Foreign Object Debris Control In Aerospace and Defense Manufacturing

Discovering the Tools of Quality and Culture Change

Annual ASQ San Diego Quality Conference

November 3-4, 2017

San Diego, CA
Agenda

• Telemetry & RF Products – Who We Are
• Objective
• FOD Control Overview
• Why Care?
• Instituting and Sustaining the FOD Control Program
L3 Technologies
Telemetry and RF Products

• Full Service Engineering & Manufacturing Facilities
  • 280,000+ total square feet
  • ISO 9001: 2000 & 2001 AS9100 Compliance
  • COTS, NDI, MIL-Q-9858, MIL-STD-2000 9001 Compliance
  • 30,000+ square foot clean room manufacturing and test facilities (L3 Telemetry-West)

• Full Environmental Testing Capability
  • Shock, Vibration, Temperature, Altitude

• 600+ Employees
  • 200+ Secret
  • 100+ Top Secret
Eight Product Areas
Key Customers

- Boeing
- General Dynamics
- Honeywell
- Lockheed Martin
- Northrop Grumman
- Orbital/ATK
- White Sands Missile Range
- NASA

- Raytheon
- Sandia
- Sikorsky
- Thales
- U.S. Air Force
- U.S. Army
- U.S. Marines
- U.S. Navy
Objective

• Foreign Object Debris (FOD) control is more than just an airplane concern

• The products manufactured in the Aerospace and Defense industry are critical to the defense of the nation and the survivability of our Nations warfighters

• This presentation will focus on the need to instill a culture of “Attention to Detail” during the manufacturing process to ensure products are FOD free when delivered to customers

• Tools and strategies to instill a FOD free culture will be a focus of the discussion
FOD Control Overview

• Foreign Object Debris (FOD) control practices have been long existing in the aviation industry; however, until recent years such controls and emphasis on FOD elimination and control have been somewhat lacking in the manufacturing industry

• Within the manufacturing environment, particularly aerospace and defense industries, established general practices and standard terms for the prevention of Foreign Object Damage to aerospace products and operating environments must become the culture

• Aerospace/Defense products include aircraft, missiles, launch vehicles, unmanned aerospace systems, satellites, engines, manufactured parts associated with aerospace products, etc. Operating environments include fabrication, manufacturing, assembly, test, hangars, ramp, airport operations, launch, flight, etc.
Why Care?

- Failures due to FOD in product could affect the lives of hundreds of thousands of people
- Failures due to FOD could incapacitate critical communications and data transmission links
- Failures due to FOD damages a company's reputation for building quality products
- Failures due to FOD can have devastating financial impacts
Where would you choose to perform a critical operation?
Instituting and Sustaining The FOD Control Program

The Foreign Object Elimination Program is a continual improvement process designed to:

• Prevent the possibility of foreign objects that could potentially affect the performance of the product

• Identify organizational and procedural responsibilities

• Establish general workmanship practices and standard terms for the prevention and elimination of FOD
Instituting and Sustaining The FOD Control Program

A successful FOD Program covers the following 12 areas:

1) FOD Point Of Contact/FOD Team
2) FOD Reporting & Investigation
3) Metrics
4) Training
5) Entry Into FOD Critical Areas
6) Housekeeping & Product Environment
7) Potential FOD Reduction
8) Tool & Hardware Accountability
9) Material Handling and Parts Protection
10) Assembly Operations
11) Supply Chain
12) Design Considerations

(Source: AS 9146/NAS 412)
Instituting and Sustaining The FOD Control Program – Where Do I Start?

• AT THE TOP!
  • Executive Leadership **MUST** fully support the FOD effort!

• IN THE MIDDLE!
  • Production Line Managers and Supervisors **MUST** support the FOD effort!

• IN THE TRENCHES!
  • Production personnel, engineers, supply chain, **EVERYONE MUST** support the FOD effort!
Instituting and Sustaining The FOD Control Program – How Do I Start?

Multi-Pronged Approach

- Training and Awareness
- Policy Development, Implementation and Sustainment
- Tool Control
- Current State Evaluation
- Networking with Successful Programs
Instituting and Sustaining The FOD Control Program - Training and Awareness

- Explain the Why
- Explain the What
- Explain the Who
- Raise the Awareness:
  - Signage
  - Attend Staff Meetings
  - Establish a Website
  - Attend Stand-ups

- Establish specific training:
  - New Employees
  - Visitors
  - Vendors
Instituting and Sustaining The FOD Control Program - Training and Awareness
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REMINDER: CLEAN AS YOU GO!

Only YOU can prevent Foreign Object Damage!
Foreign Object Elimination (BI-Q-18)

Make it a FOD FREE day!
Instituting and Sustaining The FOD Control Program - Training and Awareness

L-3 “FOD ALERT” BULLETIN # 1701

Trimmed Wires/Solder FOD

Summary: A program experienced a significant failure due to entrapment of a piece of solder trimmed from a spool. The product survived several monthly environmental and other required tests before failing during a subsequent Quarterly test. The solder trimming was found across two connector leads causing a short that shut down the product. This could have possibly resulted in a catastrophic field failure and endangered safety of end users.

In an effort to mitigate this type of product risk, the following actions should be considered:

- Where possible, remove/replace existing trimmers with Lead Capturing Trimmers (example above) and train on use and maintenance.
- Operations where cutting/trimming/striping of wires or soldering occur and entrapment is possible perform a unit “shake out” and report any dislodged Foreign Objects captured for analysis by the FOD program team.
- Use “clean as you go” philosophy; at no time during any operations should the potential for Foreign Objects on the work surface or in proximity to the product be allowed.
- All inspection operations for closed units should have a “rattle test” incorporated into the Work Instruction.

Please refer all questions to the L-3 FOD Team Lead:
Matt Strickland: Matt.Strickland@L-3com.com

This material is L-3 general capabilities information and does not contain any controlled technical data as defined within the International Traffic in Arms Regulations (ITAR) or Export Administration Regulations (EAR).

FOD Prevention isn’t expensive...it’s PRICELESS!!!
Instituting and Sustaining The FOD Control Program – Current State Evaluation

Current State Evaluation

• Establish a “FOD Squad”
  • Should be team members from the “trenches”
  • Volunteers preferred (Establishes Ownership)
  • Will become the “Subject Matter Experts”
  • Will be the Focal for their area
  • Perform “Cross Audits”

• Perform a detailed “Walk-About”
  • FOD Squad performs
  • Be critical
  • Take photos
  • Document findings in writing
  • Don’t wait for an outsider to tell you what’s wrong
Instituting and Sustaining The FOD Control Program – Current State Evaluation

Current State Evaluation

• Implement the First 4 S’s of the 5S system.
  • Sort (do I really need 15 screwdrivers?)
  • Simplify
  • Sweep (clean, clean, clean and clean again)
  • Standardize
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation

• Guiding Documents
  • AS9146 Foreign Object Damage (FOD) Prevention Program – Requirements for Aviation, Space, and Defense Organizations
  • NAS 412 – Foreign Object Damage/Foreign Object Debris Prevention Standard Practice
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – AS 9146 Overview

• The guiding STANDARD for FOD Prevention
• Establishes REQUIREMENTS for the development and implementation of FOD Prevention Programs
• Is auditable during 9100 and AS9100 certification audits
• Being incorporated into the Missile Defense Agency MAPP
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – AS 9146 Overview

SCOPE
This standard defines FOD Prevention Program requirements for organizations that design, develop, and provide aviation, space, and defense products and services; and by organizations providing post-delivery support, including the provision of maintenance, spare parts, or materials for their own products and services.

It is emphasized that the requirements specified in this standard are complementary (not alternative) to customer, and applicable statutory and regulatory requirements. Should there be a conflict between the requirements of this standard and applicable statutory or regulatory requirements, the latter shall take precedence.
4. FOREIGN OBJECT DAMAGE PREVENTION PROGRAM REQUIREMENTS

4.1 Program Management
4.2 Operations
4.3 Area Designation
4.4 Training and Personnel Access
4.5 Product Protection
4.6 Housekeeping and Clean-As-You-Go
4.7 Consumables, Hardware, and Personal Items Accountability and Control
4.8 Tool Accountability and Control
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – NAS 412 Overview

- The premier document for how to implement a robust FOD Prevention Program.
- Revision goal is to align the 412 with 9146 and to provide a roadmap for 9146 implementation and sustainment.
- Major Revisions:
  - Review/clarified all definitions ensuring alignment with the key definitions of AS9146
  - Aligned all 412 chapters to flow with AS 9146 chapters/sections
  - Re-aligned all 412 chapters to provide better flow of concepts within the chapters
  - Added section introductory statements to provide clarification as to the intent of the chapter/section
  - Removed many ambiguous/contradictory statements between chapters/sections
  - Removed the confusing “Area Designation Template”
  - Provided a table that connects the 412 “how to” to the AS 9146 requirement
  - Reduced the overall page count of the document from
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – NAS 412 Overview

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• Provided a table that connects the 412 “how to” to the AS 9146 requirement

• Reduced the overall page count of the document from 44 pages to 34
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – NAS 412 Overview

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Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – The Company Level

• Policy should clearly define:

  • Expectations to ensure compliance

    • Methods to prevent FOD
    • Procedures for responding to a FOD occurrence. (FOD detected during a process or in the course of manufacturing that has not resulted in damage.)
    • Procedures for responding to a FOD incident. (FOD that has caused damage or had the potential to cause damage or loss.)
    • Method to determine levels of control
    • Method to control vendors/contractors entering a FOD designated area
    • Method for the control of tools, hardware, and supplies
    • Method for kitting, transporting and handling parts, work in progress and finished product
    • Type, level, and frequency of training
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – The Company Level

• Policy should clearly define:

  • **Roles and Responsibilities**
    • Executive Leadership
    • Product Line Managers/Supervisors
    • FOD Program Manager
    • Quality Department
    • FOD Focals
    • Employees
    • Visitors
    • Vendors/Sub-contractors
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – The Company Level

- Policy should clearly define:
  - How the Program will be sustained. (The 5th “S”)
    - Frequency of audits
      - Daily
      - Weekly
      - Monthly
    - Who will conduct the audits
    - Scoring mechanism
    - Method to evaluate the overall program and revise if needed
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – The Company Level

- Examples of Metrics

![Graph showing 12 month average all lines combined for 2017.]

**Non-Conformance Analysis**
For All Lines Combined
August 2017

**Excellent**: 95%-100%, **Marginal**: 90% - 94%, **Unsatisfactory**: 89% and Below
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – The Company Level

• Examples of Metrics

**Conformal Coat**

- Findings: Heavy dust/dirt accumulation on top of Dispatch curing oven.
- Corrective Actions: Consistently perform cleaning of horizontal surfaces.

Excellent: 95%-100%, Marginal: 90% - 94%, Unsatisfactory: 89% and Below
Proper tool/parts control will have a documented procedure that establishes a means for positive control to eliminate the potential adverse impact to deliverable hardware or work in progress due to tool or hardware FOD.

- Program should include:
  - Procedure that defines inventory control and quick identification of missing tools/hardware.
  - Procedure to address the use of common tools/hardware.
  - Procedure to address broken or lost tools/hardware.
  - Procedure to address the acquisition of new tools.
  - Procedure to address how hardware and small parts are controlled on the production floor.
  - Procedure to control tools/hardware used by vendors and subcontractor.
Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – Tool and Parts Control

• Tool Control Examples
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Instituting and Sustaining The FOD Control Program – Policy Development and Implementation – Tool and Parts Control

• Tool Control Examples
Instituting and Sustaining The FOD Control Program – Networking With Successful Programs

• DON’T GO AT IT ALONE!

• Use available resources:
  • Others within your specific industry
    • GMD FOD Council
      • Over 40 companies with approximately 100 members
      • Repository of knowledge
      • Share best practices
      • Share challenges
      • Work through solutions as a group
  • Open dialogue with your customers
  • Internal Company FOD Councils
  • Benchmark successful companies
Instituting and Sustaining The FOD Control Program – IT CAN BE DONE!

BEFORE
Instituting and Sustaining The FOD Control Program – IT CAN BE DONE!
QUESTIONS?
Contact Information

Matt Strickland
L3 Technologies
FOD/ESD Team Lead
Matt.Strickland@L3T.com
Thank You!