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FOD Awareness

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to the aviation industry

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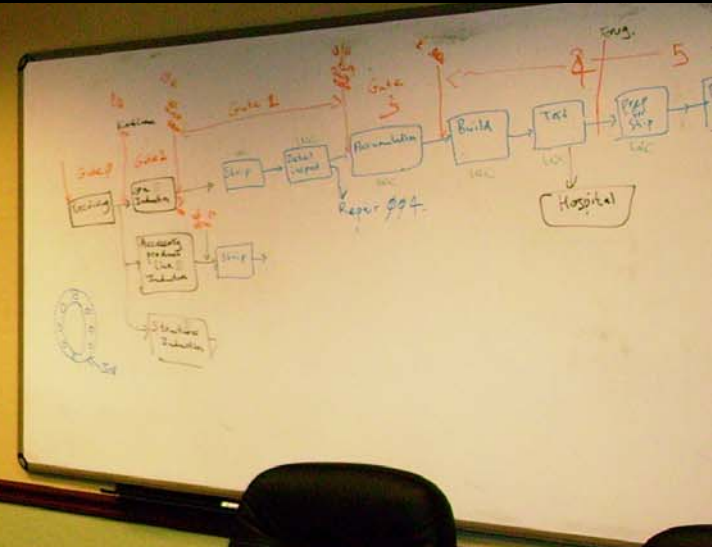
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SERVICES PROVIDED TO THE AVIATION COMMUNITY

Business Consulting Services

Business Services	Engineering	Quality Systems	Airworthiness
• Crisis Mitigation • Expert Testimony • Corporate training • Root Cause Analysis • Corrective Action • Internal audits • Supplier audits • FOD Awareness	• FAA-DER • Structural Design • Analysis • Repair & Alteration • FAA-PMAs • Interior Mods • Flammability Test Plans	• FAA- AC0056 • ISO 9001 • AS-9100 • AS9110 • AS9120 • ASA-100 • CASE 1A & 3A • FAR-145 • FAA-PMA • FAA-TSOA	• FAA-DAR Mfg. • FAA-DAR Maint. • FAA Airworthiness Approvals • FAA Part Conformity • FAA installation Conformity

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• Better Decision Making • How to Gain a Competitive Edge • Human Factors • Making the numbers in a tough economy • Management Tools for Decision Makers • Risk Management • SMART^2 Goal Setting • Supplier Performance • Supply-Chain Auditing • SWOT Analysis for success	• AC 0056 • AS-9120 /AS9110/AS9100 • ASA-100 / CASE 1A & 3A • ISO 9001 • FAA - Repair Station • FAA-PMA • Corrective Action • FOD Awareness & Prevention • Internal Auditing • Preventive Action • Process vs Procedure Audits • Receiving Inspection • Root Cause Analysis • QA Manager Training	• FAA-PMA Systems - *SAE Approved* • Accident Related Aircraft Parts • FAA SUPs • Counterfeit Parts • Documentation & Acceptable Traceability • FAA-CFRs • Human Factors for Repair Stations – *FAA IA Approved* • OEM versus PAH parts • Safety Management Systems (SMS) - *FAA IA Approved* • User-Centric Design

This Workshop is based on:

National Aerospace Standard 412

Foreign Object Damage/ Foreign Object Debris (FOD) Prevention

References

NAS 412, FOREIGN OBJECT DAMAGE/ FOREIGN OBJECT DEBRIS(FOD)
   PREVENTION (www.aia-aerospace.org)

ORM Service Guidance (OPNAVINST 3500.39, AFI 90-901, FM 100- 14)

FOD Service Guidance (MIL-STD-980, AR 385-95)
NAFPI (www.nafpi.com)

Lockheed Martin powerpoint

Bell Helicopter Textron, Inc., Foreign Object Debris and Foreign Object Damage (FOD)
   Prevention, For Aviation Maintenance & Manufacturing, 2007

John Heib, DCMA Aircraft Operations Deputy Director for Policy and Training, 26th
   National Aerospace, FOD Prevention Conference, August 9-11, 2005

NOTE: The Defense Contract Management Agency (DCMA) is the Department of Defense (DoD) component that
   works directly with Defense suppliers to help ensure that DoD, Federal, and allied government supplies and
   services are delivered on time, at projected cost, and meet all performance requirements

Learning Outcomes

The attendee should be able to understand:

1. The cost and safety risks

2. Basic FOD Terms/definitions

3. The basics of FOD Prevention

1. The Cost of FOD Damage to Airlines

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SUMMARY

The largest 300 airports collectively service slightly fewer than 55 million movements per year, and see up to 70,000 FOD incidents. Depending on traffic and the specifics of their operating environment, this FOD causes airlines to incur (collectively) direct costs as high as US$20 million per airport per year. FOD costs airlines US$263K per 10,000 movements in direct maintenance costs. Overall spend for the top 300 airports is US$1.1Bn.

If the indirect cost of delays, plane changes, fuel inefficiencies, etc., are added then the cost of FOD increases by a multiple of up to 10x, to US$12 billion pa.

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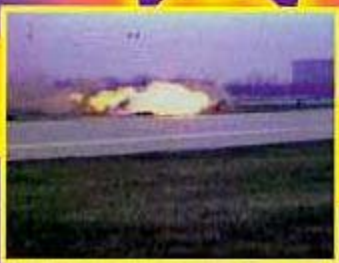
Why would you want to prevent FOD ???

+

Why ???

Here is the safety risk.
(108 people lost their lives !)

BLOCK 2

Basic FOD Terms/Definitions

Basic FOD Terms/definitions

- **Foreign Object Debris (FOD):** A substance, debris or article alien to a vehicle or system which would potentially cause damage.

- **Foreign Object Damage (FOD):** Any damage attributed to a foreign object that can be expressed in physical or economic terms which may or may not degrade the product's required safety and/or performance characteristics.

- **Foreign Object Elimination (FOE):** A program or process used to assure a FOD-free product/system.

Basic FOD Terms/definitions

Tote Tray:

- A device for storing/carrying/transporting tools or equipment in a secure manner to prevent inadvertent droppings :i.e., a tool holder, an apron with pocket rings to which tools can be secured. Tote trays with lids will have the lid secured to the tote tray body.

Basic FOD Terms/definitions

Clean-As-You-Go:

– Clean the immediate area when work cannot continue.

– Clean the immediate area when work debris has the potential to migrate to an out of sight or inaccessible area and cause damage and/or give the appearance of poor workmanship.

– Clean the immediate area after work is completed and prior to inspection.

– Clean at the end of each shift.

– If you drop something or hear something drop-pick it up!

Basic FOD Terms/definitions

Consumables: Supplies provided to workers that are expendable.

Examples include:

- Issued apparel
- Safety glasses
- Glue, paint, sealant
- Rags, sandpaper, brushes, applicators
- Stock items (e.g. rivets, washers, fasteners, other hardware)

Shadowbox / Shadow-board:

- A tool box or storage board with specific, marked locations for each tool so that a missing tool will be readily noticeable.

Basic FOD Terms/definitions

Tools:
a device that aids in accomplishing a task. (Webster's Dictionary)

- **can be *easily* marked to identify ownership**

- **typically fall into two categories…**

  - **Company owned**   • **Privately owned**

FOD

Foreign Object Debris
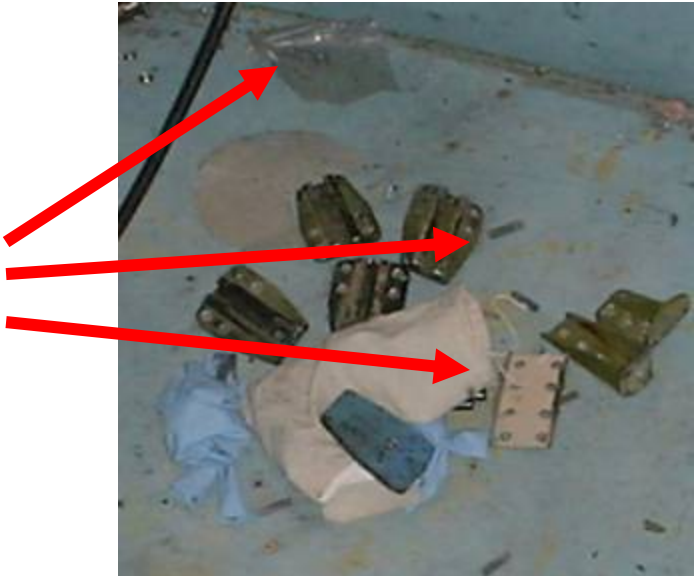
Foreign Object Damage
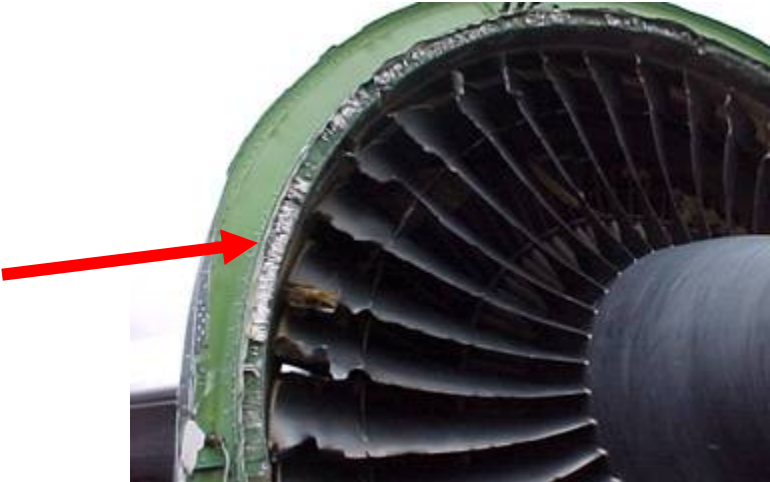
BLOCK 3

The 12 Basic Elements of a FOD Prevention program

12 Basic Elements of a FOD Prevention program

1. FOD Prevention Training.

2. Early design consideration for FOD prevention, resistance to damage, foreign object entrapment, etc.

3. Assembly sequencing and maintenance/manufacturing techniques that include proper care and use of assembly/maintenance equipment and parts protective devices.

4. Handling of material.

5. Housekeeping.

6. Control of tools and personal items.

12 Basic Elements of a FOD Prevention program (continued)

7. Control of hardware/consumables.

8. Measuring techniques for analysis, trending, and feedback.

9. Incident investigation/reporting, "Lessons learned."

10. Control of hazardous material.

11. Access controls.

12. Focal Point.

1. FOD Prevention Training.

Includes both Initial & Refresher to include:

•Proper storage, shipping and handling of material, components, and equipment.

•Techniques to control debris.

•Housekeeping.

•Cleaning and inspection of components and assemblies.

•Accountability/control of tools and hardware.

1. FOD Prevention Training (continued)

- Control of personal items, equipment and consumables.

- Care & protection of end items.

- Quality Workmanship ("Clean-As-You-Go," inspection).

- Flight line, taxiway and ramp control methods.

- How to report FOD incidents or potential incidents.

2. Early consideration for FOD prevention, resistance to damage, foreign object entrapment, etc

- When reviewing customer Contracts
- Changes in facilities
- New product lines or equipment
- Methods of packaging (e.g. crating)

Entrapped screwdriver

3. Assembly sequencing and maintenance/manufacturing techniques that include proper care and use of assembly/maintenance equipment and parts protective devices.

- Examples include kitting, & disassembly
- Packaging & preservation

3. Assembly sequencing (continued)

a. Practice 'Clean as you go".

b. Clean & flush components. Cap or seal exposed openings to deny foreign object entry.

c. Protect hardware and equipment from splatter during brazing, soldering, welding and like operations.

d. Inspect components & equipment for damage <u>prior to</u> installation and repair.

e. Verify required protective devices are in place (dust covers, temporary seals, cushioning, etc.). Inspect Items with missing protective devices.

3. Assembly sequencing (continued)

f. After cutting & deburring fluid and pneumatic lines and tubing, clean and cap ends.

g. Inspect and remove extraneous material as part of the assembly step.

h. Inspect production tooling (jigs, fixtures, handling equipment, etc.). Ensure it is clean, undamaged and free of extraneous material. This includes work stands, ladders, test equipment.

i. Protect products by using FOD barriers, foam pads, covers, etc. Cover composites and place pads between tools and the aircraft/assembly. Always protect sensitive areas and potential FOD entrapments (engine, open fuel line, harnesses, etc.)

4. Handling of material.

Control Techniques:

a. Train all employees to ensure compliance with packaging, handling, shipping and storage requirements.

b. Packaging, handling, shipping and storage materials with intimate contact with the product should be clean and free of contamination.

c. Parts should be packaged in a manner that precludes any chance of one item making contact with another during normal handling operations.

d. Protective and packaging materials should be selected based on their ability to resist penetration by tearing, splitting or piercing by forces either external or internal during normal handling operations.

4. Handling of material.

Control Techniques:

f.   Establish specific instructions for packaging, unpackaging and handling.

g.   Protective devices (edge protectors, cam, plugs, covers, filters, rub strips) shall be clean and secured to prevent accidental damage. Once installed, prohibit their removal by unauthorized persons.

h.   Particular care must be taken with items that are subject to Electrostatic Discharge (ESD) damage. ESD is considered FOD damage. The use of proper handling, grounding controls and devices and proper ESD protective packaging.

i.   Consider the visibility/detection of material used for protection so that the material itself doesn't become FOD. Consideration should include:

1. Color of packaging or protective devices so they <u>don't</u> appear to be a part of what they are protecting.

2. Streamers for removal for critical items.

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5. Housekeeping

✓ Conduct regular sweeping of traffic areas & driveways

✓ Perform scheduled FOD Walks

✓ Clean-as-you-go

✓ Maintain well lit work areas

✓ Containerized hardware
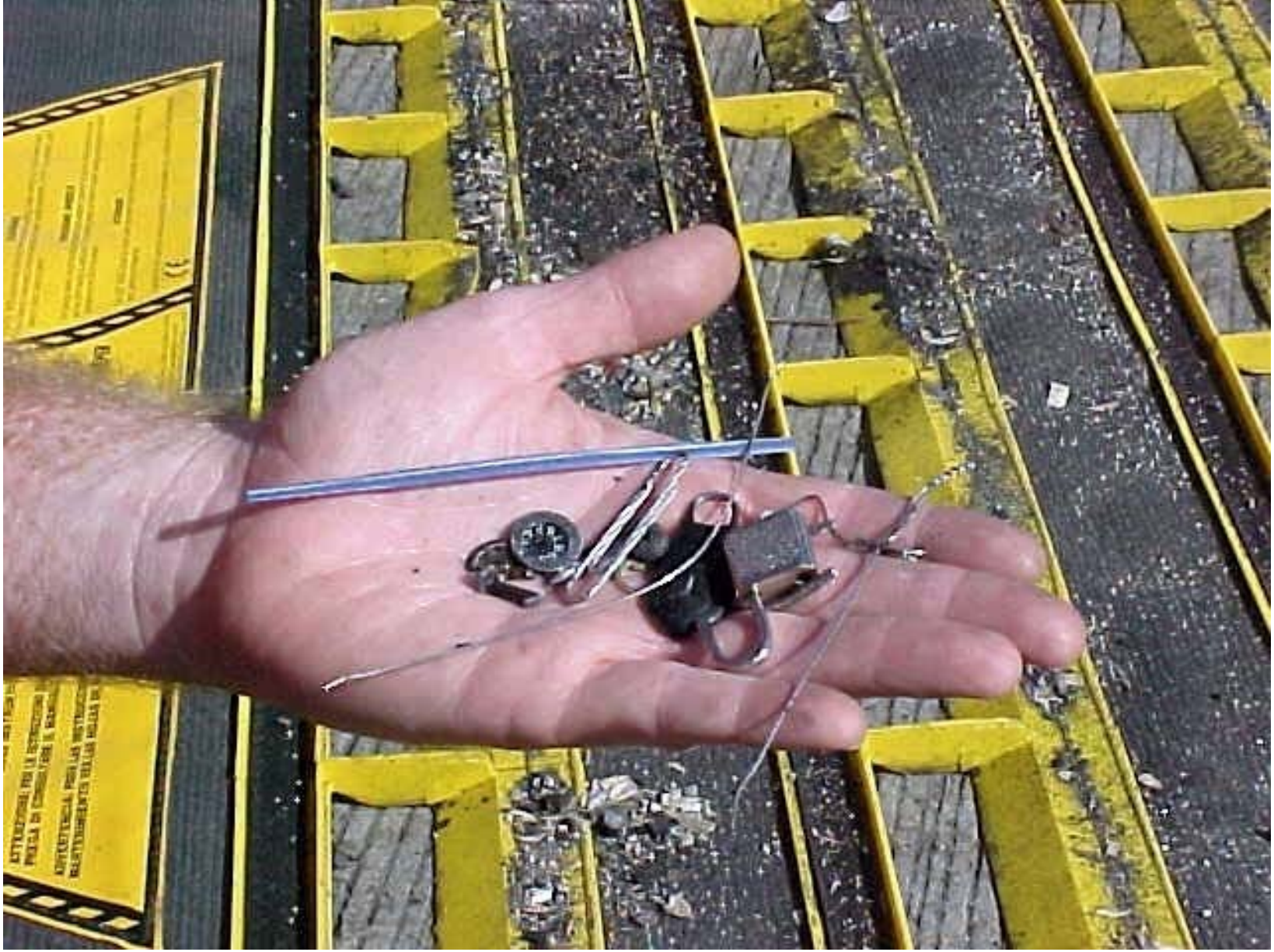
6. Control of tools and personal items.

Remember to:

- Assure each tool that is used comes back and is accounted for.

Shadowboxed Tools:

✓ Should include only those tools needed for specific task

6. Control of tools and personal items (continued)

✓ Tool Tethers

- Used in areas around structural work stands or any other locations where a dropped article could result in damage to the flight hardware, injury to personnel, or where difficulty in retrieval would result if the tool were dropped.

✓ Chit Systems

- Provides easy inventory of checked tools
- Loose chits can become FOD themselves

6. Control of tools and personal items (continued)

✓ **Marking Tools**

- Bar coding

- Employee numbers

- Color coding

- Absolutely necessary to identify previously lost tools

✓ **Maintain a clean work area**

✓ **Clean-as-you-go**

6. Control of tools and personal items (continued)

✓ Report any unaccounted-for tool

✓ Search until tool is found or until you are certain it has <u>not</u> become FOD.

7. Control of hardware/consumables

✓ Containerize (*Covered spring-loaded containers*)

✓ Take only what you need to complete the task (use 5S LEAN MFG techniques)

– Sort

– Straighten

– Shine

– Standardize

– Sustain

✓ Clean-as-you-go

8. Measuring techniques for analysis, trending, & feedback

Follow the Plan-Do-Check-Act Approach:

PLAN: Formally plan your FOD program

DO: Formally track your FOD program

CHECK: Analyze FOD reporting data

**ACT:** Take appropriate actions

– **Repeat**

8. Gather FOD Data

FOREIGN OBJECT ELIMINATION/HOUSEKEEPING CHECK LIST

SECTION———— MONITOR ———————— SUPERVISOR ————

Foreign Object Elimination and Housekeeping Daily Inspection Requirements	SAT	SUN	MON	TUE	WED	THUR	FRI
Assemblies are free of loose standard parts, tools, and other foreign objects or any excess accumulation of assembly debris.							
F.O.E. bags are available and in use.							
Tables, rollaways, standards or staging that are in close proximity of major assemblies are clean and free of tools, standard parts or other foreign objects unless properly contained.							
During work in process, standard parts are kept in flip lid containers; tools, clamps, clecos, etc, are in plastic tote trays.							
Fluid fittings and lines (test or assembly) stored or installed, are capped and kept in clean storage. Bearings, bushings, RDP ends are protected.							
Electrical plugs are capped and in clean storage.							
Opening into areas that cannot be cleaned ar covered							

8. Analyze FOD Data

Look for patterns, trends, and areas that need greater focus
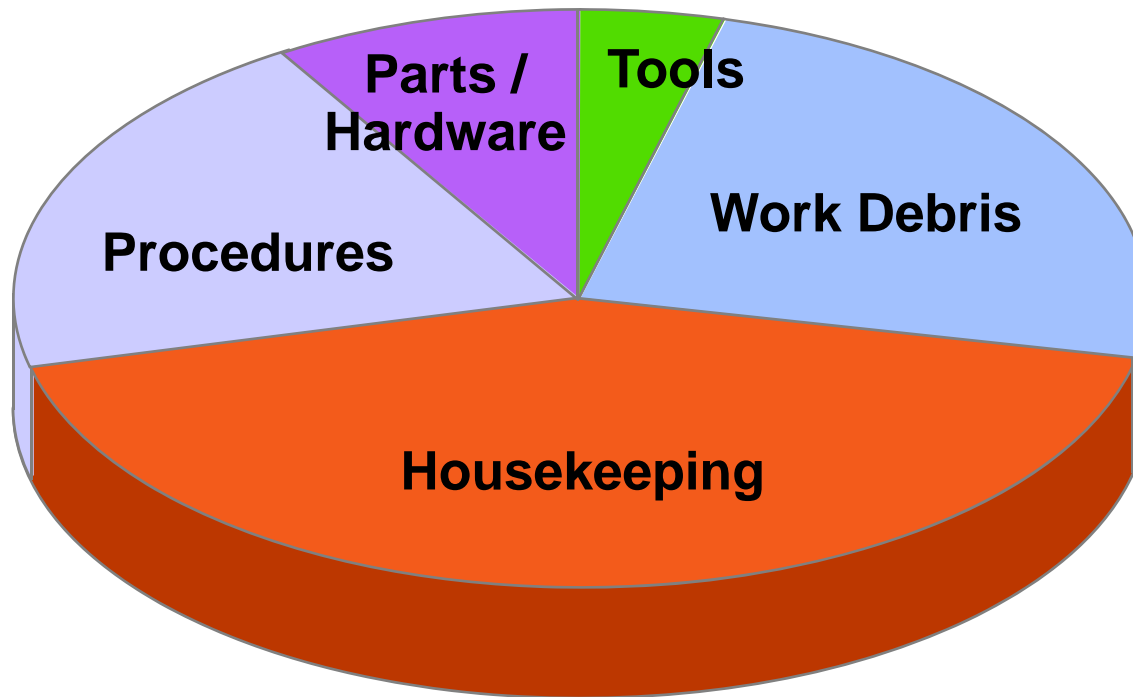
Monthly FOD Discrepancy Report Rollups

9. Incident investigation/reporting, "Lessons learned."

- Should be incorporated into your corrective action process
- To include:
  - Correction
  - Root Cause Investigation (e.g. 5-why's)
  - Corrective Action
  - Lessons-Learned

10. Control of hazardous material

Should be incorporated into your
corrective action process:

- Training
- Segregation/disposal
- Labeling
- Use Protective equipment

11. Access Controls

At the workstation level:

✓ Seal open areas

✓ Use intake/exhaust covers

✓ Shield areas below where work is performed

✓ Use approved caps & plugs to seal open hydraulic lines and protect disconnected electrical plugs

✓ Clean-as-you-go

11. Access Controls (continued)

At the facility level:

 FOD Awareness Area
(Lowest Level of FOD Sensitivity)

 FOD Control Area
(Medium Level of FOD Sensitivity)

 FOD Critical Area
(Highest Level of FOD Sensitivity)

Reference: Lockheed Martin

FOD "Awareness" Sensitivity Level:

• **Hardware that is at a low risk level for FOD Incidents:**

> • **has minimal potential for FOD migration or entrapment**
>
> • **exposure to FO will have minimal negative effects to form, fit and function of hardware**

FOD Awareness Area Basic Attributes:

• FOD Awareness placards posted at conspicuous locations, at all entrances of the area, and within the area as required

• Elevated "high standard" of housekeeping… (5-S should be performed)

• Periodic FOD Walk Downs may be performed

• All personnel who frequent, transit or work in a FOD Awareness Area must have a minimum, FOE General Awareness Training

FOD "Control" Sensitivity Level:

Hardware that is at a medium risk level for FOD Incidents

• has a medium potential for FOD migration or entrapment

• Exposure to FOs may degrade the form, fit or function of components, systems, &/or assemblies, which could lead to substandard performance of product / vehicle.

- FOD Control Area Basic Attributes:

- FOD Control Area placards posted at conspicuous locations, at all entrance areas, and within the area as required

- Stanchions / Stanchion Placards with boundary tape can be used to localize a FOD Control Area, and can be within a FOD Awareness or Critical Area

- Elevated "high standard" of housekeeping (5-S event should be performed)

- Scheduled FOD Walk Downs "must be" performed as determined by management

- All personnel who frequent, transit or work in a FOD Control Area must have initial and scheduled refresher FOE Awareness Training

FOD "Critical" Sensitivity Level:

Hardware that is at a high risk level for FOD Incidents, and has a high potential for exposure, entrapment &/or migration of foreign objects into hardware, which could cause serious damage to form, fit or function of components, systems or assemblies, which could lead to product / vehicle deterioration, malfunction and/or complete failure.

FOD Critical Area Basic Attributes:

- FOD Control Area placards posted at conspicuous locations, at all entrance areas, and within the area as required

- Stanchions / Stanchion Placards with boundary tape can be used to localize a FOD Control Area, and can be within a FOD Awareness or Critical Area

- Elevated "high standard" of housekeeping (5-S event should be performed)

- Personnel, miscellaneous small parts, hardware & tools are strictly controlled;

- Single Point Entry & Exit

- Extreme "high standard" of housekeeping… (5-S event should be performed)

- Scheduled weekly FOD Walk Downs "must be" performed at a minimum, and are scheduled management.

- All personnel who frequent, transit or work in a FOD Control Area must have initial and scheduled refresher FOE Awareness Training

12. Focal Points of Contact

Top Management:

- Get employees involved from the start.

- Clearly demonstrate company commitment from the start.

FOD Administrators:

- develop and implement plans and programs to prevent hardware damage during associated design, manufacturing, assembly, test, acceptance, packaging, handling, storage, transporting, maintenance, flight line, and launch operations.

- Are appointed by Top Management and have sufficient authority and organizational freedom to identify and implement FOD preventive measures whenever and wherever required.

12. Focal Points of Contact

FOD Administrators:

- Conducts FOD Audits

- Investigates FOD incidents

- Ensures corrective actions address root causes

- Oversees overarching FOD prevention training curricula

To sum up…

A successful FOD Prevention Program requires committing more than just resources.

It requires embracing a FOD free work ethic throughout the entire organization… from the CEO down.

QUESTIONS?

The good news… we only had one piece of FOD !

Thank You!

and remember…

"To stop learning…. is to stop living."

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