

Voluntary Consensus Standards (VCSs) are NOT Voluntary

**An Electronic Parts Perspective on
NASA's Use of VCSs**

CQSDI, Cape Canaveral, Florida

March 17, 2009

Michael J. Sampson,
Co-Manager, NASA EEE Parts and Packaging
Program (NEPP) <http://nepp.nasa.gov>
301-614-6233 michael.j.sampson@nasa.gov

Overview

- **OMB A-119**
- **VCS Use is NOT Voluntary**
- **VCS Participation is NOT Voluntary Either**
- **NASA Participation in VCS**
- **NASA Parts Policy**
- **Lead-free and VCSs**
- **GEIA 0005 Standards**
- **Tin Control**
- **Why Use VCSs?**
- **Issues with VCSs**



OMB Circular A-119

- OMB Circular A-119, dated February 19, 1998, mandates government use of Voluntary Consensus Standards (VCSs) unless “inconsistent with law or otherwise impractical” AND it goes on to say
 - “The use of such standards, whenever practicable and appropriate, is intended to achieve the following goals:
 - » a. Eliminate the cost to the Government of developing its own standards and decrease the cost of goods procured and the burden of complying with agency regulation
 - » b. Provide incentives and opportunities to establish standards that serve national needs
 - » c. Encourage long-term growth for U.S. enterprises and promote efficiency and economic competition through harmonization of standards
 - » d. Further the policy of reliance upon the private sector to supply Government needs for goods and services”

Thursday
February 19, 1998

Part IV
Executive Office of
the President

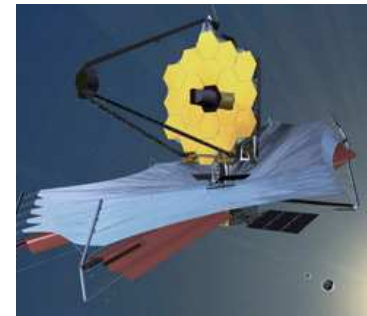
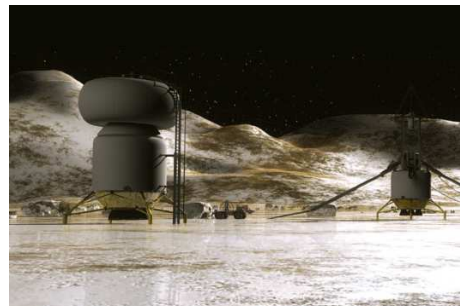
Office of Management and Budget

OMB Circular A-119: Federal Participation
in the Development of Voluntary
Consensus Standards and in Conformity
Assessment Activities: Notice

A119

VCS Use is NOT Voluntary

- Best procurement vehicle for some electronic parts for space use is now a VCS (often based on a MIL spec)
 - Connector Contacts
 - Insulated Wire
- Newer Test Methods are standardized as VCSs
 - IPC J-STD-002, Solderability tests for component leads, terminations, lugs, terminals and wires
 - » Current revision includes requirements for unleaded solder
- The industrial base prefers VCSs
- The MIL system is “status quo” or shrinking, new specifications and standards are VCSs
 - Areas such as software have not had a strong government specification presence



Participation in VCSs is Not Voluntary Either

- Although A-119 is correct, VCSs do eliminate the cost of government maintaining its own standards, NASA still needs to fund standardization
- VCS bodies often include a broad range of interests from low cost commercial to space
 - Space is in the minority
 - Whatever your business, if you don't participate your needs may not be met by the VCS standard
- VCS participation can require:
 - Extensive travel (including international)
 - Multiple personnel to cover multiple committees and task teams
 - Extensive work time reviewing documents, participating in telcons, researching and writing content

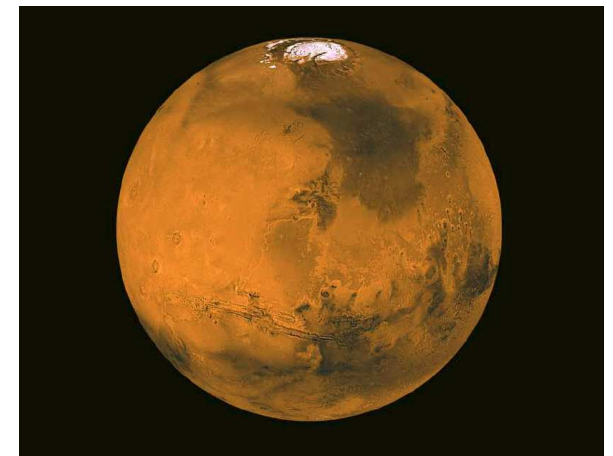
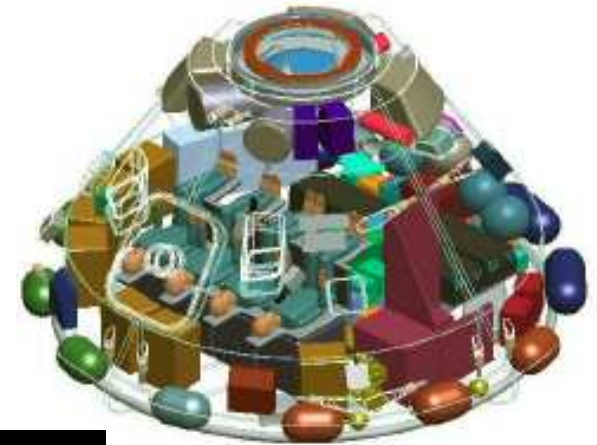
An effective level of support for VCS activities is the same or greater than for an equivalent in-house standards system

NASA Participation in VCS Activities

- NASA has always used some VCSs covering such things as test methods for materials but use has grown considerably since A-119
- Currently, NASA participates in and/or uses products from at least 29 VCS bodies
 - Only a few of these VCS organizations cover electronics-related areas
 - See Next Slide



Society	Name
AIA	Aerospace Industries Association
AIAA	The American Institute of Aeronautics and Astronautics
ANSI	American National Standards Institute
ASAE	American Society of Agricultural Engineers
ASM	American Society for Metals
ASME	American Society of Mechanical Engineers
ASNT	American Society of Non-Destructive Testing
ASQ	American Society for Quality
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CCSDS	Consultative Committee for Space Data Systems
EIA	Electronic Industries Association
IAU	International Astronomical Union
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IENT	Institute of Environment Sciences and Technology
IPC	Institute for Interconnecting & Packaging Electronic Circuits - Association Connecting Electronics Industries
ISO	International Organization for Standardization
ISOC	The Internet Society
ITRI	Industrial Technology Research Institute
NACE	National Association of Corrosion Engineers
NCSL	National Conference of Standards Laboratories
NFPA	National Fire Protection Association
NHA	National Hydrogen Association
OASIS	Organization for the Advancement of Structured Information Standards
RTCA	Radio Technical Commission for Aeronautics
SAE	Society of Automotive Engineers
SFCG	Space Frequency Coordination Group
TIA	Telecommunications Industry Association



Electronics Workmanship VCSs Used by NASA

- IPC
 - IPC-2221 Generic Standard on Printed Board Design
 - IPC-2222 Sectional Design Standard for Rigid Organic Printed Boards
 - IPC-2223 Sectional Design Standard for Flexible Printed Boards
 - IPC-2225 Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies
 - IPC A-600 Acceptability of Printed Boards (Class 3 requirements)
 - IPC-6011 Generic Performance Specification for Printed Boards (Class 3 requirements)
 - IPC-6012 Qualification and Performance Specification for Rigid Printed Boards (Class 3/A requirements)
 - IPC-6013 Qualification and Performance Specification for Flexible Printed Boards (Class 3 requirements)
 - IPC-6015 Qualification and Performance Specification for Organic Multichip Module (MCM-L) Mounting and Interconnecting Structures
 - IPC-6018 Microwave End Product Board Inspection and Test
 - J-STD-001, Requirements for Soldered Electrical and Electronic Assemblies
 - J-STD-001DS, Amm1, Space Applications Electronic Hardware Addendum to Requirements for Soldered Electrical and Electronic Assemblies
 - IPC A-610 Acceptability for Electronic Assemblies (not preferred but keeps showing up)
 - J-STD-004, Requirements for Soldering Fluxes
 - J-STD-006, Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications
- ANSI/ESDA
 - ANSI/ESDA S20.20, For the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
 - ANSI-NCSL-Z540, Calibration Laboratories and Measuring and Test Equipment, General Requirements
- ASTM
 - ASTM 2240 Hardness, Standard Test Method for Rubber Property — Durometer Hardness

VCSs Invoked by NASA Parts Policy

NPD 8730.2C -- main

Verify Current version before use at:
<http://ntrs.nasa.gov>

Page 1 of 5

[| NODIS Library | Program Management\(8000s\) | Search |](#)



NPD 8730.2C
Effective Date: November 03, 2008
Expiration Date: November 03, 2013

COMPLIANCE IS MANDATORY

[Printable Format \(PDF\)](#)

Request Notification of Change (NASA Only)

Subject: NASA Parts Policy

Responsible Office: Office of Safety and Mission Assurance

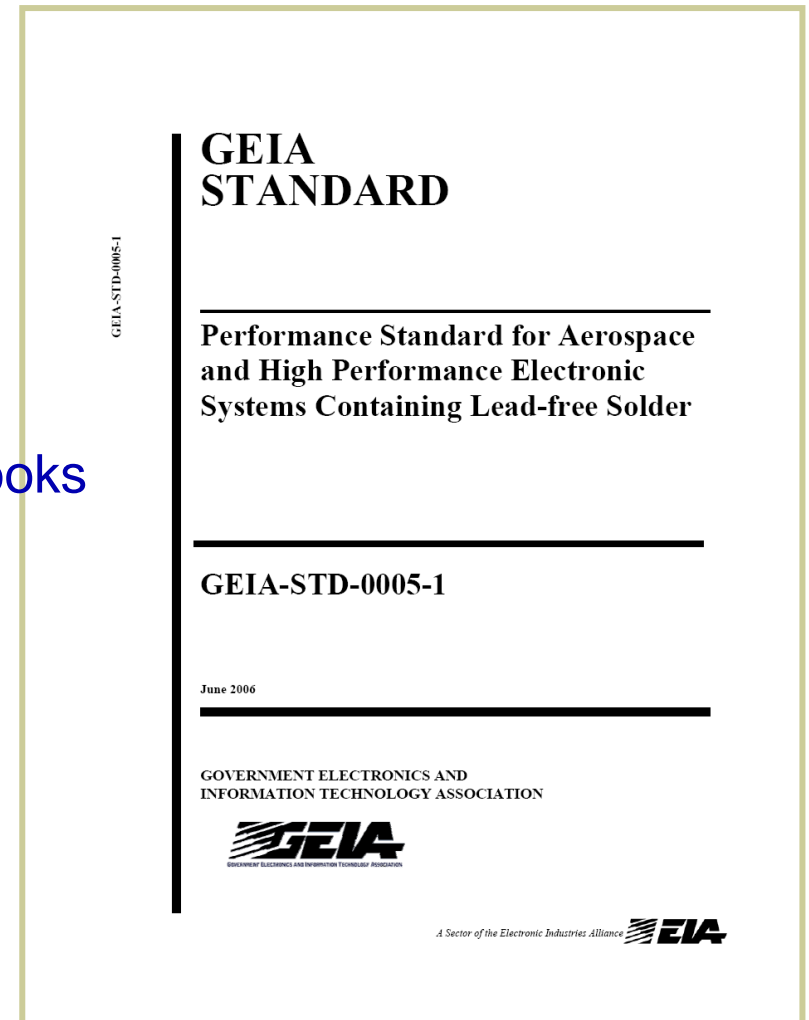
- NPD 8730.2C, NASA Parts Policy, references the following VCSs to cover 2 new issues, lead-free electronics and counterfeiting:
 - TechAmerica (was GEIA, EIA)
 - » GEIA-STD-0005-1, Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder
 - » GEIA-STD-0005-2, Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems
 - » GEIA-HB-0005-1, Program Management/Systems Engineering Guidelines For Managing The Transition To Lead-Free Electronics
 - » GEIA-HB-0005-2, Technical Guidelines for Aerospace and High Performance Electronic Systems Containing Lead-free Solder and Finishes
 - SAE AS5553
 - » Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition (in Final Ballot)

Lead-free Electronics and VCSs

- NASA and other aerospace entities face risks from the international move to lead-free electronics
 - Unknown solder joint reliability from new alloys, especially in severe environments
 - Unknown impacts on electronic part reliability from higher processing temperatures needed
 - Unknown impacts from mixing alloys during rework and repair
 - Tin whiskers and tin pest from the use of lead-free tin platings on terminations, lugs etc.
- NASA needed a way to control or at least understand the lead-free content in its future hardware
 - NASA turned to VCSs

GEIA 0005 Standards and Handbooks

- NASA joined the Lead-free Electronics in Aerospace Project (LEAP) WG soon after its inception
- NASA shared its knowledge of tin whiskers and the results of joint NASA/DoD lead-free assembly tests (JGAP1)
- LEAP collected a lot of information from worldwide sources and distilled it into a series of consensus standards and handbooks
- It was decided to offer the documents to GEIA to publish as they had established infrastructure and international recognition
- The IEC was asked to release them as “Publicly Available Specifications” to make them truly international (In process)



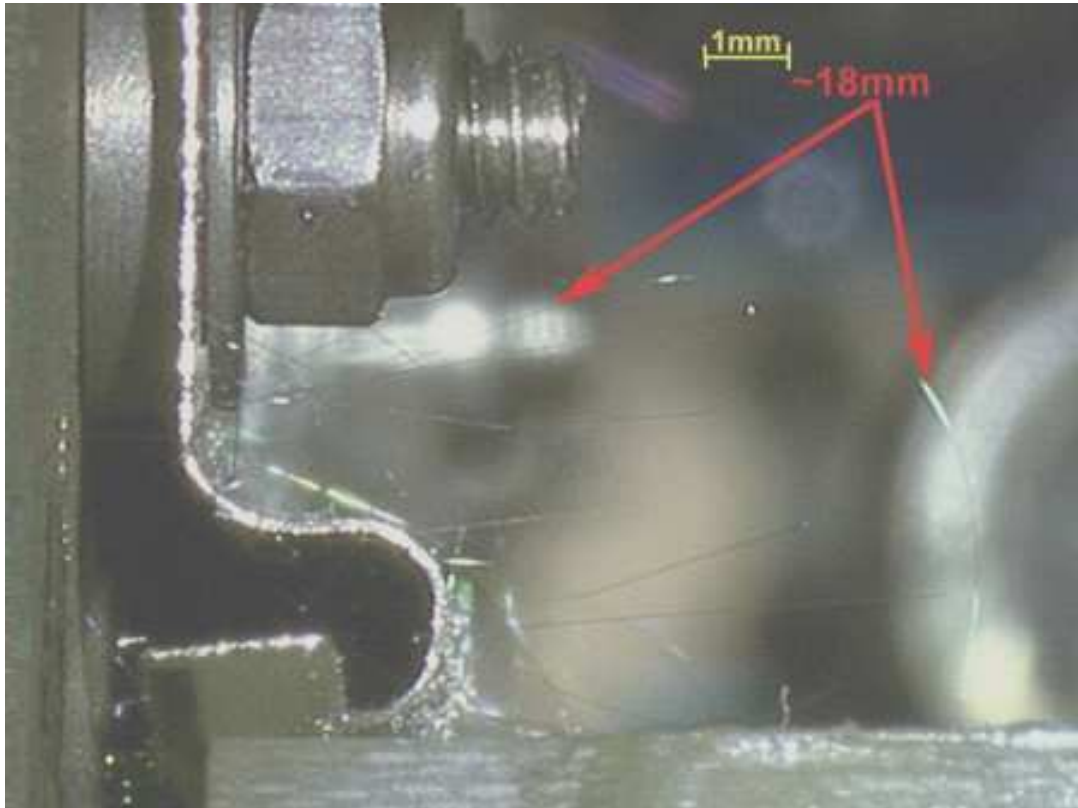
LEAP Actionable Deliverables

GEIA-STD-0005-1	Performance Standard	Lloyd Condra, Boeing	Published GEIA 30 June 2006	Submit to IEC 31 March 2007
GEIA-STD-0005-2	Tin Whiskers	Anduin Touw, Boeing	Published GEIA 30 June 2006	Submit to IEC 31 March 2007
GEIA-HB-0005-1	Program Mgmt Guide	Pat Amick, Boeing	Published GEIA 30 June 2006	Submit to IEC 31 March 2007
GEIA-HB-0005-2	Technical Guidelines	Stephan Meschter, BAE	Published November 2007	Submit to IEC Nov 2008
GEIA-STD-0005-3	Performance Testing	Tony Rafanelli, Raytheon	Published June 2008	Submit to IEC Nov 2008
GEIA-HB-0005-3 (in work)	Rework / Repair	Tim Kalt, USAF	Published September 2008	Submit to IEC Nov 2008
GEIA-HB-0005-4 (in work)	Reliability Assessment	John Biel, Smiths Aerospace	In process	TBD
New Document	Configuration Control	Dan Korte, Rockwell Collins	New Document	New Document

A Closer Look at Tin Control

- There is nothing to force NASA to use lead-free solders except for the special applications where they have always been used (high temp., non-toxic etc.)
- The primary threat to NASA from lead-free is the use of pure tin plated finishes replacing tin-lead for easily solderable terminations
 - Tin is a risk for:
 - » Whiskers – conductive filaments that can cause short-circuits
 - » Tin pest – a phase transformation that changes solid, shiny tin into a crumbly dull form at temperatures between 13.2C and -40C
 - » Whiskers are a general risk and have a proven "track record"
 - If tin cannot be avoided it must be controlled
 - » The control must be effective but practical

What is NASA Trying to AVOID?



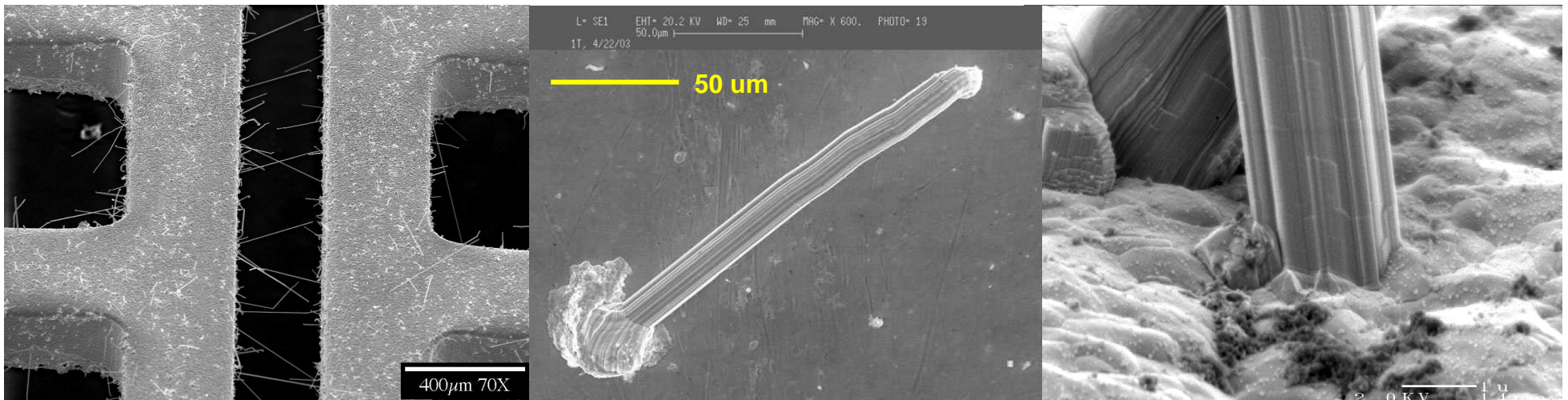
- Longest whisker photographed to date
- About 2 micron in diameter
- Aspect Ratio is ~ 9000 : 1!
– Very difficult to image with light
- Shorter whiskers have crippled satellites
- Whiskers in vacuum can form plasma arcs capable of carrying hundreds of amps

- Shuttle hardware >20 years old
- Older the hardware, longer the whisker
- Only known effective suppressor is alloying with lead

More on whiskers:
<http://nepp.nasa.gov/whisker/>

Why Use a VCS for Whisker Control?

- Flexibility afforded by plan development vs strict requirements
- What NOT How
- Assigns responsibility for the technology unknowns to the supplier but customer must be knowledgeable
- Gives the supplier the option to offer innovative solutions provided there is technical support
- Solutions can adapt as technical knowledge improves
- Ideal because there are many critical unknowns for whiskers

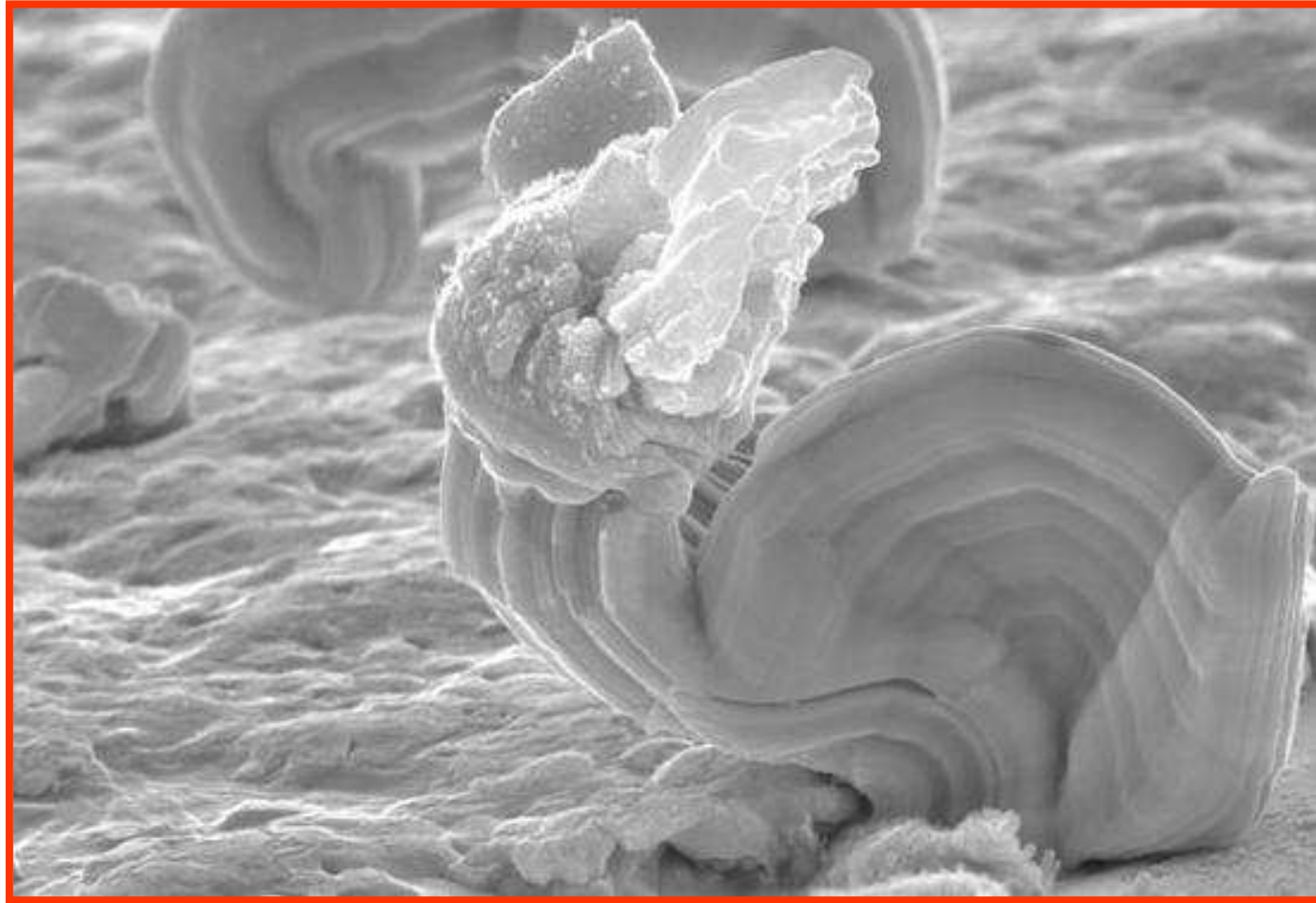


BUT VCSs are NOT Perfect

- Good for guidelines and standards that specify plans
- Not so good for standards requiring specific parametric requirements
 - Broad applications create a broad range of needs
 - What's good enough for toasters may not be good enough for space
 - Can result in confusing multi-level requirements or very broad tolerances
 - Companies tailor to one level for their business
- A particular current problem is “holdover” of technical “language” from MIL specifications into the succeeding VCS
 - MIL terminology is not relevant but still used
 - » Connector contacts still referred to as M and not AS39029
 - MIL terminology may not map precisely to VCS
 - » Fluxes still referred to as “R” or “RMA”
- Most must be purchased and are copyrighted so information exchange can be inhibited and utilization can be costly



Cute Whiskers



“Not So” Cute Whiskers

Thank You for Your Attention!!!



