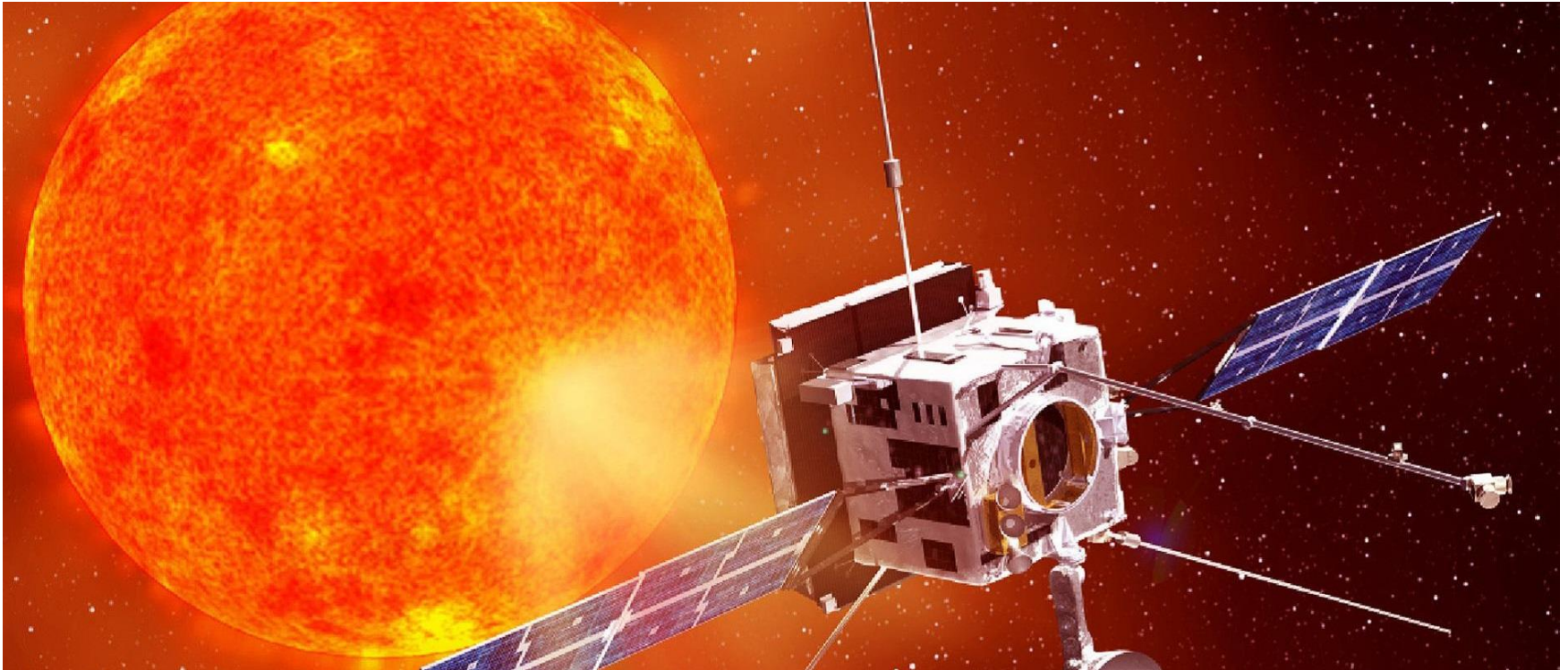
## Long Term Storage Workshop

ESA / ESTEC (7<sup>th</sup> June 2016)

Gonzalo Fernandez Romero

# AEROSPACE & ELECTRONIC BUSINESS UNIT

**ALTER**  
TECHNOLOGY GROUP



ALTER TECHNOLOGY GROUP: with **30** years experience in the sector.



# PRESENTATION OUTLINE

- ✓ Introduction
- ✓ Referenced document
- ✓ Storage degradation mechanisms
- ✓ Component related
- ✓ Storage related
- ✓ Long term storage approach
- ✓ Case studies
- ✓ Summary / Conclusions



# INTRODUCTION I/II

**ALTER TECHNOLOGY – TÜV NORD S.A.U. has an extensive experience in EEE parts engineering, procurement and storage.**

Long Term Storage was one of our early studies. In 1993, in the frame of COLUMBUS project, we got an ESA contract to assess the “Long Term Storage for High Reliability Components”.



A summary was presented in a paper within the *ESA Components Conference 1993*, in which the degradation mechanisms, the mitigation techniques, the verification test methods and procedures in conjunction with the housekeeping rules were set-up.

# INTRODUCTION III/II

Procedures and storage area was put in place.

- ATN perform for the European space Agency (ESA) the official storage of parts surplus coming from different ESA projects.
- ATV and HTV projects: ATV parts procurement performed in 1999 to cover needs for 4 flight units. The scheme was repeated in 2003. Same approach for HTV project.

**In all the cases, the parts were selected, ordered, received, tested, packed, and stored with a periodic verification (when required), supplying the components to the different equipment manufacturers through programmed deliveries.**



# REFERENCED DOCUMENTS

We are familiarized and continually use the MIL and ESA procedures relevant to manage the storage process and their associated tasks. As reference see:

- ESCC 24900 “Minimum requirements for controlling environmental contamination of components”.
- ESCC 20600 "Preservation, packaging and dispatch of ESCC electronic components“.
- IEC 61340-5-1. Electrostatics – Protection of electronic devices from electrostatic phenomena –
- MIL-MIL-PRF-81705 Barrier Materials, Flexible, Electrostatic Discharge Protective, Heat-sealable, etc.
- MIL-STD-19491 “Packaging of Semiconductor Devices”.
- MIL-STD-39028 “Packaging of Capacitors”.
- MIL-STD-55330 “Packaging of Connectors, Electrical and Fiber Optic”.
- ECSS-Q-ST-60 “EEE Components”.
- ECSS-Q-ST-60-14 Relifing Procedure – EEE Components”.
- ECSS-Q-ST-70-01 “Cleanliness and Contamination Control”.
- ECSS-Q-ST-70-20 “Determination of the Susceptibility of Silver-plated Copper Wire and Cable to “Red-plague" Corrosion”.

# STORAGE DEGRADATION MECHANISMS

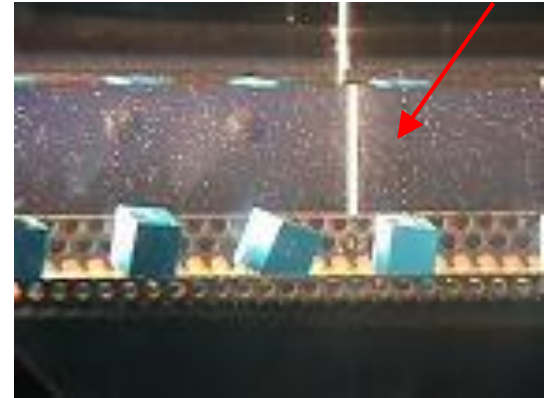
Device degradation occurred during storage can come from different sources:

- ✓ Chemical degradation
- ✓ Mechanical degradation
- ✓ Thermal degradation
- ✓ And combined effects, the most relevant.

**The degradation can vary severely from one device to another in the same environmental conditions.**

## Component Related

- Component technology.
- Component package: hermetic, plastic,...
- Lead material and finish.
- Supplier packaging.
- Handling prior to storage.
- Device cleanliness.
- Device ESD sensitivity.





# STORAGE DEGRADATION MECHANISMS

## Storage Related

- Temperature range and stability.
- Humidity range and stability.
- Industrial / corrosive atmosphere.
- Storage duration.
- Handling.
- ESD management.
- Storage packaging.
- Special considerations: MBB bags, dry storage, N2 cabinet, moisture indicator, desiccant pouch,....,etc.



# LONG TERM STORAGE. AFFECTING FACTORS

- EEE components selection.
- Parts procurement policy & procurement paths.
- Acceptance testing design & performance.
- Device packaging, identification labeling.
- Storage conditions.
- Stock monitoring and verification.
- Relifing rules.
- Process management and monitoring.

# LONG TERM STORAGE. AFFECTING FACTORS

## EEE Components Selection

- Screening and quality level: commercial, industrial, MIL (QML V, QML Q, Y, S, ..., 883), ESCC.
- Qualification level: qualified, non qualified, EPPL, automotive, ...
- LAT / QCI level
- Maximum age (date code restrictions)
- Package type, lead material, ...
- Obsolescence
- Past experience: preferred manufacturers, types, special testing ...

# LONG TERM STORAGE.

## Device Packaging and Identification

We must use the right materials and processes to pack, re-pack the lots and prepare the kits in the most suitable way to support the next operation step: long term storage, delivery, assembly, etc.

The packing must consider the available procedures for example: IEC 61340, MIL-B-81705....It is needed to have available techniques to cover the spread range of components types: trays, bars, tape & reel, preformed boxes, MBB bags, vacuum and N2 purge sealing,...

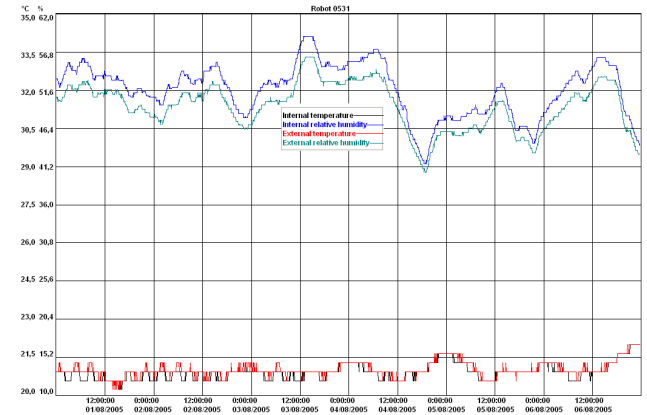


# LONG TERM STORAGE

## Storage Conditions

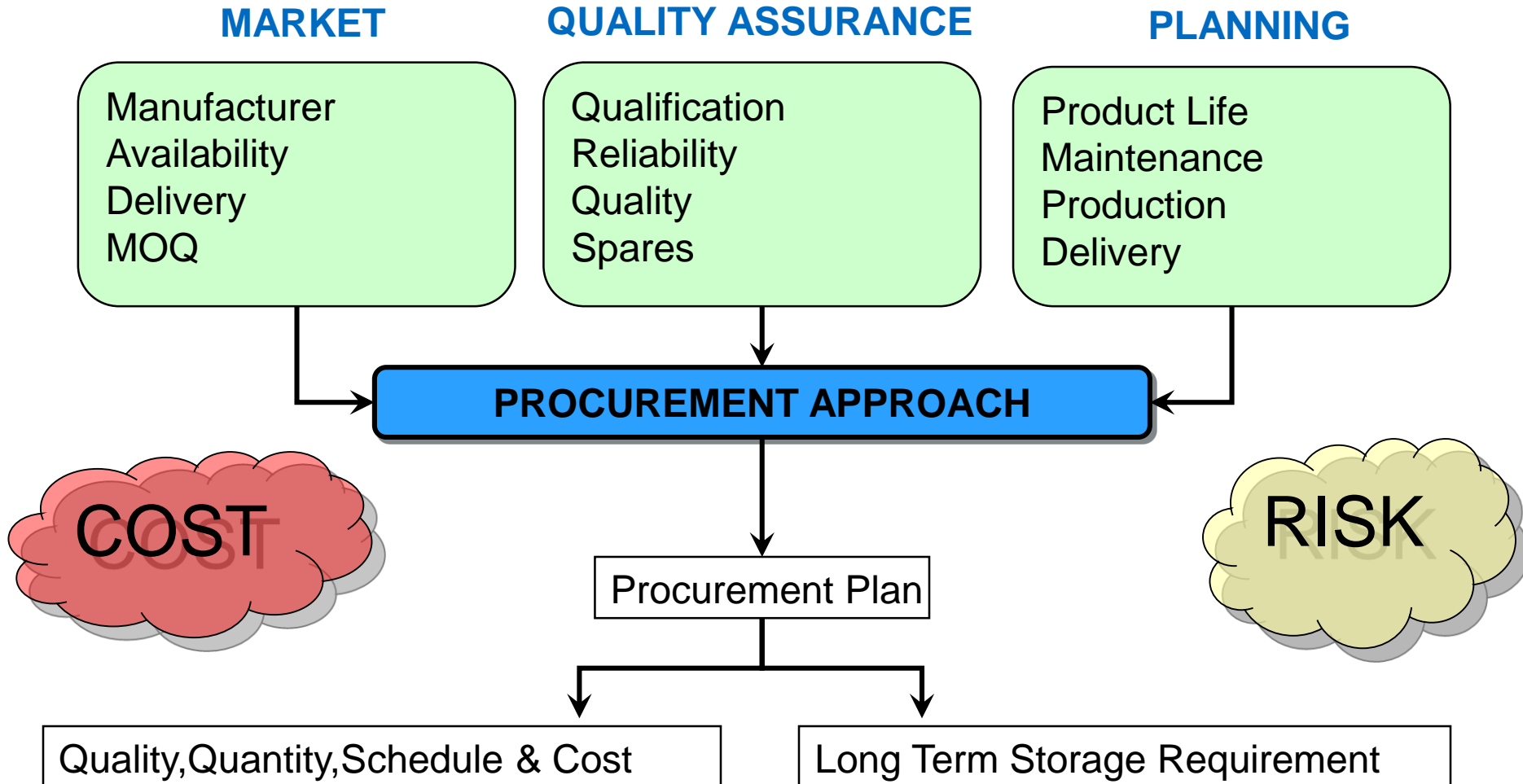
The storage conditions and the environmental variables must be under control and monitored:

1. Temperature
2. Humidity
3. Smoke and fire detection plus extinguishing system
4. Access control and security systems
5. ESD store management: floor, table, ground connections, conductive or static dissipative materials use,...
6. Special storage conditions: dry cabinet,..
7. Housekeeping rigorous procedures, etc..

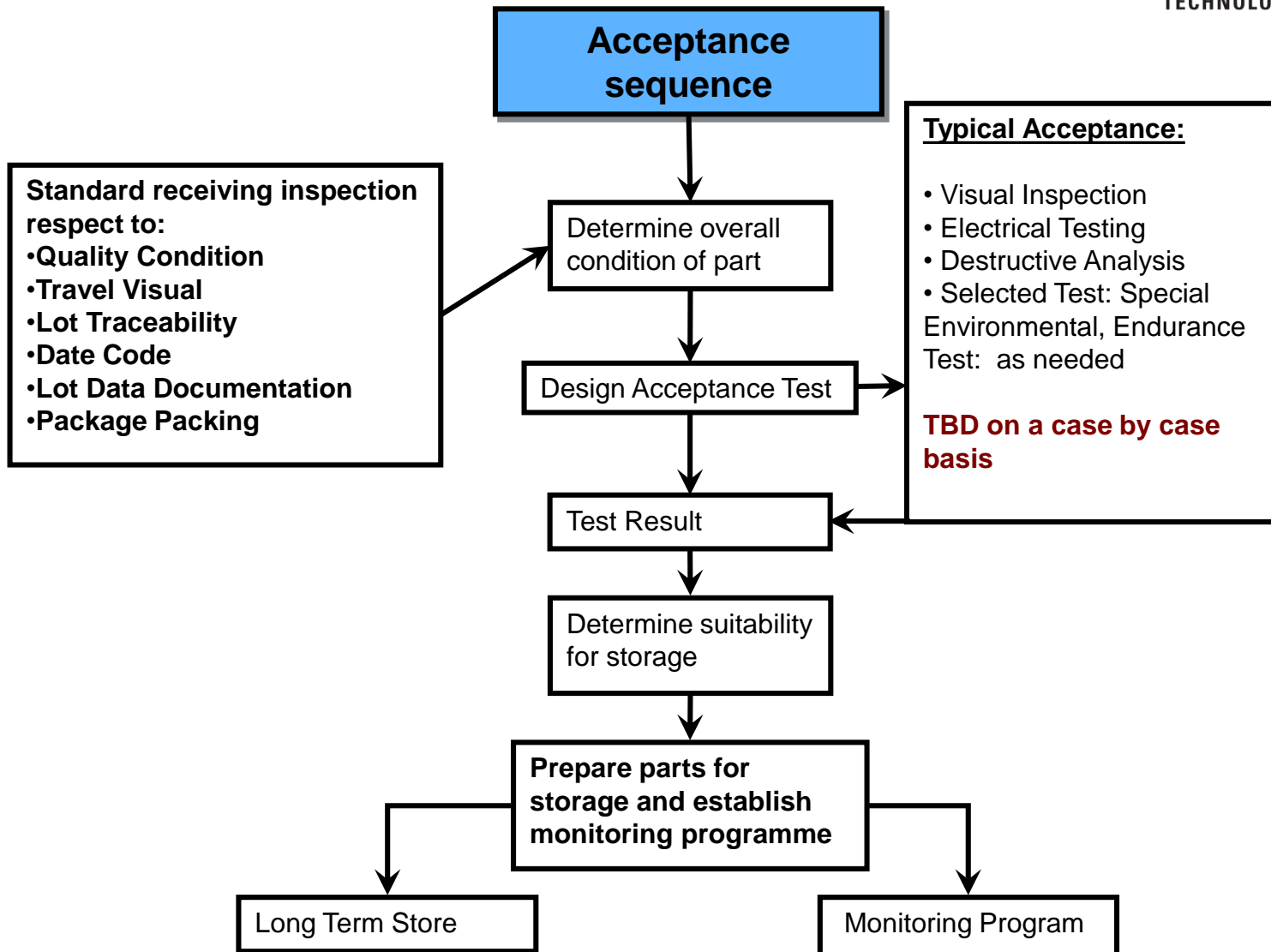


# LONG TERM STORAGE APPROACH

## Parts Procurement Policy & Procurement Paths

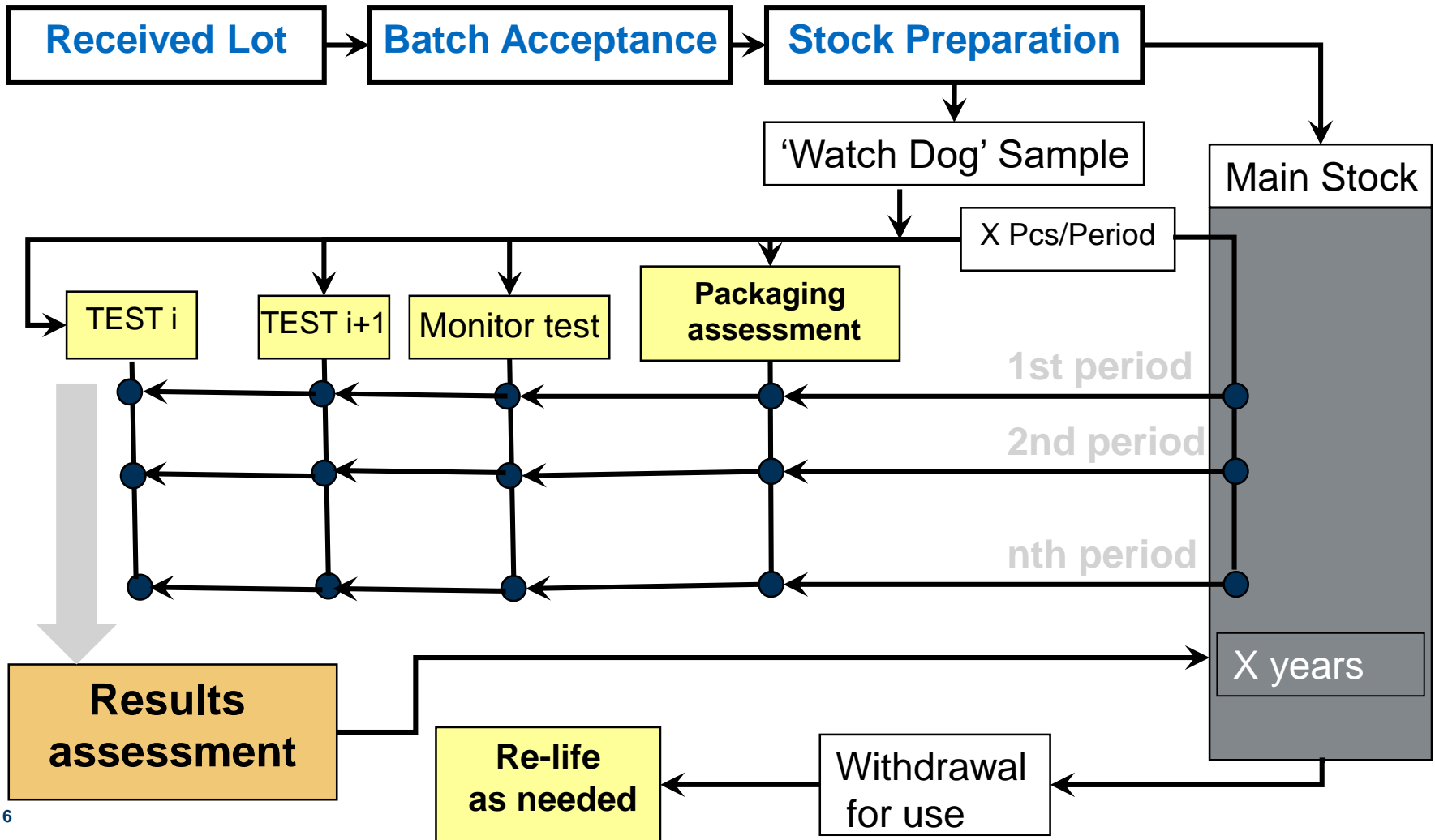


# LONG TERM STORAGE APPROACH



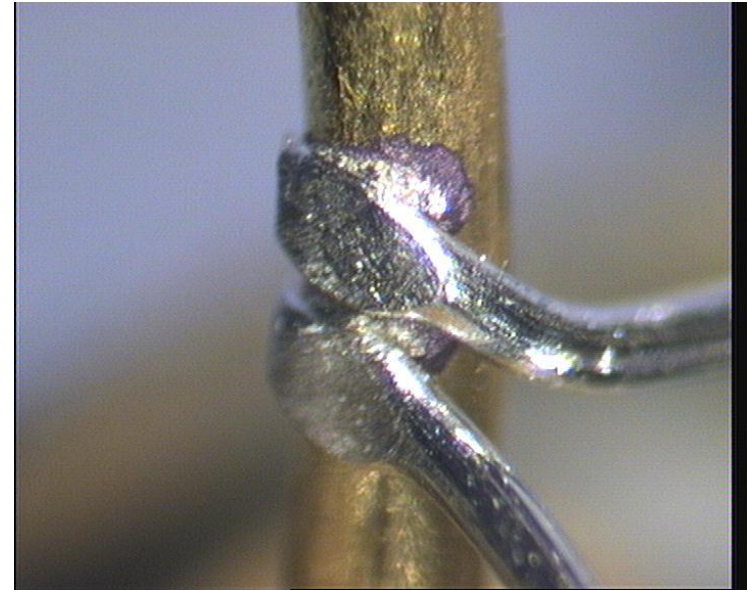
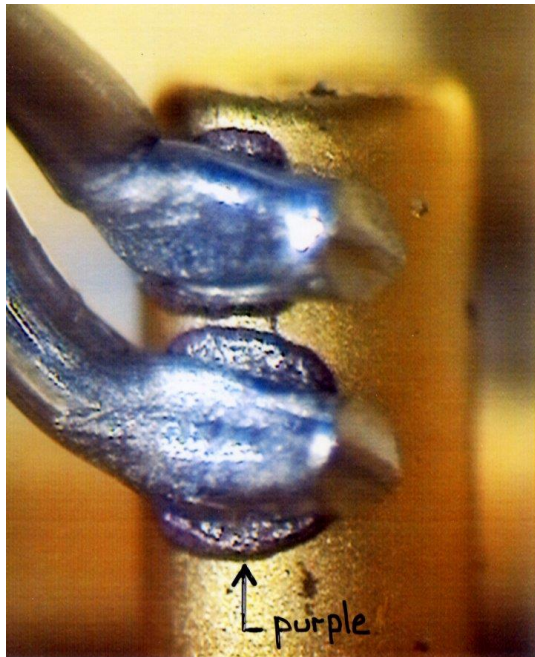
# LONG TERM STORAGE APPROACH

## Stock Monitoring and Verification.



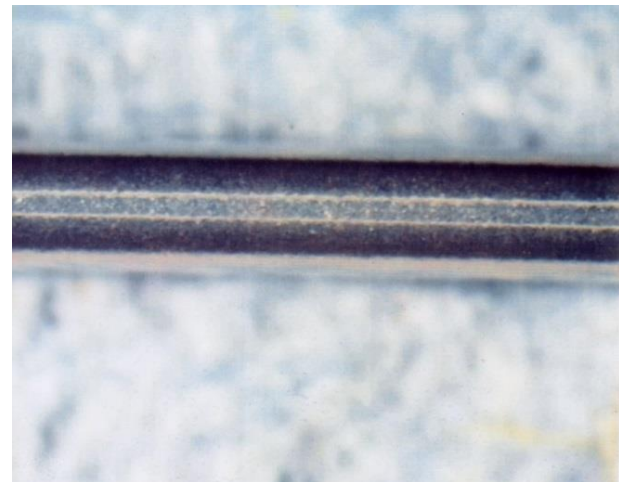
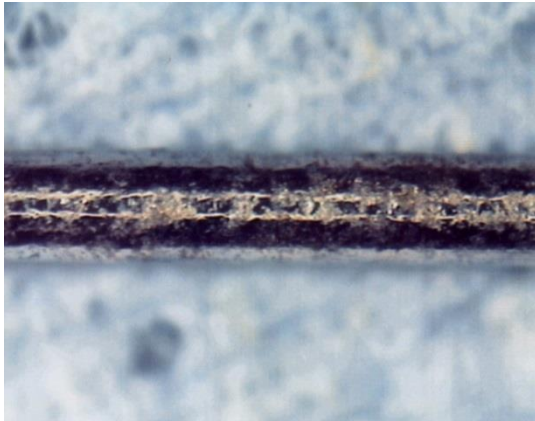


# CASE STUDY 1



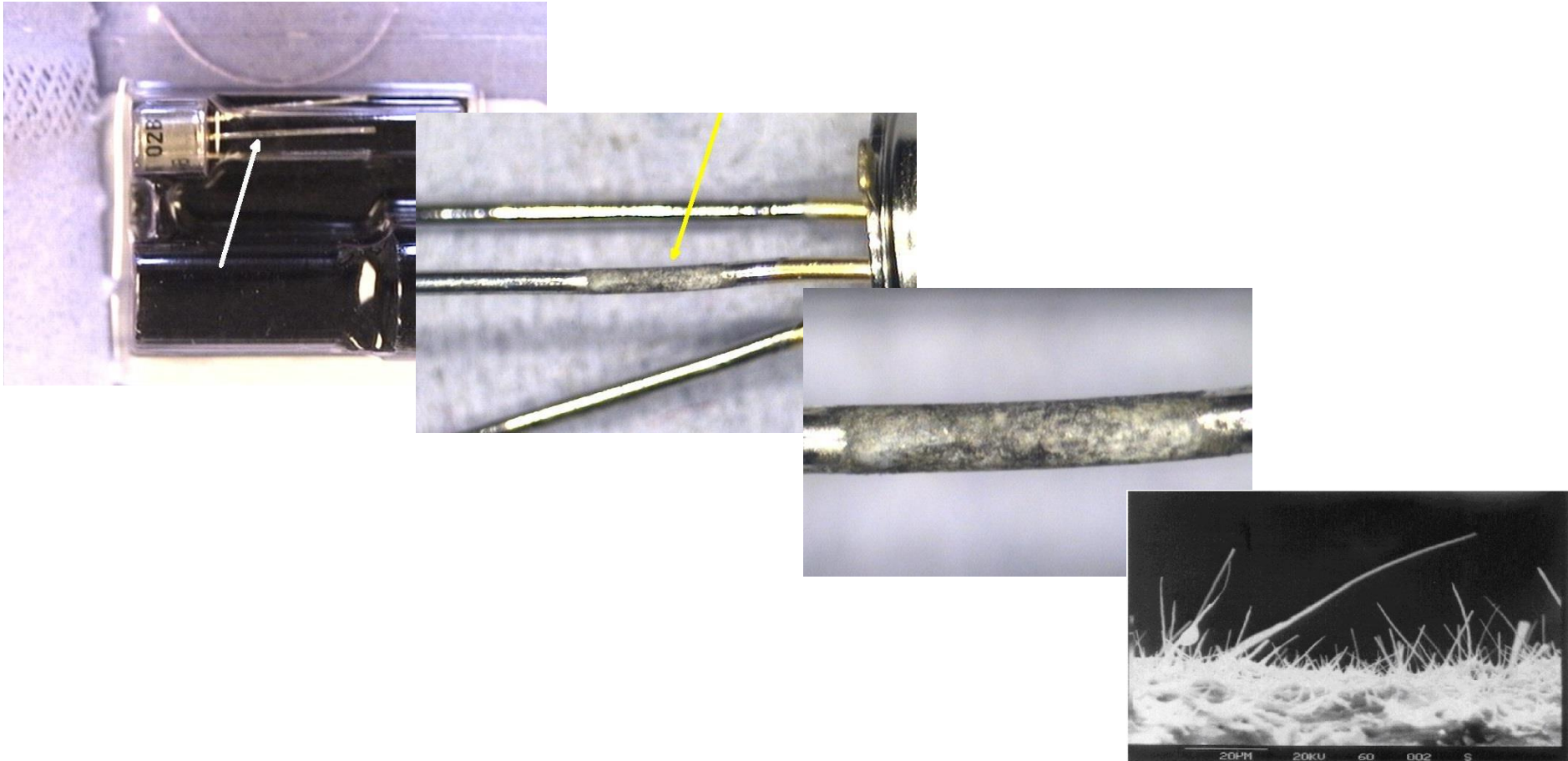
Comparison of a five year old D.P.A. Report with an inspection made after storage from the study

## CASE STUDY 2



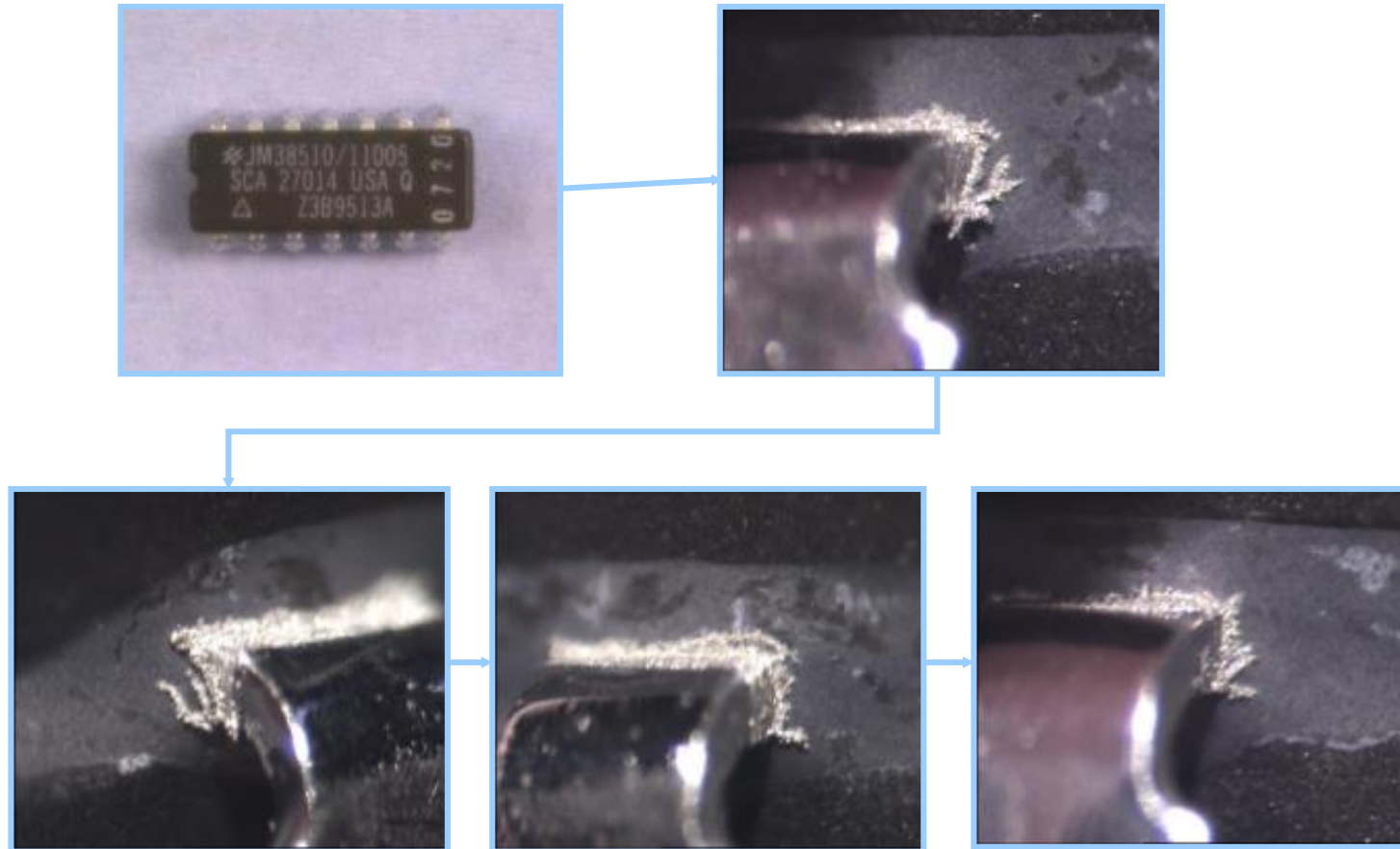
A typical solderability problem found at relife  
and an example of reworked component

# CASE STUDY 3



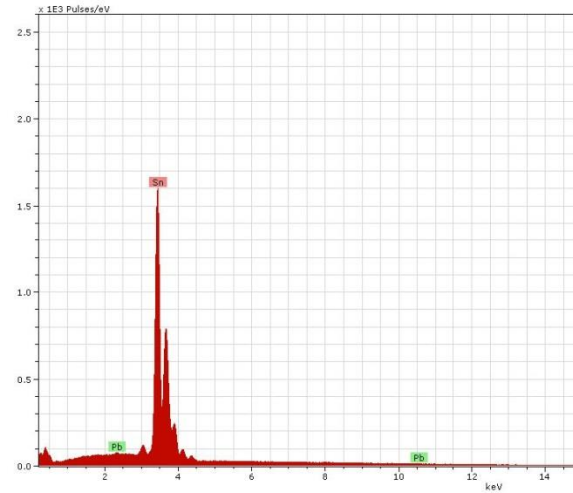
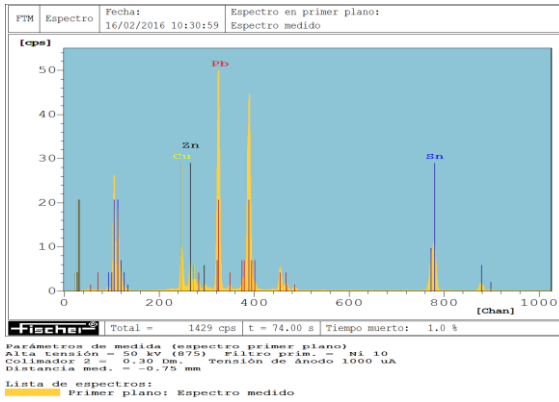
Not all packaging is safe enough

# CASE STUDY 4

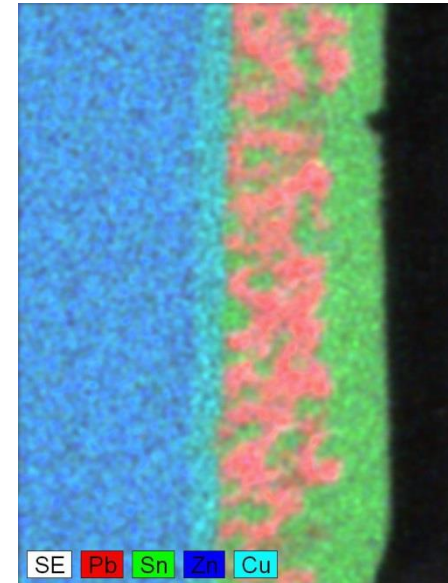
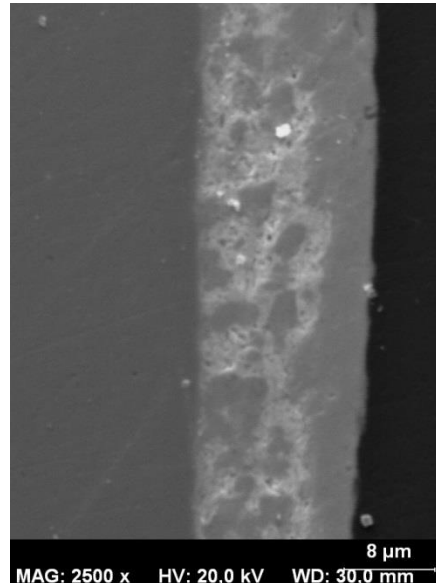
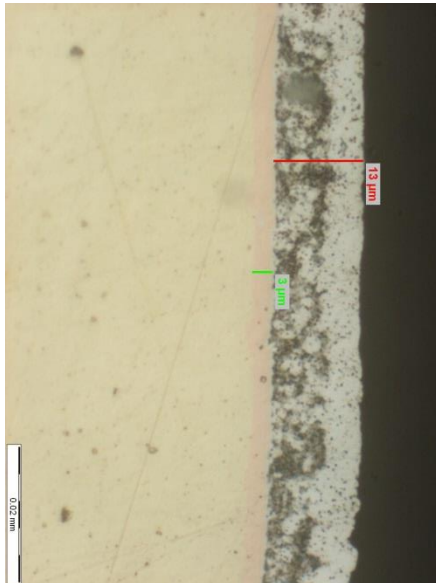


Whiskers Developing After Seven Years in Storage

# CASE STUDY 5



SnPb= 15.0  $\mu$ m Sn= 68.9 % Pb= 31.1 %

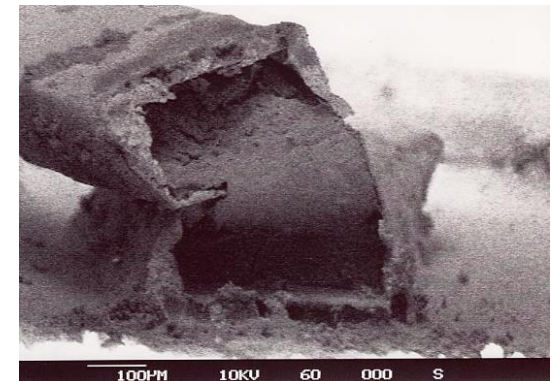
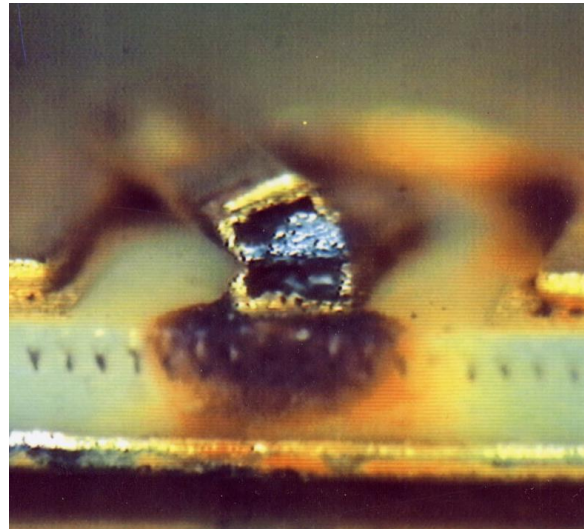
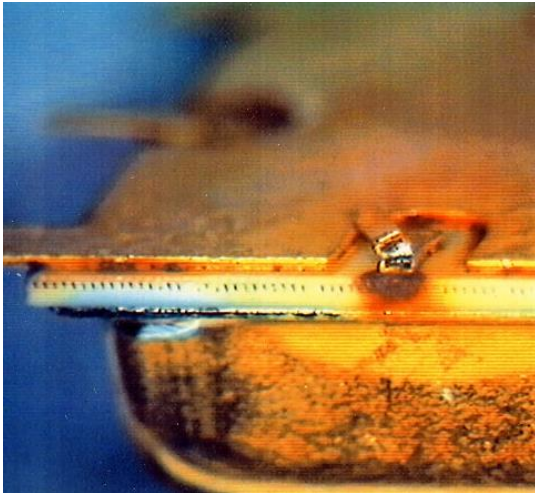


# CASE STUDY 6



A known cosmetic anomaly in the brazing area some times evolve rapidly during storage although rarely has an impact in the mechanical robustness.

# CASE STUDY 7



A component leadouts degrades in a very short period of time, failure occurred within two years of the component's date code.

The nickel-iron leadout has been completely corroded leaving only the gold and nickel platings.

# SUMMARY / CONCLUSIONS I/II

1. There is limited information on the effects of long term storage on EEE devices, specially for new technologies and device packaging techniques.
2. Long Term Storage is not just placing the parts in an controlled environment storage area.
3. Successful long term storage requires the adoption of good engineering “Best Practices”, at different levels:
  - a) Parts and manufacturer selection,
  - b) Parts procurement,
  - c) Parts test and verification,
  - d) Packaging and Store control,
  - e) Overall process management.
4. The results of this combined engineering work with a deep knowledge of each individual device behavior is the key to reduce the storage risk and increase the parts survival making possible the long term storage success.



# SUMMARY / CONCLUSIONS II/II

1. LTS can be an answer to some problems of **OBSOLESCENCE** Management.
2. LTS may be the only solution for **“LAST TIME BUYS”** of specialised components.
3. LTS is a practical solution if components require **“UPSCREENING”** or **“UPRATING”**



**THANK YOU FOR YOUR ATTENTION**

Gonzalo Fernández  
Technical Advisor

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[gonzalo.fernandez@altertechnology.com](mailto:gonzalo.fernandez@altertechnology.com)



**C/ Tomás Alba Edison, nº4, PCT Cartuja, 41092, Seville, Spain**  
**Phone: + 34 95 446 70 50**