



International Aerospace Quality Group

**9146:2016 Ballot Draft
FOREIGN OBJECT DAMAGE (FOD)
PREVENTION PROGRAM
Guidance Material**

March 2016

Foreign Object Damage (FOD) is a major concern in the aviation, space, and defense industry. While there is a large amount of information and guidance available about the prevention of FOD, no requirements standard exists. This standard identifies FOD Prevention program requirement that can be flowed down in contractual agreements.

The aviation, space, and defense industry established the International Aerospace Quality Group (IAQG) for the purpose of achieving significant improvements in quality and safety, and reductions in cost, throughout the value stream. This organization includes representation from aviation, space, and defense companies in the Americas, Asia/Pacific, and Europe.

The IAQG benchmarked industry best practices and guidance to develop the requirements of this FOD Prevention Program standard. This document standardizes FOD Prevention Program requirements to the greatest extent possible and can be used at all levels of the supply chain by organizations around the world to mitigate FOD risk to aviation, space, and defense products and services.

9146 is a new standard.....

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.

Foreign Object (FO)

An alien substance or article (e.g., tools, consumables, hardware, product protective devices, personal items, product process debris, operations debris and environmental debris) that could potentially enter and/or migrate into/on the product or system becoming FOD and potentially cause FOD, if not removed and controlled.

Foreign Object Debris (FOD)

Any FO that has entered and/or migrated into/on the product or system, and could potentially cause FOD, if not removed and controlled.

Foreign Object Damage (FOD)

Any damage attributed to FOD that can be expressed in physical or economic terms, which could potentially degrade the product or system's required safety and/or performance characteristics.

9146 FOD Prevention Program Requirements

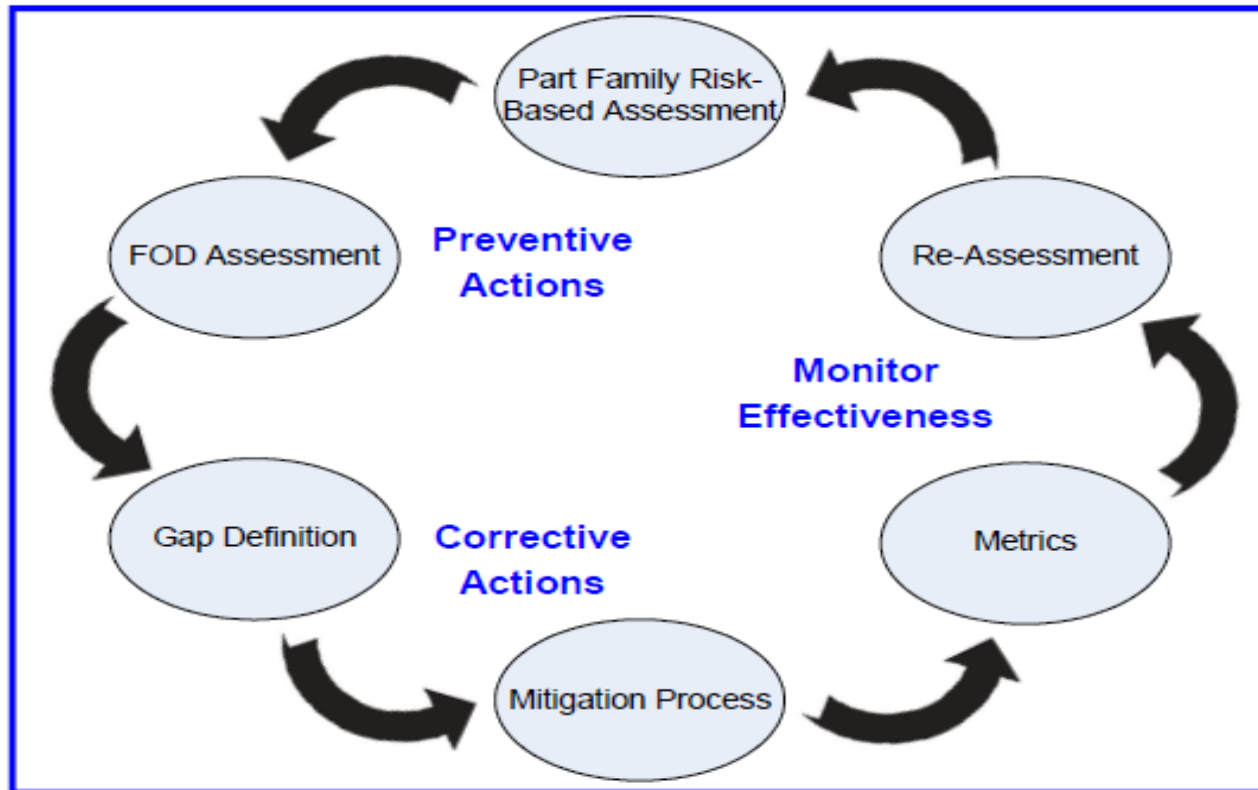
FOREIGN OBJECT DAMAGE PREVENTION PROGRAM REQUIREMENTS

- **Program Management**
- **Operations**
- **Area Designation**
- **Training and Personnel Access**
- **Product Protection**
- **Housekeeping and Clean-As-You-Go**
- **Consumables, Hardware, and Personal Items - Accountability and Control**
- **Tool Accountability and Control**

8 Primary Elements for FOD Prevention Program

FOD Prevention Program

Establishing and maintaining an effective FOD prevention program involves using a “continual improvement” cycle approach that proactively addresses the events (conditions and actions) leading to FOD (see diagram below). Organizations vary in their method of implementing this approach.



The organization's top management shall demonstrate leadership and commitment to the FOD Prevention Program.

The organization shall designate a FOD Prevention Program management representative with the responsibility and authority for establishment, implementation, and maintenance of the program.

The organization shall maintain documented information of a FOD risk assessment for procured product and flow down FOD prevention requirements commensurate with that risk.

The organization shall maintain documented information of FOD Prevention Program nonconformities and FOD / FOD product nonconformities in accordance with its "control of nonconforming outputs" processes.

The organization shall report FOD Prevention Program nonconformities and FOD / FOD product nonconformities in accordance with its management review process.

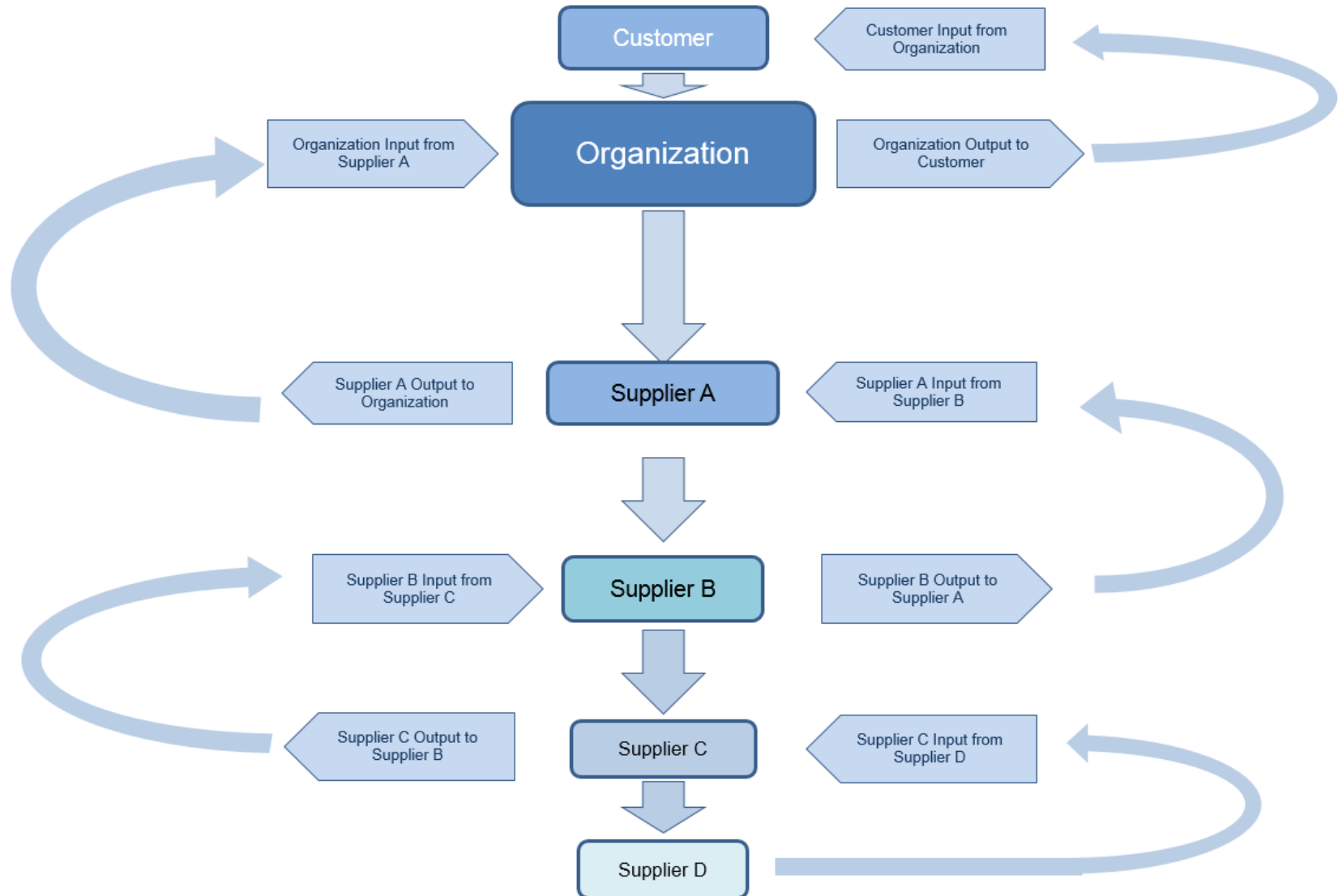
The organization shall evaluate effectiveness of the FOD Prevention Program based on internal, customer, statutory, and regulatory requirements.

The organization shall communicate results and effectiveness of the FOD Prevention Program to relevant internal and external interested parties.

The organization shall establish, implement, and maintain documented information of a FOD Prevention Program commensurate with a FOD risk assessment for product characteristics and operations. The FOD Prevention Program shall include consideration of the following elements:

- **Operations.**
- **Area designation.**
- **Training and personnel access.**
- **Product protection.**
- **Housekeeping and clean-as-you-go.**
- **Consumables, hardware, personal items - accountability, and control.**
- **Tool accountability and control.**

FOD Prevention Program Requirements Deployment Strategy



The organization shall establish, implement, and maintain FOD/FOD prevention processes for operations.

The processes shall establish requirements for:

- **Product design considerations for the prevention, inspection/detection, and removal of foreign objects.**
- **Selection, application, and control of protective devices/measures for products, processes, and personnel.**
- **Plan and sequence operations to reduce FO/FOD/FOD risk to product.**
- **Identification of critical openings requiring protection from FO/FOD.**
- **Capabilities for cleaning and FO/FOD inspection/detection.**
- **Inspection/detection methods for contamination, damage, and deterioration at appropriate steps or intervals.**

The organization shall determine area designation based on FOD risk analysis of product characteristics and operations.

The organization shall establish, implement, and maintain appropriate level of controls for each area designation that include consideration of the following elements:

- **Operations**
- **Training and personnel access.**
- **Product protection.**
- **Housekeeping and clean-as-you-go.**
- **Consumables, hardware, personal items accountability, and control.**
- **Tool accountability and control.**

Visual Management

FOD Prevention Area Designation signs communicate awareness and promote compliance



ATTENTION VISITORS!!!

ASSEMBLY & TEST ARE FOD CONTROLLED AREAS
Strict Adherence to FOD Control Procedures is Mandatory

Entrance to Assembly & Test areas requires:
Engine Center FOD Badge/Sticker Displayed
-OR-
Escort by FOD Certified Employee

P&W Employees, Resident Customers, Resident Suppliers:
• Obtain FOD Certification Badges / Stickers upon completion of FOD training.

Visitors:
• Affix stickers to visitor badge after review of Foreign Object Damage Prevention guidelines.

Return all badges to the Plant Protection Lobby Desk in Building 130 at end of visit

• Not FOD Trained? You must remain on main aisles unless escorted
• Escort required? - Contact Plant Protection @ 344-4074

Emergency 5111



Training and Personnel Access

The organization shall establish, implement, and maintain a FOD prevention training program commensurate with FOD risk assessment results.

The training program shall:

- **Determine the appropriate initial training criteria and content.**
- **Identify internal and external personnel training requirements.**
- **Establish training methods. (e.g. lecture, electronic)**
- **Establish recurring training criteria, content, and intervals.**
- **Evaluate training effectiveness (e.g. measuring employee competency, FOD/FOD nonconformities)**
- **Maintain documented information of training program compliance.**

The organization shall establish provisions to ensure anyone entering FOD prevention designated areas has received required FOD prevention training or is escorted by trained personnel. This includes personnel not typically assigned to the designated area such as customer, visitors, contractors, and infrastructure maintenance.

The organization shall establish, implement, and maintain a process for product protection through all stages of operations.

The process shall include provisions for:

- **Protection against contamination (such as bags, caps, covers, or plugs).**
- **Storage, handling, and transportation of product (such as cleanliness of carts, containers, and pallets).**
- **Protection against physical and functional damage (such as part separation).**

The organization shall establish, implement, and maintain housekeeping and clean-as-you-go processes in all work areas and infrastructure.

NOTE: Infrastructure includes buildings, warehouse, workspace, associated utilities, and process and support equipment.

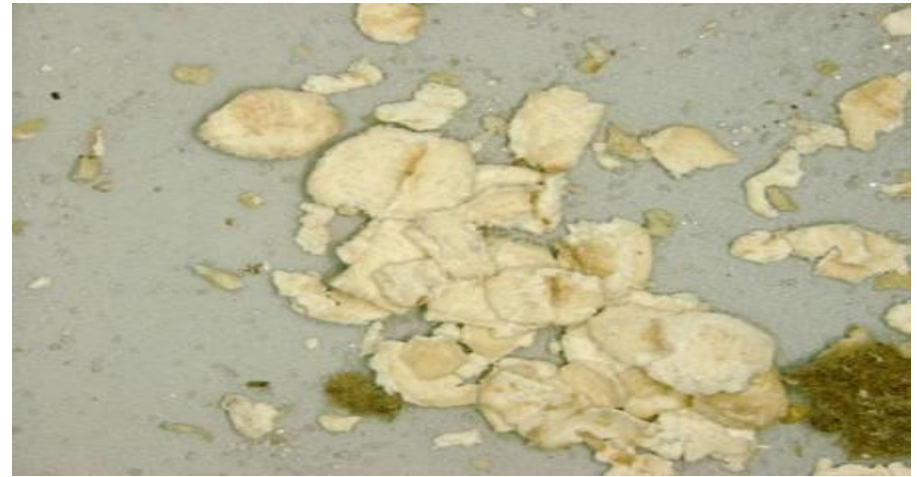
The process shall:

- **Mitigate FO/FOd/FOD risks at appropriate intervals associated with accumulation of debris and waste in all work areas (commonly referred to as “housekeeping”).**
- **Mitigate FO/FOd/FOD risks in immediate work area of the product at appropriate intervals for production, maintenance, and service processes. (commonly referred to as “clean-as-you-go”).**

NOTE: Examples of operations debris include application of adhesives, grease, or sealant in excess or in areas outside of product requirements; machining chips; drill shavings; safety wire remnants; solder balls; coatings; tie wraps; grit blast; shot peen; tumbling media; and hardware remnants, etc.

Example of FOD

- Oatmeal pieces found on a Turbine Blade



Example of FO

- Trash in part container



Consumables, Hardware, Personal Items Accountability & Control

The organization shall establish, implement, and maintain processes to account for and control consumables, hardware, and personal items to mitigate FOD risk to the product.

The organization shall maintain documented information for a process of reporting lost consumables, hardware, and personal items to mitigate FOD risk to product.

Consumables, Hardware, Personal Items Accountability & Control



FO= Apex tip



FOd= Broken Apex tip



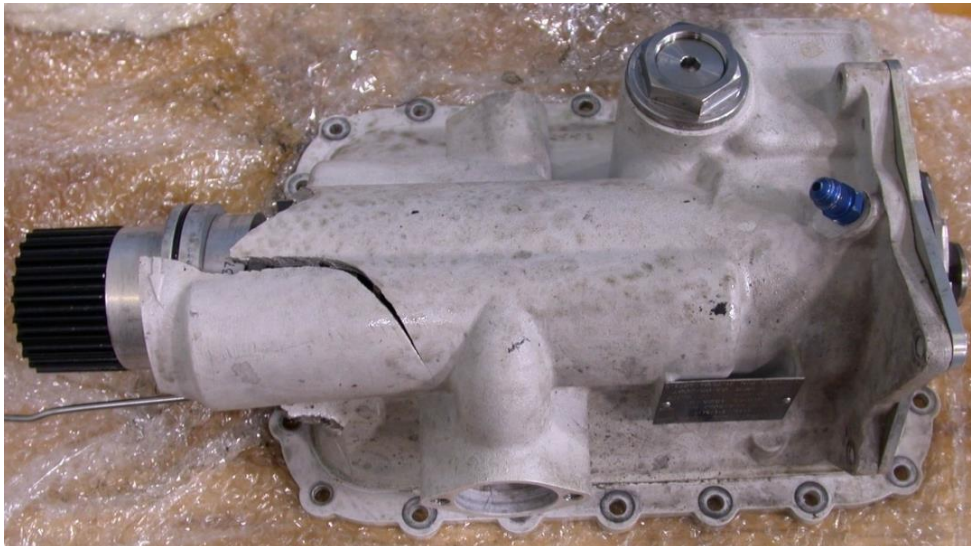
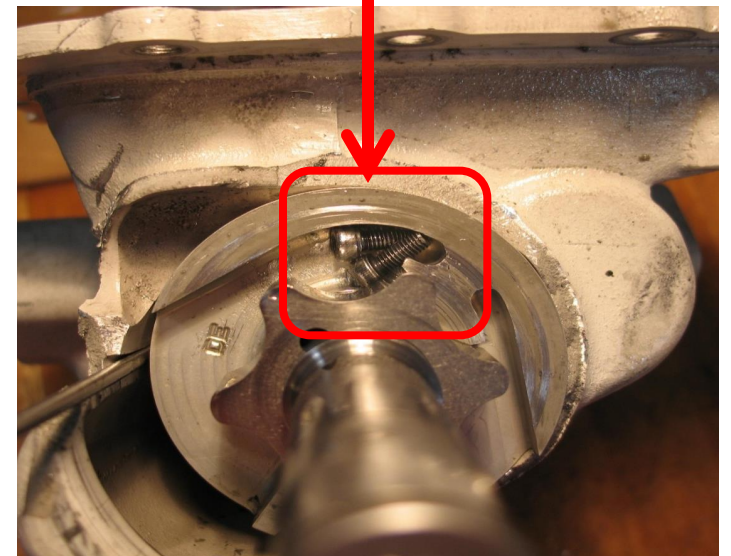
NOTE: Accountability and Control of Consumables, Hardware, and Personal Items is critical to a successful FOD Prevention Program.



Consumables, Hardware, Personal Items Accountability & Control

Hardware Can Cause FOD

This pump was destroyed by ingestion of screws that were not accounted for during the Operations process.



The organization shall establish, implement, and maintain a process to account for and control both company and personally owned tools to mitigate FOD risk.

Tool accountability and control shall include:

- **Storage and preservation.**
- **Identification and inventory.**
- **Tool location and management (e.g. knowledge of tool locations at all times).**
- **Maintenance, serviceability, and condition (e.g., cleanliness, no broken pieces, missing pieces).**
- **Design considerations to avoid generating or entrapping foreign objects and to enable their detection and removal.**

The organization shall define and maintain documented information of a process for reporting lost tools to mitigate FOD risk to the product (e.g., tool, broken tool piece, tool detail).

Examples of how tools can become FO/FOD.

- Hand tools must be monitored for loose parts, breakage or required maintenance.
- After repeated use, screws can back out of flex socket.



The following slides are provided to illustrate examples FO/FOD/FOD

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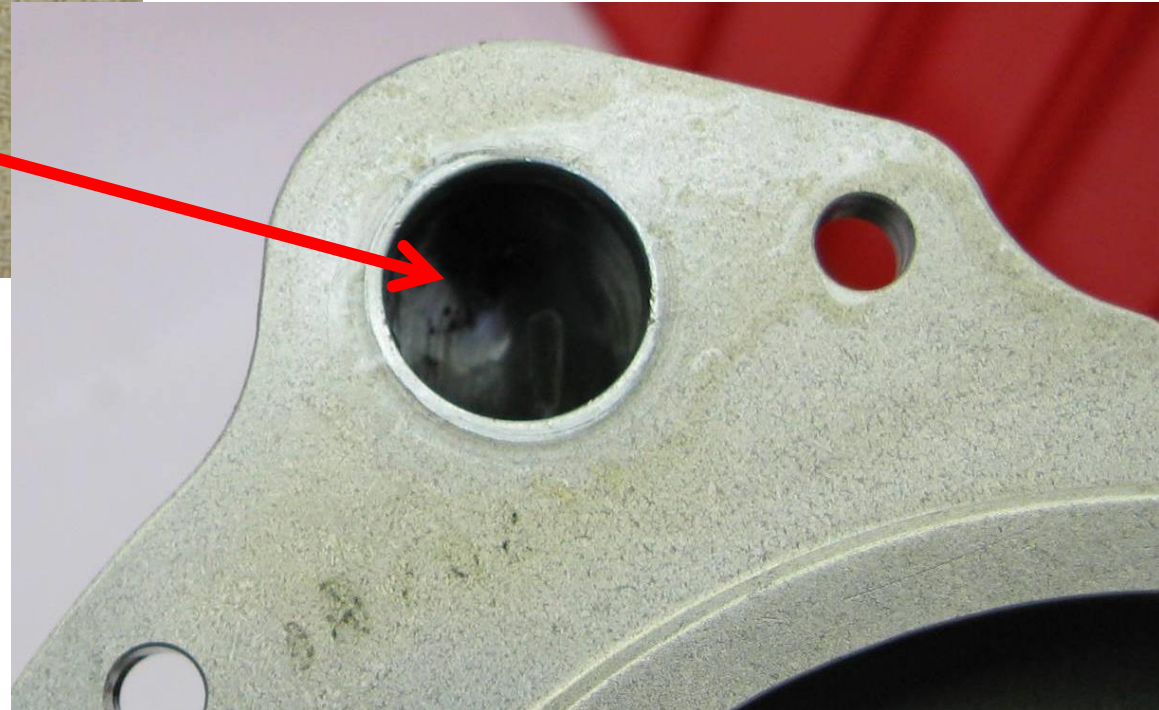


Polishing Material – FO/FOd



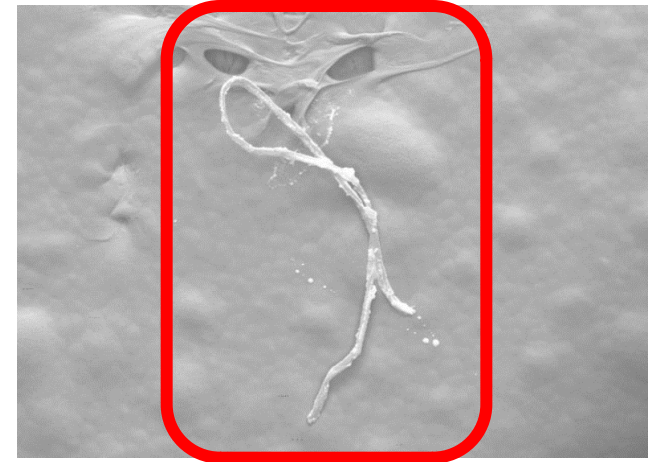
FO: Abrasive Cloth

This pump was returned by a customer because of FOd contamination



Product leaked during acceptance testing

- Leak was caused by FOd preventing seal integrity at a manifold interface
- Lab analysis of FOd revealed the FO to be a nylon fiber.
- Likely source of FO was either clothing or a lab coat



Example of FO

- Machining chips formed during machining processes must be thoroughly cleaned and removed from parts.

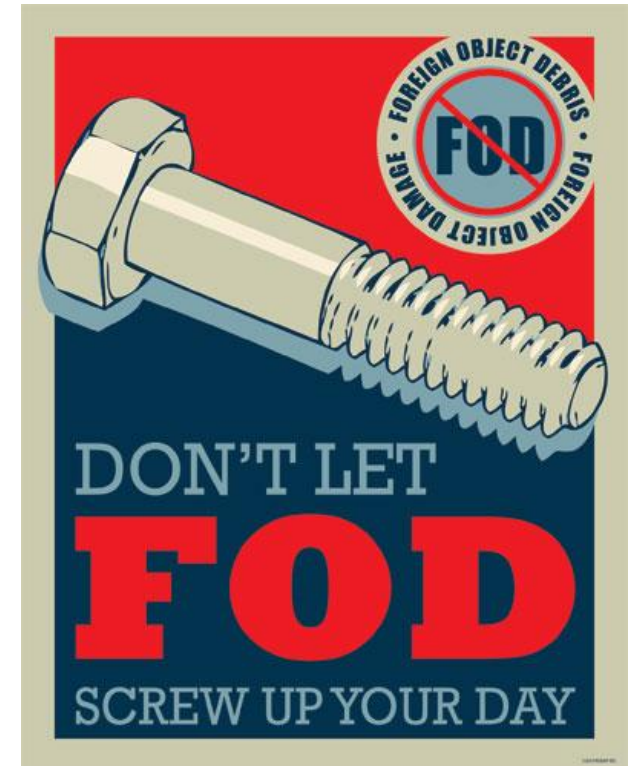
Example of FOd

- Machining chips were embedded into cavity when chips were not properly cleaned from component



Effective FOD Prevention Program:

- **Identifies Potential Problems**
- **Corrects Negative Factors**
- **Provides Awareness**
- **Supplies Effective Employee Training**
- **Uses Industry “Lessons Learned” for Continuous Improvement**
- **Capability for Self – Assessment**



Summary

FOD Prevention is a “Team” sport. An active FOD Prevention Program requires dedicated resources and a Champion to provide vision, direction and strategy.

Raising employee awareness to practice FOD Prevention requires consistency and creativity.

Benefits

- **Reduce FOD incidents and repetitive FOD occurrences**
- **Assigns specific tasks supporting a creative approach to FOD Prevention**
- **Supports Collaboration with Customer to establish / sustain FOD Prevention**
- **Professional environment – Higher confidence in Product Quality**