EEE Parts Related Issues

JAXA/ESA/NASA

Trilateral Safety and Mission Assurance Meeting

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EEE Parts Related Issues

- Water Soluble Flux
- Non-Hermetic Packages
- (Counterfeit Parts)
- Lead-Free Solder

Water Soluble Flux

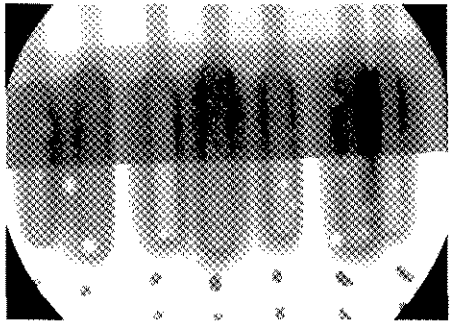
- Use of Water Soluble Flux WSF is rapidly increasing due to cost of cleaning rosin flux in “green” business environment
- WSF leaves hard-to-detect Weak Organic Acids (WOA) behind which increase latent defect risk
- Screening method not available for WOAs. Must use both the standard ionic contamination screen plus a ion chromatography process quality monitor.
- All process quality monitors known for WOAs are destructive and are done on test articles. Ion Chromatography is best and fastest.

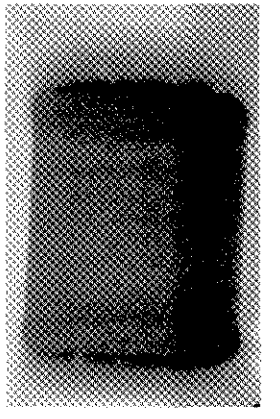
Water Soluble Flux

- Voiding Concerns -

WSF can result in solder voiding, potentially reducing joint strength. Qualification using life testing is required to establish acceptable level of voiding.

1. What attributes and boundary conditions differentiate problematic voids from no-impact voids?
2. Assurance through item screening: How can solder joints be screened for macro-voids?
3. Assurance through process qualification: What are the process parameters which prevent macro-voids?

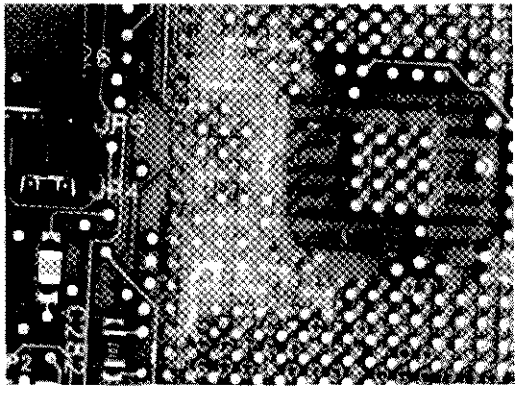




Water Soluble Flux

- Cleanliness Concerns -

- Un-reacted flux constituents can corrode metals: solder, plating, copper PCB traces



- Ions + Water + Potential difference (V)
  - → Electromigration of metal causing shorts
  - → Conduction through electrolyte
  - → Conduction through formed metallic salts

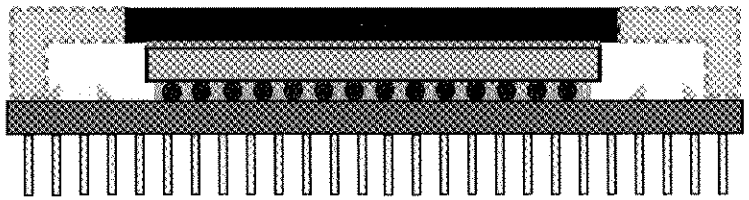
- Un-reacted WSF is source of Water: Weak Organic Acids (WOA) in WSF readily bind with water.

- Multiple sources of ions: halide additive, “dirty” boards. “dirty” parts.

Nondestructive cleanliness screening test not available. Must use process-based quality control and periodic quality monitor.

Non-Hermetic Packages

- Acceptance of complex devices in non-hermetic packages will become essential for space applications
- Space application subjects the packages to stresses that they were not designed for (e.g., vacuum)
- Ways must be found to obtain assurance in the integrity of the packages
- NASA is working on a new Space Class for non-hermetic packages (Class X versus Class V)
- Testing for package integrity will be required but can be package specific as described by a Package Integrity Test Plan
- The plan is developed by the manufacturer and approved by the Government



Schematic of a non-hermetic Ceramic Column Grid Array (CCGA) package, with flip-chip and included capacitors

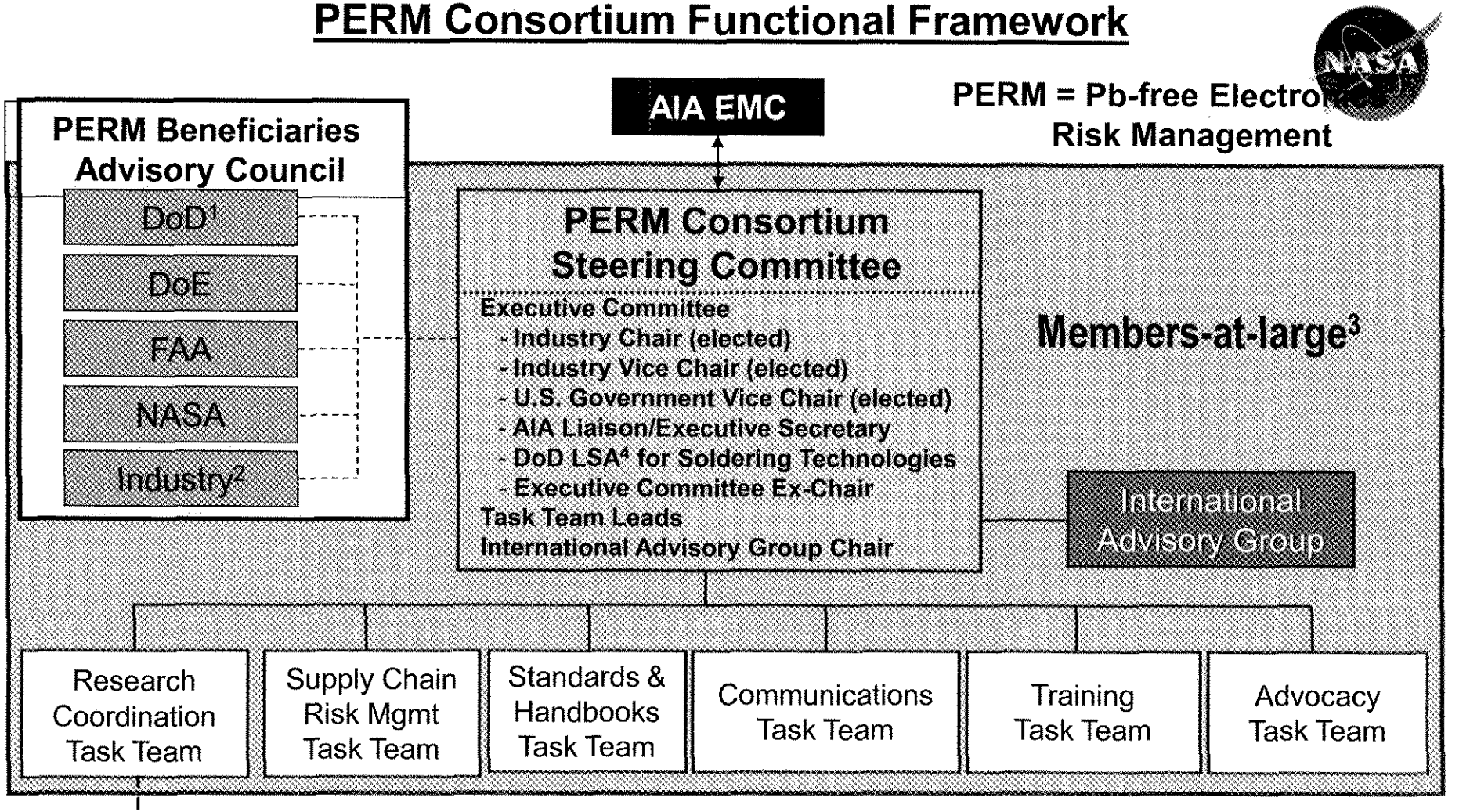
Lead-Free Solder

New lead-free solders are introduced continuously

- Kester, a large US solder supplier lists 24 lead-free solder alloys:
  - Most are 3 element such as SnAgCu (SAC)
  - Six are 4 element such as SnInAgBi or SnAgBiCu
  - How consistent/predictable are these complex alloys?
  - SAC alloys have large grains so each solder joint is different
  - What are the impacts of mixing, with lead or other alloys during rework/repair?
- Sometimes tin-lead is better, sometimes lead-free
  - Application and stress dependent
  - How to tell which to use?
  - What is long-term performance?

There is no single, effective whisker mitigation approach and even combinations of several do not guarantee success

PERM Consortium Functional Framework



Lead-free Electronics Research Manhattan Project (Gov't Contract)

- **Develop standards and training, guide research, provide advocacy**
- **Major research effort to provide answers to key questions in 3 years**