NASA Counterfeit Parts Awareness and Inspection

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Training Course Objectives

• This course provides a high-level overview of suspect counterfeit external visual inspection related to government and industry best practices.
  
  • Learn hands-on verification and inspection processes for the detection of suspect parts
  
  • Learn the limitations of visual inspection
Section 1 – External Visual Inspection
Assessing Incoming Parts

Is this part suspect or counterfeit?

- The part is suspect.
- Determining if a part is counterfeit depends upon the subsequent investigation.
Assessing Incoming Parts

Parts are suspect, but are they counterfeit?
Assessing Incoming Parts

1. External visual
   a) Physical mold features
   b) Part surface
   c) Part markings
   d) Indents
   e) Pins
Suspect-Part markings

• OCMs follow quality standards and major imperfections are uncommon
  • P/N will be in a certain location on the part
  • P/N will not be misaligned, crooked, or misspelled
  • Manufacturer logos do not vary from part to part
  • Part markings designed to withstand rigors of testing

• Part on right has laser burn markings
• Markings missed the part on the left side
• Part on right belongs to batch that had markings in a slightly different location on each part
Suspect-Part markings
Suspect-Part markings
Suspect-Part markings
Suspect-Part markings

Ghost markings
Suspect-Part markings

Evidence of re-marking
Assessing Incoming Parts

1. External visual
   a) Part markings
   b) Part surface
   c) Indents
   d) Physical mold features
   e) Pins
Suspect-part surface

Directional sanding markings

Uneven thickness resulting from sanding
Suspect-part surface

Blacktopping: resurfacing of a component so it can be re-marked
Blacktopping

Authentic

Suspect
Suspect part surface

• Different textures can be indicative of remarking

• Top and bottom of part should have same texture

• Top and bottom of the same part have two different textures: rough vs. smooth
Suspect-part surface

- Blacktopped surface was shiny and smooth but with an unnatural orange peel finish
- Scraping the top layer revealed the Altera logo underneath

Over-sanding
Suspect-part surface

Plastic leaded chip carrier (PLCC) package

Nice try! Counterfeiter blacktopped not only the top surface, but the sides and bottom. Just didn’t get this one corner well enough.
Suspect-part surface
Assessing Incoming Parts

1. External visual
   a) Part markings
   b) Part surface
   c) Indents
   d) Physical mold features
   e) Pins
Good-Part indents

• Example: clean indents on good parts under two different lighting scenarios
Suspect-Part indents

- Identical part markings
- Parts on the left is marked Philippines, part on the right is Malaysia
- Indent is half-filled with black top
- Letters have rough texture
Suspect-Part indents

- Indent has been filled in with blacktopping material
- Original indents should always be clean
Blacktopping
Suspect-Part indents
Suspect-Part indents

- Part has marking inside indent
- Indents with markings can signify a suspect part
Suspect-Part indents

- Identical part number markings
- Indents between the two parts are not identical
Suspect-Part indents
Assessing Incoming Parts

1. External visual
   a) Part markings
   b) Part surface
   c) Indents
   d) Physical mold features
   e) Pins
Suspect-mold features

Same P/N, manufacturer, D/C but three different moldings!
Suspect-mold features

• Top surface: Identical part markings
• Bottom surface: three completely different markings
Assessing Incoming Parts

1. External visual
   a) Physical mold features
   b) Part surface
   c) Part markings
   d) Indents
   e) Pins
New vs. Suspect Part Leads

New leads: uniform, consistent finish and shape

Used leads: rough texture
Lead Pads

Authentic

Suspect

Courtesy: SMT Corp
Good-Part leads

Tooling marks: result of lead formation or “bending” of leads to meet specification
New vs. re-tinned leads

Leads with obvious witness marks

Same part re-tinned, witness marks are hidden
Tooling marks absent
Exposed copper

Authentic

Suspect
Exposed copper

Authentic

Suspect

Courtesy: SMT Corp
Suspect-Part leads
Suspect-Part leads
Suspect-Part leads
Section 2 – Advanced Testing Procedures
Marking Permanency: Solvents Testing

- Inspection for Re-marking or Resurfacing
  - 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 with a razor blade
  - Dilute acetone 3:1 with water & swab with Q-Tip
  - 3:1 mineral spirits:alcohol
  - Heated acetone
  - DynaSolve

Courtesy: Mil Std 883 Method 2015; SAE AS5553
Marking Permanency: Solvents Testing

Scraping from razor removed fake “top”

Ghost markings

Courtesy: GIDEP
Marking Permanency: Solvents Testing

Acetone removes black from surface of part

Courtesy: GIDEP
Microscopy

• High magnification
  • 20x-1000x
  • Confocal capabilities
X-Ray Fluorescence (XRF)
Real-time X-ray

• Provides internal inspection of IC while being able to manipulate sample
  • Nondestructive technique
  • High magnification and resolution

• Inspect die attach, wire bonding, lid seals, etc.
Detecting a repackaged part: X-ray

• Effective to look for manufacturing differences in die size, lead frame, bond wire patterns and voids. In some cases there have been no bond wires.

Source: American Electronic Resource
Detecting a repackaged part: X-ray
Detecting a repackaged part: X-ray
Other package styles: Transistor outline (TO) cans

How do these TI 4N23 optocouplers look?
Other package styles: TO cans

How do these TI 4N23 optocouplers look now?
Other package styles: TO cans

How do these TI 4N23 optocouplers look in x-ray?
Other package styles: TO cans

How do these TI 4N23 optocouplers look internally?
Other package styles: TO cans

How do these Motorola 4N24A optocouplers look?
Other package styles: TO cans

How do these Motorola 4N24A optocouplers look now?
Other package styles: TO cans

How do these Motorola 4N24A optocouplers look in x-ray?
Other package styles: TO cans

How do these Motorola 4N24A optocouplers look internally?
Other package styles: ceramic DIP

Ceramic dual in-line package

Linear Technology LT1846J/883
Switching controller, MIL-spec
Other package styles: ceramic DIP

Ceramic dual in-line package

Linear Technology LT1846J/883
Switching controller, MIL-spec

...with sanded (refurbished) leads
Other package styles: cermet DIP

Obsolete Harris integrated circuit, ceramic package with metal lid, HS1-81C55RH-8:

Unknown origin, D/C 9232A

Known good, D/C 8606
Other package styles: cermet DIP

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Other package styles: cermet DIP

Obsolete Harris integrated circuit, ceramic package with metal lid, 5962R9570801QJC:

Unknown origin, D/C 9501A

Unknown origin, D/C 9844

Manufacturer was bought many years ago, new owner says they no longer have golden part or die mask marking information
Other part and package styles:
Passive parts—ceramic capacitors

TDK C5750Y5V1H226Z capacitor:
real or counterfeit?
Other part and package styles: Passive parts—ceramic capacitors

AVX capacitor: real or counterfeit?
Other part and package styles: Passive parts—ceramic capacitors

AVX capacitor: real or counterfeit?

A cross section may be the only way to know—if you have a known genuine part for comparison.
Additional References

• SAE Aerospace Standard AS5553: Counterfeit Electronic Components; Avoidance, Detection, Mitigation, and Disposition

• SAE Aerospace Standard AS6174: Counterfeit Materiel; Assuring Acquisition of Authentic and Conforming Materiel


• SMT Corp. – Miscellaneous charts and images on sample counterfeit parts

• IDEA-STD-1010-B: Acceptability of Electronic Components Distributed in the Open Market


• http://counterfeitparts.wordpress.com

• http://www.acq.osd.mil/dpap/index.html

• http://www.integra-tech.com/