Counterfeit Parts Inspection Overview

PRESENTED BY

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Agenda/Purpose

- Awareness/Introduction to the following:
  - Electronic Components Counterfeit Issue
  - Steps in Conducting a Basic Visual Inspection
  - A glimpse on a few Inspection Tools/Equipment
- Generate Interest - Demonstration Station
  - View counterfeit parts in greater detail
  - Examine different kinds of packaging, labels and documentation
  - Discuss Electrostatic Discharge issues/implementation

**AUTHENTIC**

**SUSPECT**

NOTE: NASA/JPL provides a more in depth Awareness Training class and an Inspection Training class.

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Introduction
Counterfeiting Process Example

- Sand-off markings, resurface ("blacktop"), remark

NOTE: There are also more sophisticated methods of counterfeiting that are difficult to detect just by visual inspection.
Counterfeit Parts Definition

- Broad Industry Definition per AS6741: Materiel misrepresented as meeting the customer’s requirements and has been confirmed to be a copy, imitation or substitute that has been represented, identified, or marked as genuine, and/or altered by a source without legal right with intent to mislead, deceive or defraud.

- For Law Enforcement: Counterfeit means counterfeit trademark.
  - Customs and Border Patrol (CBP) and Immigration and Customs Enforcement (ICE) conduct civil enforcement under 19 U.S.C. § 1526(e) and criminal enforcement under 18 U.S.C. § 2320 against semiconductor devices and traffickers of devices that are affixed with counterfeit trademarks.
Impact of Counterfeit Parts

- SYSTEMS DO NOT FUNCTION AS DESIGNED
  - Immediate failure, Latent failure
- LOSS OF LIFE
- MISSION FAILURE
- COST AND SCHEDULE DELAYS

“The failure of a single electronic part can leave a soldier, sailor, airman, or Marine vulnerable at the worst possible time,”

-US Senate Committee Report

Minimizing Counterfeit Risk

- PROCUREMENT PRACTICES and SUPPLIER SELECTION PROCESS
- INSPECTION, MEASURING AND TEST EQUIPMENT (IMT&E)
  - Calipers
  - Microscope
  - X-Ray Fluorescence (XRF)
  - Real Time X-Ray
  - DTEK
  - Acoustic Microscopy
- VISUAL INSPECTION
Risks Associated with Inspection

- Physical Damage to Hardware
- Mishandling
- Loss of Traceability
- Must be important, here’s an Example of a 20 page document on handling:

[Link to Handling Guideline document](http://www.altera.com/literature/an/an071.pdf)
Risks Associated with Inspection
Electrostatic Discharge Damage (ESD) due to lack of ESD precautions

- REF ANSI/ESD S20.20 – Std of the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment
Risks Associated with Inspection

- Electrostatic Discharge (ESD) Summary
  - May occur undetected
  - Damage can be immediate or latent – part can fail at a later date
  - Precautions can be taken to minimize ESD damage risk
    - Observe handling and packaging requirements
    - Properly grounded workstation
    - Electrostatic dissipative surfaces
    - Grounded wrist strap
    - ESD smock
Visual Inspection Checklist

• Documentation
  – Inconsistencies between shipping documents
    - Certificate of Conformance, shipper, purchase order

• Packaging
  – General:
    - Inspect shipping boxes for authenticity and possible prior use.
    - Evidence of tampering and/or seals are intact.
    - Complies with applicable ESD and humidity control requirements
  – Trays/Chip Carrier:
    - Verify labeling information matches supplier documentation (e.g. part number, date code/lot number, quantity).
    - Verify carrier is not damaged.
    - Verify carrier matches lid (e.g. discoloration differences, over or undersized lid compared to carrier).
Visual Inspection Checklist

- Packaging
  - Reels:
    - Tape is consistent and appropriate in type and color and conforms to the norm for the manufacturer.
    - Inspect for missing parts within the tape.
    - Parts are facing the same direction within the carrier tape.
  - Packaging-Tubes:
    - Parts are facing the same direction inside the tubes.
    - Tube size and configuration is appropriate for the part.

- Part Traceability:
  - Inconsistencies in date code(s)/lot code(s) (i.e. dates that are not possible, mixed date codes within a shipment, etc.).
  - Inspect for multiple countries of origin with the same lot code.
  - Authenticity of labels (parts and packaging material), logos and manufacturing markings, verify barcode information.
Visual Inspection Checklist

• Component Inspection
  – Proper pin arrangement and pin count, part dimensions
  – Part markings match information on the C of C
  – Inspect date code(s)/lot code(s) marked on parts for inconsistencies
  – Inspect part markings for multiple countries of origin with the same lot code
  – Inspect part markings for authenticity of logos and manufacturing markings
  – Inspect part markings for inconsistencies in font style, thickness, print color, and marking/identification placement
  – Inspect part markings for smeared, illegible, or poor quality
  – Verify that markings on top of the parts are consistent with bottom markings as applicable
  – Resistance to Solvents Test
Component Inspection

- Inspect leads for possible prior use – bend and co-planarity outside allowable limits, oxidized or contaminated, tinning or solder, consistency of gloss/shine, color and texture
- Inspect for signs of previous programming (i.e. colored dots or ink marks)
- Inspect the surfaces of the parts for evidence of re-surfacing (for example: blacktopping, directional scratches, indents that are no longer clean and flat)
- Inspect for stickers, underlying etching on the part’s casing or any evidence of re-identification
- Inspect for cracks on the surface of the parts and suspect laser burn marks
- Inspect surface of parts for burn marks indicating exposure to excessive heat
Visual Inspection Checklist

- Component Inspection
  - Inspect for evidence of tool / pull marks or heat-sink witness markings indicating prior use
  - Inspect for color or shading discrepancies on the top vs. bottom of part
  - Inspect for traces of glue or adhesive on the surface of the parts
Inspection Measurement and Test
Hand Held Measurement Tools- Calipers

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Inspection Measurement and Test
X-Ray Fluorescence (XRF)
• X-Ray Fluorescence Example
  – Maxim MAX199ACNI

  – Manufacturer’s website: 85% tin 15% lead
  – JPL Receiving Inspection XRF Machine Results: 88% tin, 12% lead

  – XRF readings from counterfeit parts may show traces of additional or different material composition from factory specifications.
Real Time X-Ray example

- External markings indicate parts are the same BUT X-Ray shows the truth: they are completely different!
Inspection Measurement and Test

- Real Time X-Ray
  - X-Outside packaging made to appear authentic
  - ray image of dummy part = absence of a die and wire bonds

* NASA Public Lesson Learned Entry: 1832
* http://www.celnav.de/hv/sn7490.jpg

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Inspection Measurement and Test

- Real Time X-Ray example
System Attributes:
- Non-Destructive
- Usable by Non-Expert
- Rapid, 5 Min Lot Time
- Safe (no solvents/radiation)

Information in Reports:
1. Results to 4 Tests
   - Pass-Fail-N/A
2. Component Images
   - JPG Exportable
3. Other Information at User’s Discretion

Contact:
Covisus Corporation
180 N. Vinedo Ave.
Pasadena, CA 91107
www.covisus.com
Skylar Gauss
sgauss@covisus.com
(805) 452-7025
Inspection Measurement and Test

- Acoustic Microscopy
  - Finds hidden defects such as internal cracks and delamination
  - Transmits and receives ultrasonic pulses that interacts within the sample.
• This reflected energy is analyzed and is used to generate an image.
Certificate of Conformance

- A formal statement by the supplier that certifies that the product meets all applicable requirements.
Date Code Primer

- Manufacturers use:
  - Date codes to identify the date of production (sealing) of a part
  - Lot codes to identify the production lot of a part
  - MIL-PRF-38535 paragraph 3.6.6 specifies how date codes must be marked:

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0849 A/xxxxx
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- First 2 numbers are last 2 digits of the year
- Last 2 numbers are the week of the year
- If more than one lot are produced in the same week, they are uniquely identified by letter
- Lot Code, preceded by a slash, may follow

Everything after the 1st 4 digits is optional; it may or may not be included.
Date Code Verification Exercise

THE MAGIC PART*

- Date code indicates:
  - part was made in November of 2003 (47th week of 2003)
  - Part was received on June 3, 2003

This part was marked with a date code five months into the future compared to the date of receipt!!
Marking Permanency Test

- **Inspection for Re-marking or Re-surfacing**
  - Standard “resistance to solvents” test methods can be effective, but more aggressive methods may be necessary to remove coatings applied to disguise sanding marks, and to reveal other indications that the original device marking has been removed.
    - Scrape surface of part w/a razor blade
    - Dilute acetone 3:1 with water & swab with Q-Tip
    - 3:1 mineral spirits/alcohol
    - Pure/heated acetone
    - DynaSolve

- **If part has been re-marked, a grayish to black substance may be visible on the Q-Tip**

*Warning! Will not detect re-packaged CF parts in molded (plastic) packages!*

- **MIL Std 883 Method 2015**
- SAE Aerospace Standard AS5553: Counterfeit Electronic Components; Avoidance, Detection, Mitigation, and Disposition

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