



# PEDs and PEMs in Space Standards Readiness for PEMs

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Artist's depiction of the Mars Helicopter that will be part of the  
Mars 2020 Rover mission.

Image Credit: NASA/JPL-Caltech

# Cubesats for Deep Space Exploration

- **Growing Use of NASA Cubesats**

- Many new NASA missions are Cubesats and Smallsats.

- **Cubesats support to Insight Lander**

- Mars Cube One, or MarCO was a Cubesat mission comprising two functionally identical six-unit Cubesats accompanying the Insight Mars Lander.
- Excerpts from November 27, 2018 email from the Office of Director to the JPL community:
  - ❖ We knew almost immediately that Insight had landed safely thanks to MarCO A and B.
  - ❖ By successfully relaying data from another planet, this technology experiment has opened new possibilities for space exploration.

- **The Mars Helicopter for Mars 2020**

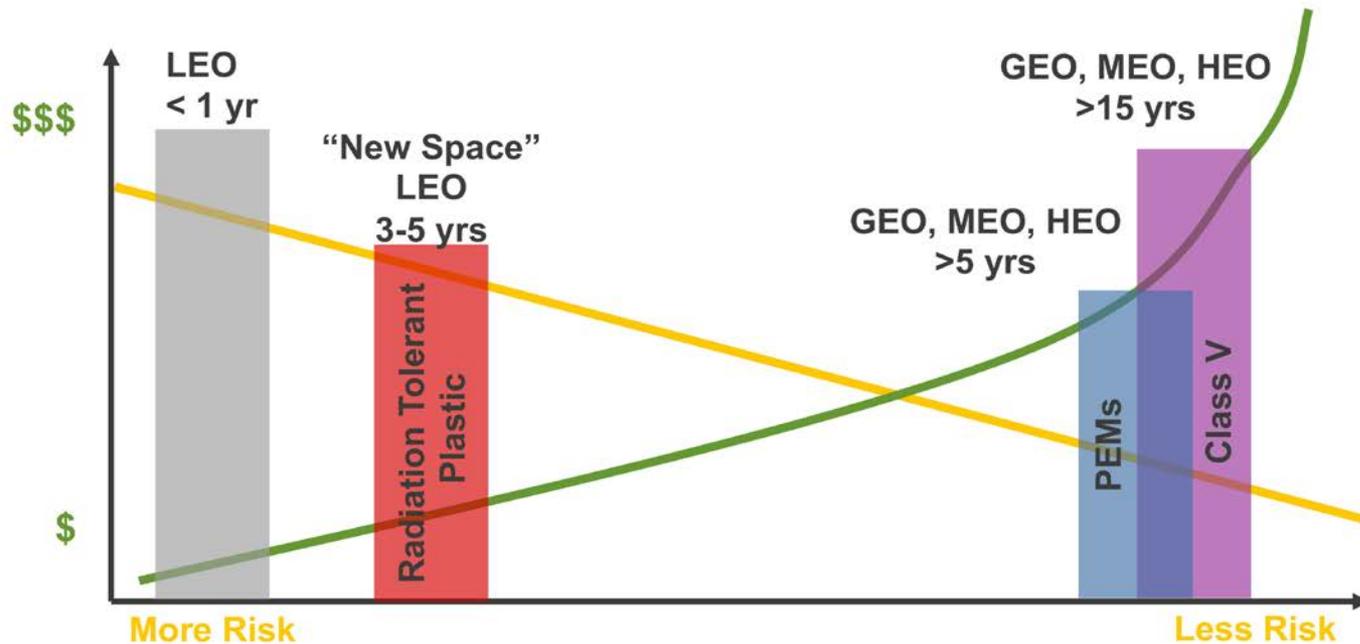
- The Mars Helicopter will be part of the Mars 2020 Rover mission (see cover page). Weighing at less than 4 lbs, it is made of light weight carbon fiber and other materials like aluminum, silicon and foil. Many challenges include withstanding temperatures dipping down to -130F (-90C).

# Cubesats for Deep Space Exploration

- **Parts Application Spectrum is getting broader**

- The use of Cubesats is growing. This is mainly due to the need for low-cost communications satellites, new business evolving around earth observation services, and so on. These drive the need for new product solutions for smaller, lighter, and lower cost spacecraft which can not be produced using the traditional space-qualified, Class 1, hermetic QML/QPL products.
- For Cubesats and Smallsats, the durability and radiation requirements are significantly lower due to the satellites operating mainly in the LEO and GEO (as opposed to deep space missions) for a relatively short period. For such missions, DLA's radiation hardeness assured space-grade parts are often an overkill.
- This is not to say that the demand for standard QML products are going away – the manufacturers have reported robust sales of standard microcircuits.
- Major suppliers, such as Texas Instruments, Analog Devices, Cobham, and Renesas, offer a range of up to seven solutions depending on quality, reliability, radiation, and cost.

# Renesas (Formerly Intersil)



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BIG IDEAS FOR EVERY SPACE

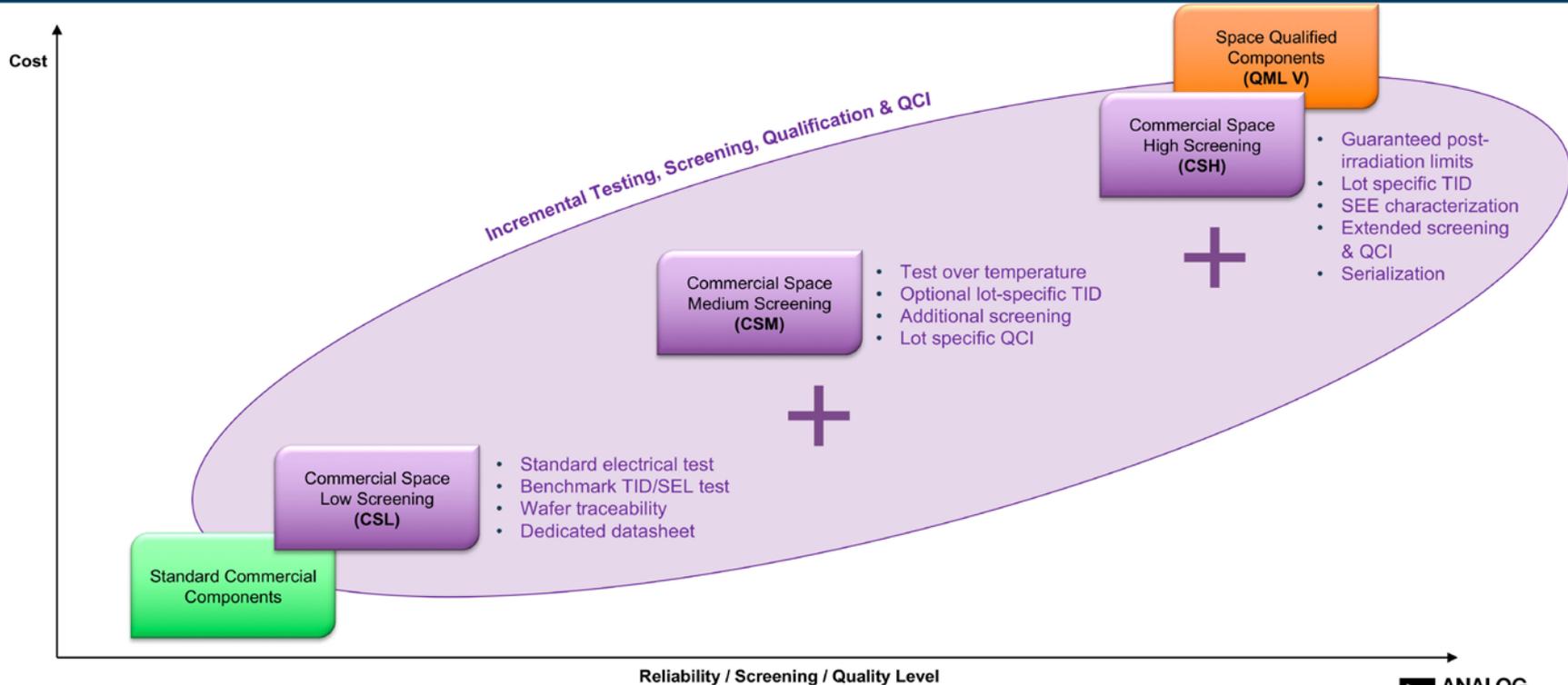


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- Newer products use a mix of Rad Hard and commercially developed products. Renesas calls this the Radiation Tolerant (RT) Plastic flow.
- This flow is based on SAE International Aerospace Standard AS6294/1.

# Analog Devices, Inc. (ADI)

## Commercial Space Flow Overview



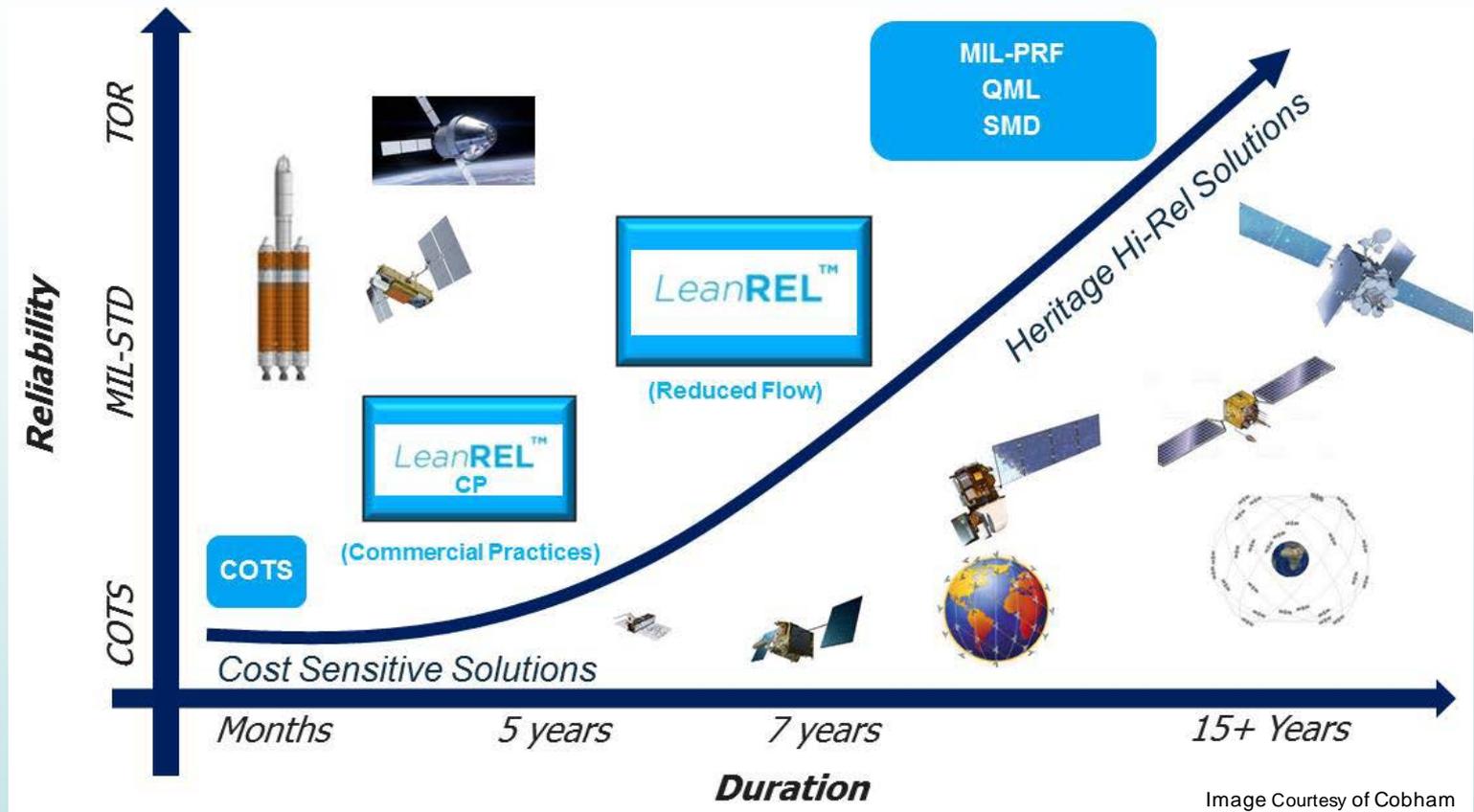
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- ADI is offering three grades of commercial space products as shown above: CSL, CSM and CSH.
- Prior to their acquisition by ADI, Linear Tech (LTC) had developed the RT (Radiation Tolerant) family of products. CSH replaces the RT family. (Linear Tech delivered PEM LTC1604 24-bit A/D converter screened to a flow developed with NASA)

# Cobham Colorado Springs



- Cobham is working to define product technologies and associated screening flows optimized and suitable for constellation space applications.
- Their LeanREL approach is aimed at meeting the mission assurance requirements for radiation performance, reliability, traceability, and cost.
- For PEMs the advantages of small footprint and mass, high performance and low cost, must be weighed against the challenges in defining acceptable flows for space.

# Texas Instruments (TI)

## Space EP Baseline Controlled Flow

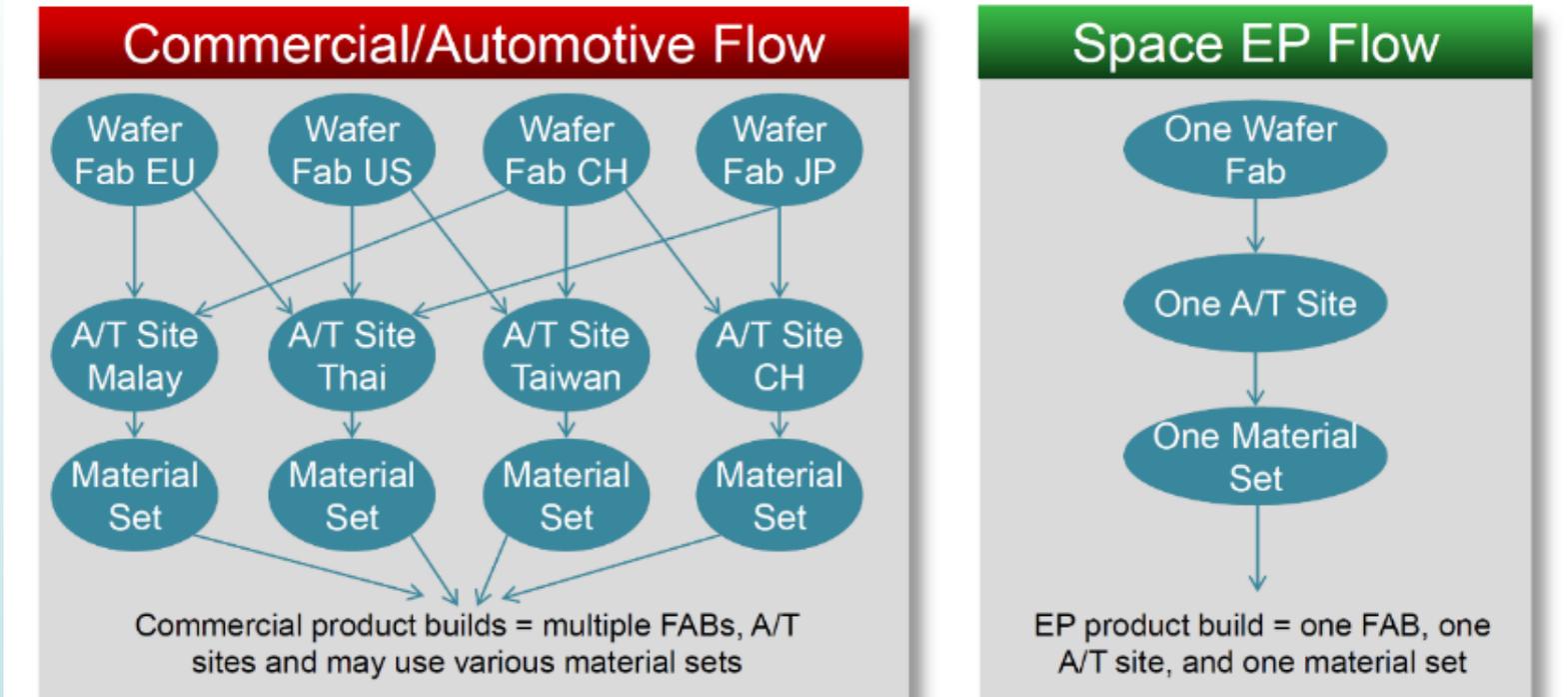


Image Courtesy of Texas Instruments

- The above chart provided by TI shows that their commercial/automotive products maybe built at multiple foundries, assembly/test facilities and may use various material sets.
- (NSC developed the ceramic version of a PEM PLL for NASA)

# DLA's VID (Vendor Item Drawing) Program



## Current Supplier's Program Benefits

1. Single Standardization Document
2. Product change notification of processes, materials, electrical performance, finish, molding compounds and manufacturing locations.
3. Extended temperature performance.
4. Enhanced Pedigree - Reliability and electromigration checks, electrical characterization over temperature and confirmation of package performance over temperature.
5. Enhanced Obsolescence management.
6. No pure tin.
7. No copper wire bonds.

## DSCC ANNOUNCES THE RELEASE OF A NEW TYPE OF STANDARDIZATION DOCUMENT.

DSCC is releasing new Vendor Item Drawings (VIDs) almost daily. These documents have been created to provide a procurement vehicle for enhanced commercial products. Specifically, commercially available microcircuit products are being documented for the first time on a standardization document. Use of these DSCC VID's will avoid the use of manufacturer generated specification control drawings (SCDs) or manufacturer's VID's and avoid the potential proliferation of non-standard products. The participating manufacturers have agreed to provide information and services that have not traditionally been associated with commercial products. See our website for a list of documents that are currently available.



All Vendor Item Drawings are ***NOW*** available on the DSCC web site

<http://www.dsccl.dla.mil/Programs/MilSpec/>

- Analog and digital functions offered.

# Evaluating Automotive Parts for Potential NASA Applications

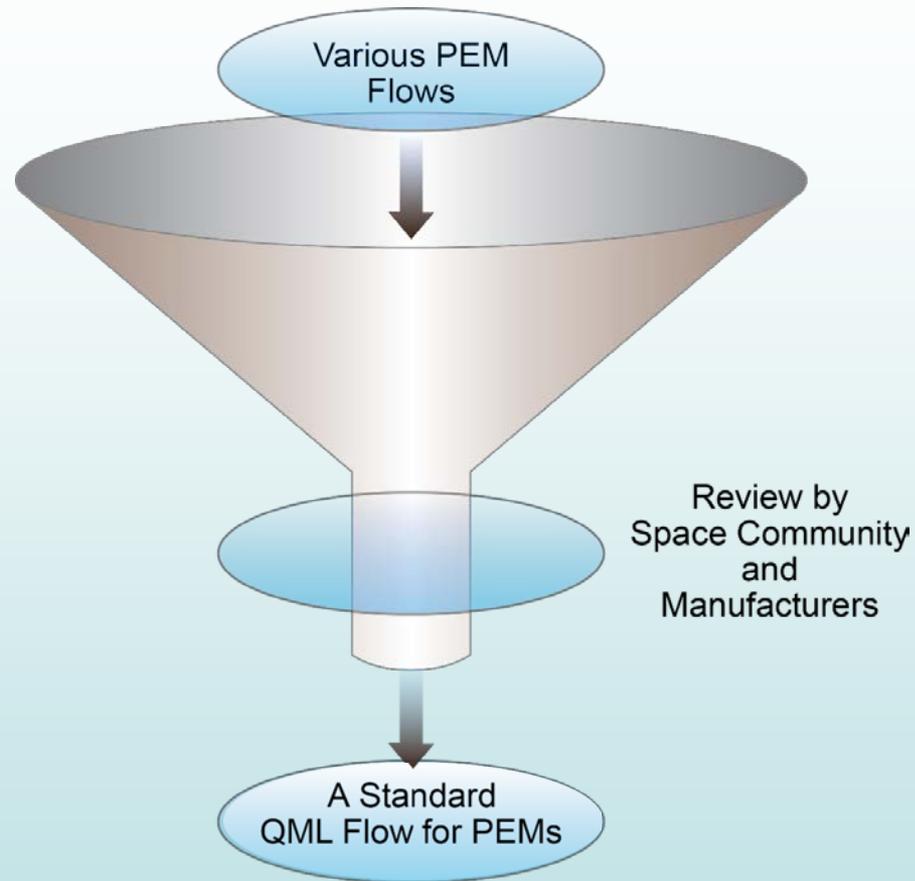
- **The main drivers are size, weight, and cost of electronic components**
  - Commercial electronic parts usually offer varied functions
  - How do automotive parts compare to catalog commercial?
- **Commercial Parts Options**
  - Manufacturers make parts to meet the needs of their chosen market(s)
  - Automotive parts are designed to meet the needs of subsystem suppliers to automobile manufacturers
- **Space**
  - Parts from manufacturers that are qualified to the Automotive Electronics Council (AEC) Q specifications seem to offer advantages for the smallsat users
  - NASA is doing a limited evaluation of automotive electronic parts

# Evaluating Automotive Parts for Potential NASA Applications – Cont'd

**AEC Q specifications are Qualification Requirements Only, Focused on:**

- **A One-Time INITIAL QUALIFICATION of a Device Family**
  - “Device Family” is Common Materials, Processes, Designs, Manufacturing Location, etc.
  - “Generic Data” may be used provided relevance of data can be demonstrated
- **Requirements for REQUALIFICATION**
  - Provides recommendations as needed
- **Requirements for process change notification (PCN) to automotive customers**
- **THEY DO NOT PROHIBIT PURE TIN**
  - Whisker mitigation is recommended!

# Path to Standardization



- DLA conducted their EP (Engineering Practice) study
- This is a first step towards standardization.

# JC-13.7/CE-12 Task Group 2018-02

## DLA Engineering Practice (EP) Study

EP study on  
Update of non-hermetic microcircuits class N (military, terrestrial and avionics application  
and class Y (Space application) to MIL-PRF-38535.

- I. **OBJECTIVE:** The purpose of this Engineering Practice (EP) Study is to obtain input and justification from the military services, microcircuit manufacturers, and space application user's communities, concerning the update/addition of non-hermetic class N (military, terrestrial and avionics application) and class Y (non-hermetic Space application) microcircuits to MIL-PRF-38535.
- II. **BACKGROUND:** MIL-PRF-38535 offered non-hermetic class N (plastic package) and class Y (ceramic substrate non-hermetic device for space application). In table IB, class N has an inclusive table that comprises screening and QCI tests requirement, which called tests/monitors for plastic package. However, this inclusive table fails to distinguish between screening and QCI test flows that creates confusion with periodic QCI test monitoring issue as well as product reliability.

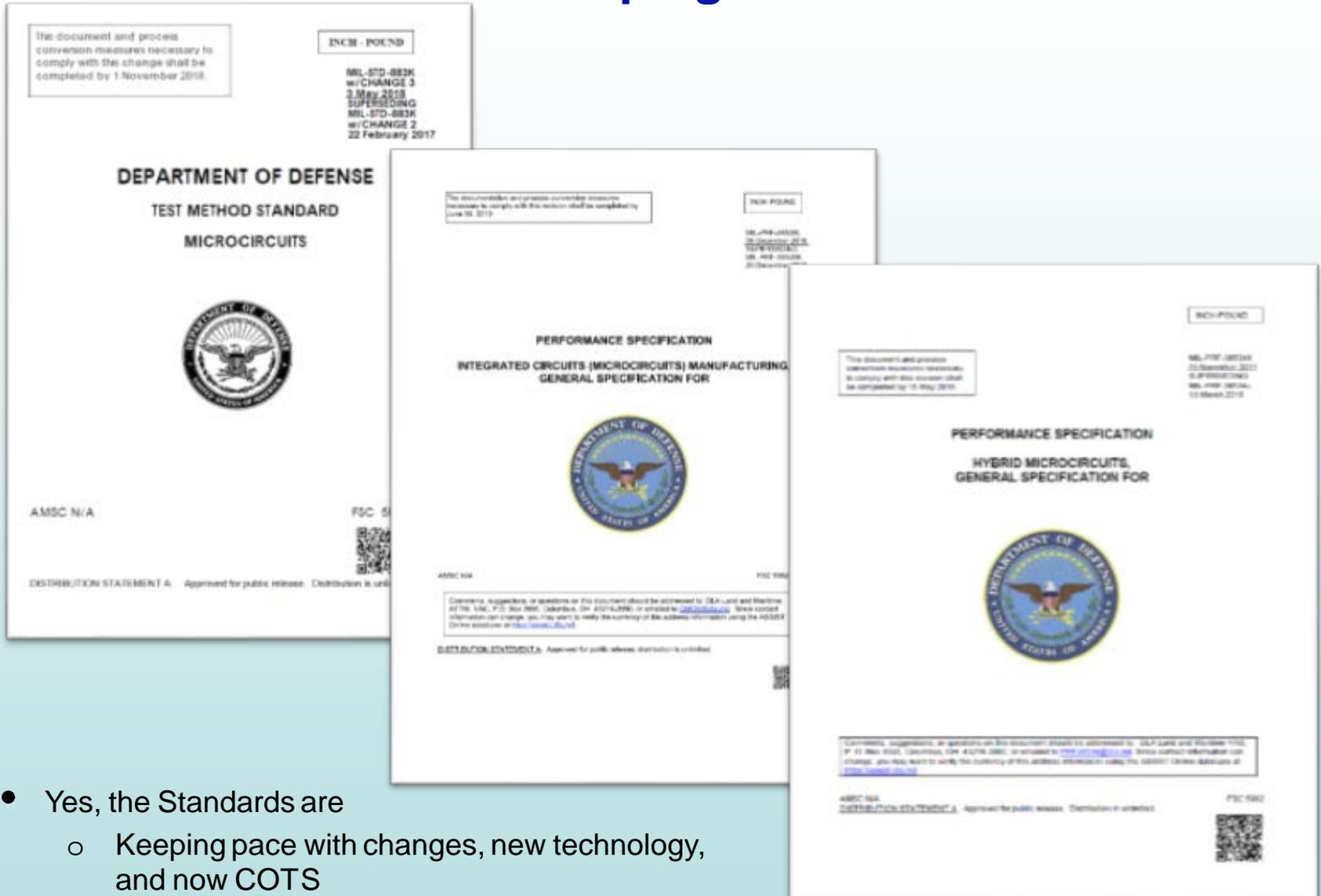
On the other hand, design requirement of modern electronics satellite/warfare systems are growing faster and moving forward with an advance and complex package technologies. Considering complexity of new technologies and device packaging techniques, JEDEC CE-12 formed a task groups (TG) for exploring the state of the art class Y concept to develop a new organic substrate flip chip devices, and 2D, 2.5D and 3D package technology requirements for qualification and screening of non-hermetic microcircuits packages for space applications.

Accordingly, to bring advancement and adopting new package technologies into QML system to MIL-PRF-38535, DLA Land and Maritime-VAC is conducting an EP study (phase 1) which includes:

- (1) Update class N with separating screening and QCI tables to make robust high reliability plastic encapsulated microcircuits(PEM) devices for military, terrestrial and avionics application;
- (2) Update/create a new appendix K (Next Gen) with other appendix/sections update for non-hermetic microcircuits devices that includes organic/ceramic substrate flip chip devices, 2D, 2.5D and 3D package technology requirements for space applications.

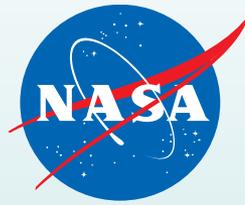
DLA Land and Maritime-VAC is requesting to review all attachment and send comments and feedback to DLA within the stipulated time for discussion and further development. Survey questionnaire (see attachment # 1) to evaluate the industries overall opinion for adding/updating class N and class Y devices package construction technical issues. Proposed non-hermetic class N and class Y devices screening and QCI requirements (see attachment # 2). Proposed update Appendix H (new technology qualification including PIDTP update (see attachment # 3). Proposed addition of Appendix K (Next Gen) for non-hermetic class Y devices including organic/ceramic substrate flip chip device, 2D, 2.5D and 3D package technology requirements for space applications (see attachment # 4).

# Are Standards Keeping Pace with Times?



- Yes, the Standards are
  - Keeping pace with changes, new technology, and now COTS
  - This has been happening ever since NEPAG was formed about 20 years ago

<http://nepp.nasa.gov>



### **ACKNOWLEDGMENTS**

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