

The top of the slide features a collage of images: a jet engine, a hand holding a handheld X-ray device, and an industrial facility. The NITON logo is prominently displayed in a teal box on the left side of this collage.

NITON

Aerospace Applications of NITON Portable X-Ray Fluorescence Analysers

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Aerospace Testing Europe
Hamburg 2005**

Outline

Basic Theory

☼ Testing Aerospace Components and Alloys

☼ Recent example

☼ Northrop Grumman Space Technology
Material Directors Award 2003

☼ Instrument Demonstration



XRF Alloy Analysis

Advantages

- Fast
- Nondestructive
- Qualitative and quantitative
- Multi-element simultaneous
- Little or no sample prep
- Many different sample types, sizes and shapes
 - solids, powders, liquids, turnings, etc.
- Robust calibration: detection limit to 100%

Limitations

- Limited capability for light elements (below atomic number 19)

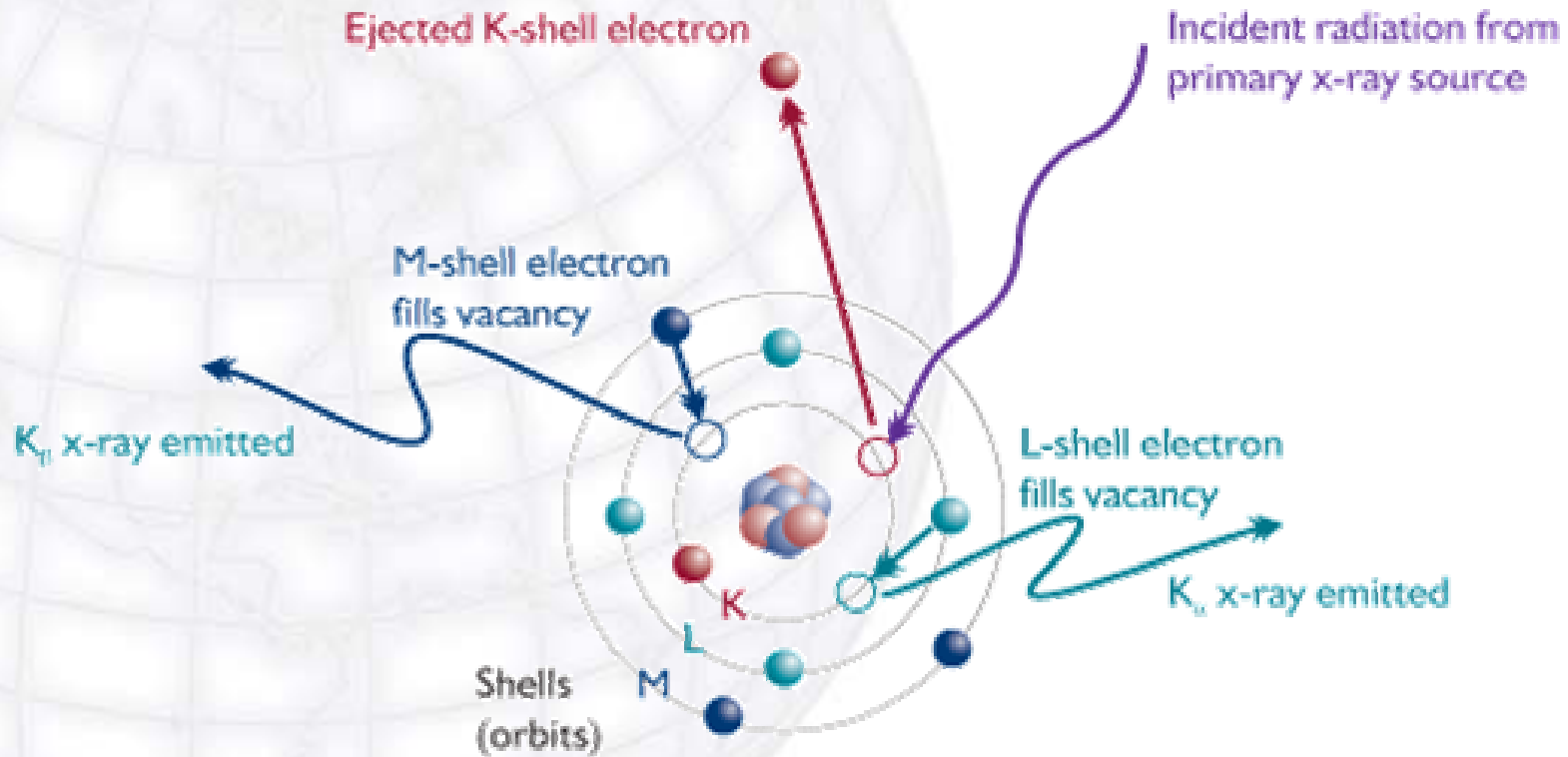


Typical Alloys Tested using XRF

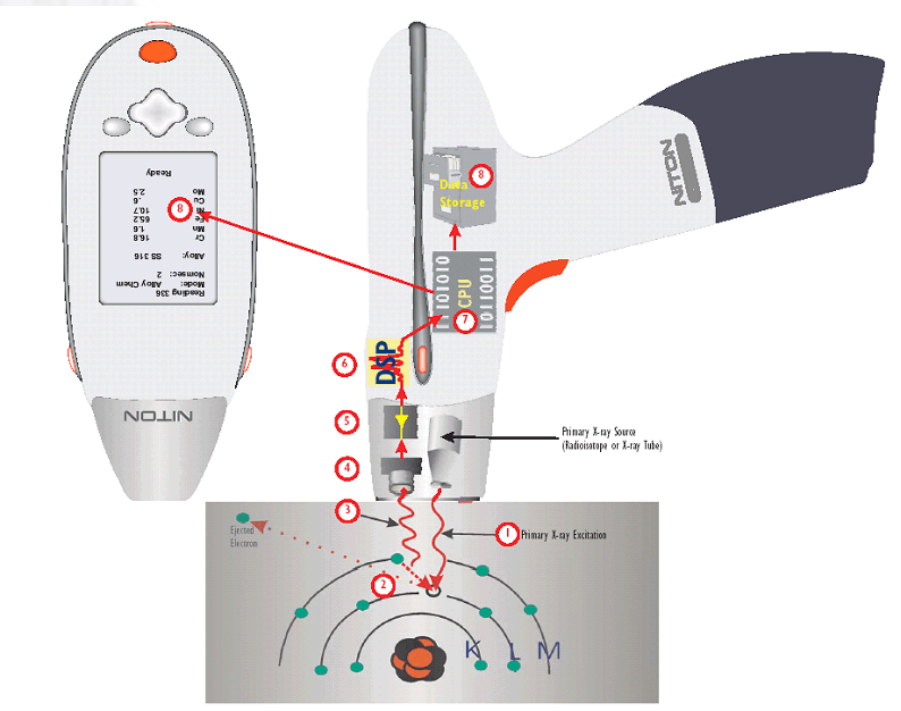
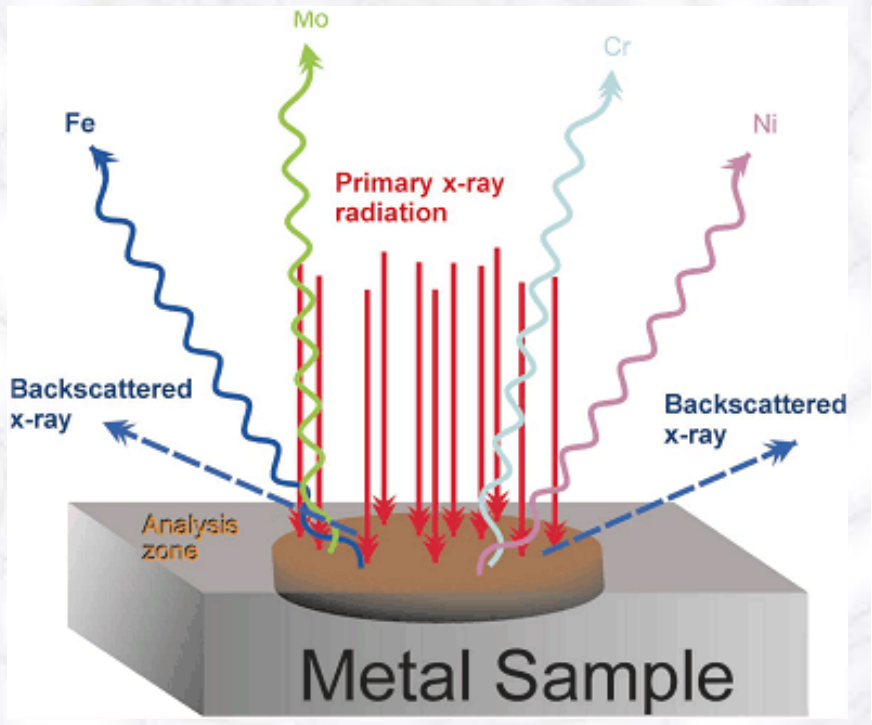
- Stainless Steels
- Copper based alloys (incl. Sn and bronzes)
- Titanium stabilised alloys
- Nickel based alloys
- Cobalt based alloys
- Tool Steels
- Aluminiums (1100, 2024, 3003, 5000 Series, 6061, 6063, 7075, 7050)
- V, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, W, Se, Pb, Bi, Zr, Nb, Mo, Ag, Sn, Sb



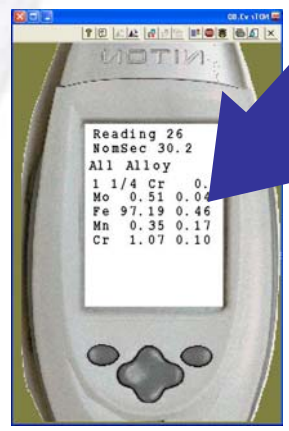
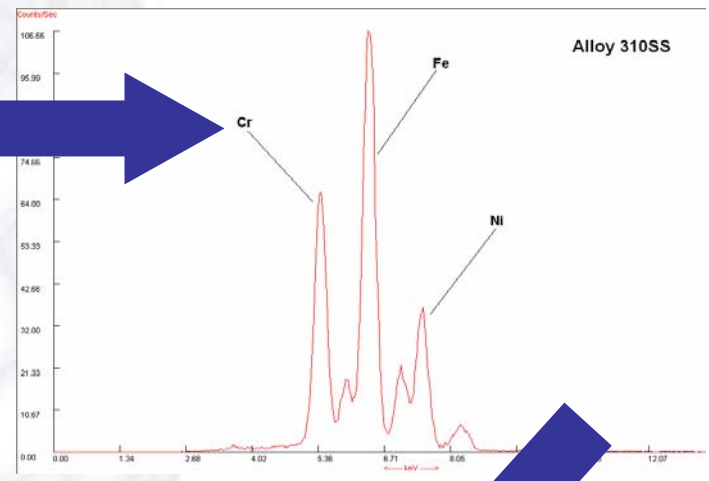
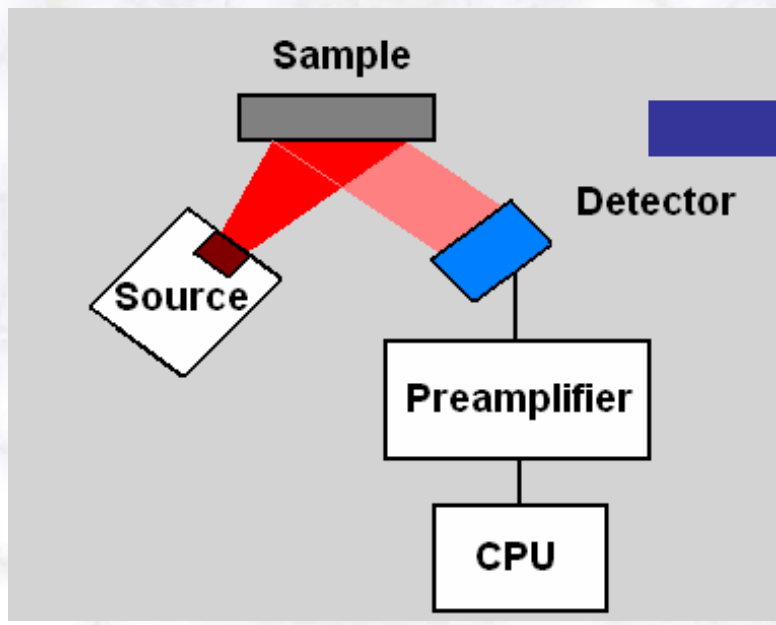
Principle of X-Ray Fluorescence



Energy Dispersive X-Ray Fluorescence

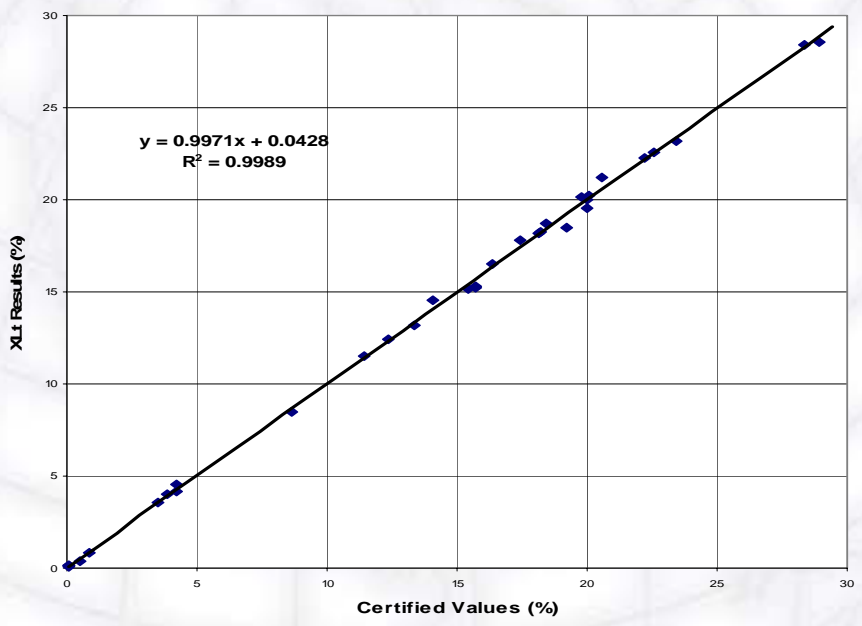


Instrument Operation Schematic

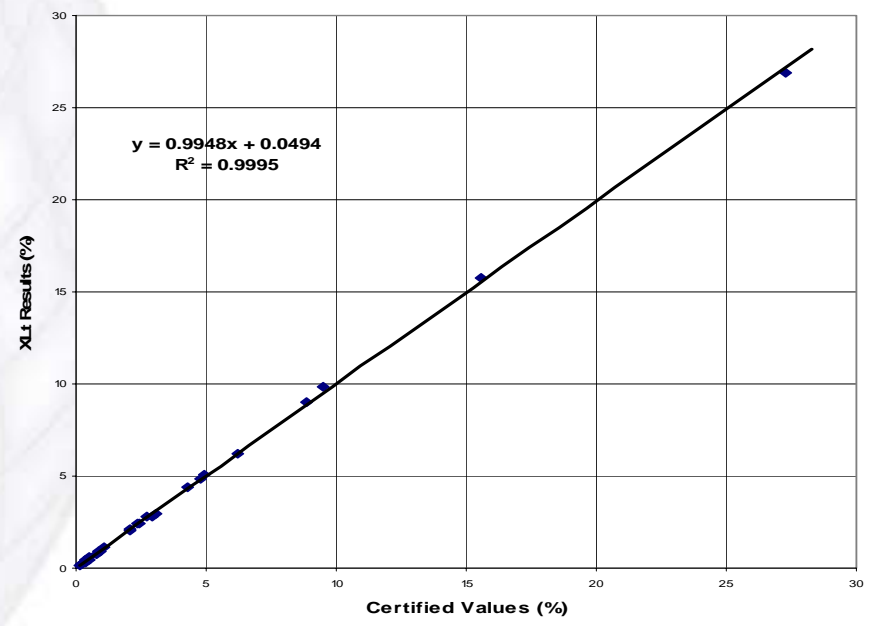


Typical Accuracy

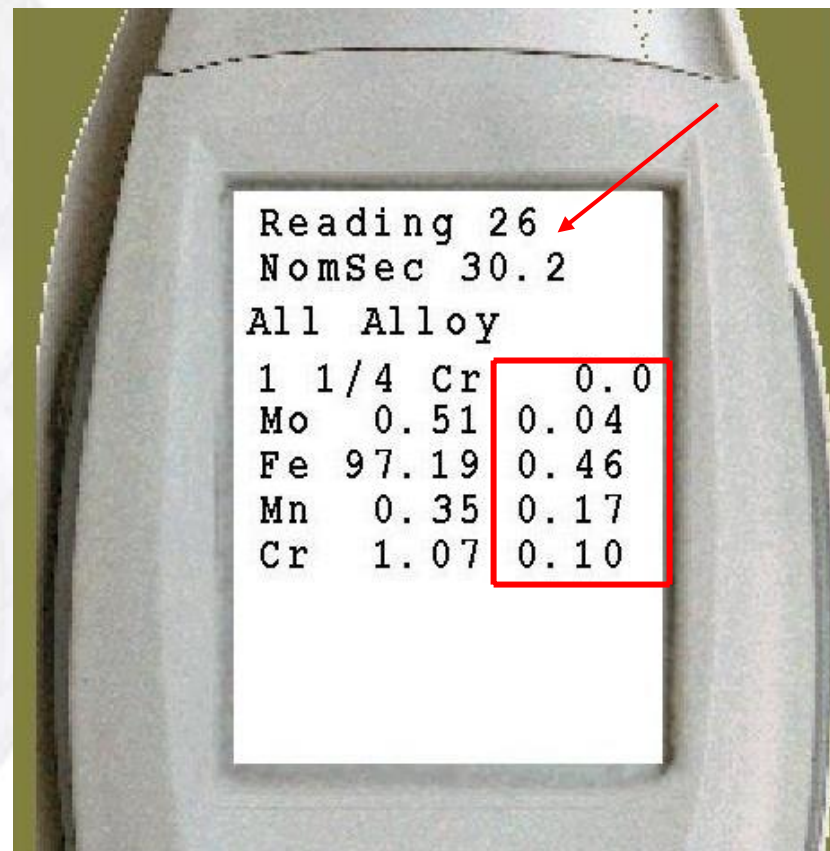
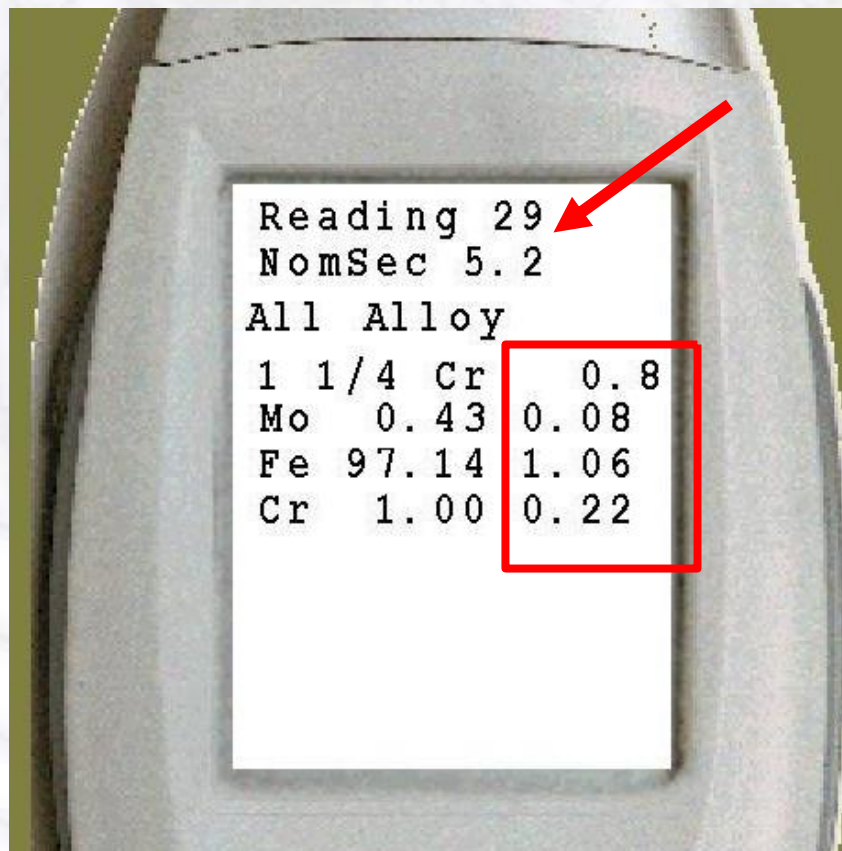
Correlation Curve for Chromium
in Alloys of Iron, Cobalt, Nickel, and Copper



Correlation Curve for Molybdenum
in Alloys of Iron, Cobalt, and Nickel



Typical Precision



The NITON logo is displayed in white capital letters on a dark teal rectangular background. It is positioned in the upper left corner of a banner image that shows an aircraft wing, a robotic arm, and an industrial setting.

Alloy Verification in Aerospace Production QC

- Material verification in aerospace is CRITICAL
- Certification inadequate for most audited Quality Systems



Typical Components

- ✚ Bearings
- ✚ Fasteners
- ✚ Turbine Blades
- ✚ Rocket Heads
- ✚ Engine Components
- ✚ Electronic Circuitry
- ✚ Solders
- ✚ Wear Metals
- ✚ Coatings



Typical Alloys used in Aerospace

- Hastelloys, Monel, Waspaloy
- Wrought Aluminium: 2024, 7075, 7050
- Titanium: 6-4, 6-6-2, 6-2-4-2
- Stainless Steel: 300 and 400 Series
- Low Alloy Steels
- Refractory Containing Materials PWA 693, N-115, N-155



The top of the slide features a collage of images: a blue and white aircraft on the left, a hand holding a handheld NITON device in the center, and a factory or industrial setting on the right. The NITON logo is a teal rectangle with the word "NITON" in white, bold, sans-serif capital letters.

NITON

A large, semi-transparent globe with a white grid pattern is positioned on the left side of the slide, partially overlapping the text.

**Northrop Grumman Space
Technology Material Directors
Award
2003**

Case Study

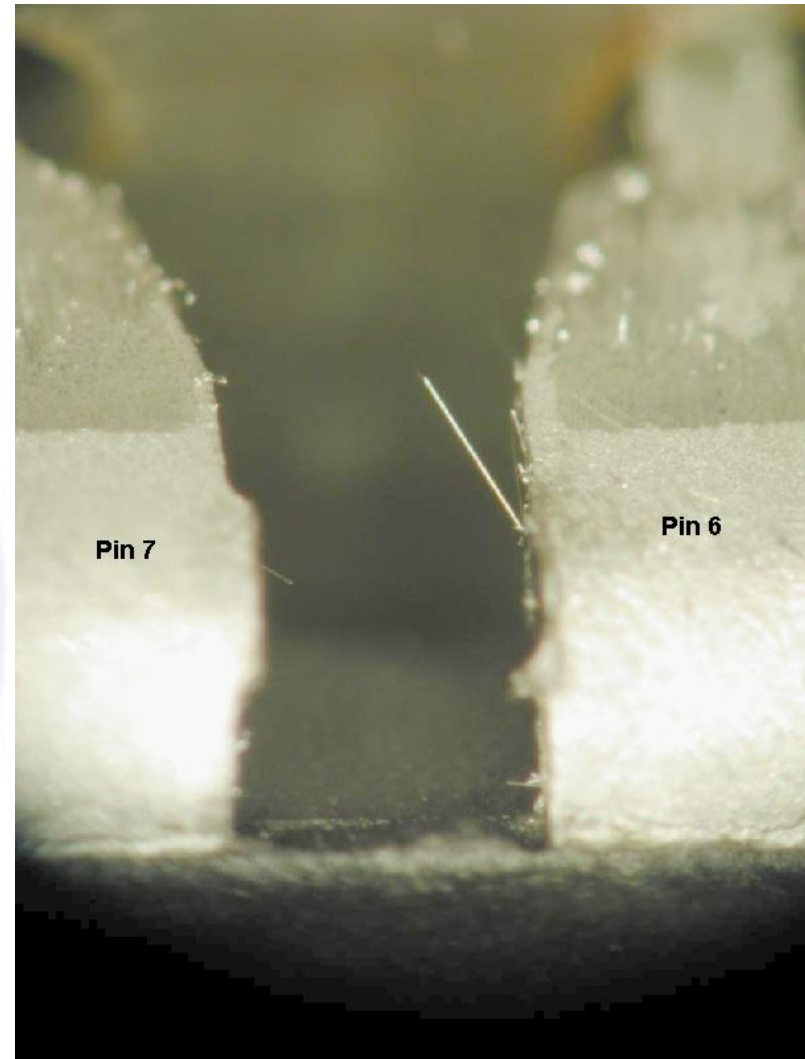
Issue

-  Producer of Space Technology Systems
-  Components requiring precision and dependability in design and construction
-  To date 7 satellite system failures have been attributed to tin whiskers
-  Established Prohibited Materials Mitigation Program

Whiskers

What are They?

- ❏ Pure tin solder may grow metal filaments or “whiskers”
- ❏ Extremely thin
 - ❏ 1-2 μ m typically
 - ❏ Grow as straight, kinked or spiraled single crystals
 - ❏ Can reach length of 9mm (3/8") & carry 10mA current



L= SE1

EHT= 10.0 KV

WD= 34 mm

MAG= X 112.

PHOTO= 15

200 μ m |-----|

ZINC WHISKER, 4/1/03



Materials Screening Program Features

- ❏ Design out parts and finishes that can present sneak paths
- ❏ Part specification analysis (potential entry paths e.g. low cost, high risk parts)
- ❏ Rigorous vendor certification (first tier and sub tier vendors that provide substantiated certification by analysis)
- ❏ In house and roving testing using portable and laboratory EDXRF

Materials Screening Program

- ❁ 20 portable EDXRF instruments
- ❁ Half used for quality control of incoming goods at each inspection point
- ❁ Half used for vendor inspections
- ❁ Reliability statistics have significantly improved
- ❁ Suppliers have adopted portable EDXRF screening

Materials Screening Program

- ☼ All critical components being tested
 - ☼ Incoming solder
 - ☼ Circuit Board Terminals
 - ☼ Fasteners
- ☼ Sn must be alloyed to at least 3% to be acceptable for space flight

Thank you

 For further information on NITON Analyzers:

www.niton.com

Offices Worldwide including:

Munich

Billerica, Boston

Hong Kong

Shanghai





NITON



Instrument Demonstration