

ATA Safety Guidelines

SG 907

Preventing FOD and Wildlife Damage

Version 2010.1

Original Issue

Air Transport Association of America, Inc.
1301 Pennsylvania Ave., N.W., Suite 1100
Washington, D.C. 20004-1707

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Highlights

Release History

Original Issue: January 2010

Original Issue 2010.1

Location	Description of Change
All	Original Issue

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Chapter 1. Introduction

1-1. Scope of This Document

This document is written for airports, airlines, and service providers and establishes best practices and procedural guidelines for the prevention of aircraft Foreign Object Damage (FOD) and wildlife strikes. The objective of these guidelines is to promote ground and flight safety by developing effective prevention programs for FOD and wildlife damage.

1-2. Definitions

- **APHIS** – Animal and Plant Health Inspection Service
- **Bird Strike** – See Wildlife Strike.
- **Foreign Object Debris (FOD)** - A substance, debris or article alien to a vehicle or system which would potentially cause damage. Examples include but not limited to:
 - Rocks, loose paving material and construction debris
 - Pieces of cargo containers, luggage hardware, and ground service equipment, other assorted debris and trash on terminal or hangar ramps
 - Tools, hardware, nuts, bolts, safety wire or other objects left or unsecured after maintenance is completed
 - Aircraft parts including parts of tires, panel doors, and fuel caps
 - Ice, snow, salt and sand
 - Birds and other wildlife
- **Clean As You Go (Housekeeping)** – Practices such as:
 - Maintaining work areas FOD free as work is being performed.
 - Cleaning work areas as tasks are completed vs. waiting until the whole project is done.
 - Retrieving an object when dropped or misplaced.
 - Accounting for all parts and tools.
- **Foreign Object Damage (FOD)** – Any damage attributed to a foreign object that can be expressed in a physical or economic terms which may or may not degrade the product's required safety and/or performance characteristics. This includes damage to engines, wings, fuselage, tires, etc.
- **FOD Critical Areas** – Areas where aircraft are routinely operated, serviced, or overhauled.
- **NAFPI** – National Aerospace FOD Prevention Inc.
- **Snarge** - The residue smeared on an airplane after a bird/plane collision. The snarge is generally all that is left of the bird.
- **Tool Control** – Any formal system designed to assure tools and equipment are accounted for so that they do not become FOD.

- **USFWS** – United States Fish and Wildlife Services
- **Wildlife Strike** - A wildlife strike has occurred when:
 - A pilot reports striking one or more birds or other wildlife;
 - Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike;
 - Personnel on the ground report seeing an aircraft strike 1 or more birds or other wildlife;
 - Bird or other wildlife remains, whether in whole or in part are found within 200 feet of a runway centerline, unless another reason for the animal's death is identified;
 - The animal's presence on the airport had a significant negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, aircraft left pavement area to avoid collision with animal) (criteria 1-4 adopted from Transport Canada (MacKinnon et al. 2001)).

Chapter 2. Foreign Object Damage Prevention

2-1. Background

Foreign Object Damage (FOD) has been around as long as there have been aircraft. Preventing foreign objects from hitting propellers, being ingested into jet engines, cutting tires, puncturing or causing dents on wings or the fuselage of aircraft is an important part of the daily operations. As the airline industry has grown and the environment has changed, FOD incidents and costs have increased. A study suggests that FOD, especially engine FOD, can cost an airline as much as one million dollars a month.

2-2. Effective FOD Prevention Programs and Basic Elements

An effective FOD prevention program should take the “continuous improvement” approach and include preventive practices such as housekeeping and tool control, performance measurements, FOD awareness training, and focal point/authority, such as FOD committee.

The FOD Prevention Program should be a written document placed in a notebook or binder with at least one copy posted in the Operations office. The program should be available for review. In addition, the FOD Prevention Program and any related costs such as pavement repair should be included in the corporate planning process.

2-2-1. Preventive Practices

There have been advancements in FOD identification techniques and in FOD clean-up equipment, yet the same overall prevention strategy applies: areas where aircraft operate must be kept free of FOD. The following are basic, yet effective FOD preventive practices:

1. Housekeeping

Proper housekeeping is an important part of the daily operation in FOD Critical Areas. The use of sweepers and vacuums is highly recommended. Make the rule “Clean As You Go”.

2. Tool Control

Mandate equipment and tool control for all FOD critical areas. There are many tool control systems; some are more elaborate than others. Find the system that works for each situation. Here is a list of some techniques:

- Perform tool counts at the end of each task.
- Utilize shadow boxes and shadow boards to account for all tools.
- Utilize tool and equipment tethering when work is being performed in locations where a dropped tool may cause damage to the aircraft or an engine, or where a dropped tool may be difficult to recover.
- Utilize a separate kit of tools for each job. The employee is supplied only the tools and supplies that the task card requires.
- Utilize accounting tags for each tool or piece of equipment that is checked out.
- Tool identification program – Every tool has the name of the owner or a tracking number on it, so it can be tracked back to the person that is responsible for it.

3. Control of Personal Items, Hardware, and Consumables

Personal items such as hats, sunglasses, keys, pens, and coins can end up as FOD. In order to prevent these items from becoming FOD, there should be a system for controlling hardware and consumables that are used in daily operations. The following may be considered:

- Prohibit food or drinks in vehicles.
- Require personnel items (e.g., personal cellular phones) to be stored in lockers and not carried in pockets while in FOD Critical areas.
- Use AOA badges that can be properly restrained by an arm band.

4. Vehicle Inspections

Mandate regular vehicle inspections for FOD in cabs and beds of vehicles and non-motorized equipment, such as carts and containers. FOD in vehicles tends to fall out unnoticed. The undercarriage of GSE should be inspected on each shift change for loose or missing nuts, bolts, washers, and major components such as shock absorbers, brake shoes, tie rods, etc.

5. Aircraft Cargo Bin Inspections

Perform an inspection and clean-up of aircraft cargo bins (at least) daily. This is an area often overlooked. FOD is introduced with luggage and bulk cargo, hidden away in a cargo bin to later be knocked, blown, and dragged out onto the ramp. To assure that this task is performed, require personnel to inspect and remove FOD prior to exiting bins.

6. Airline Ramp Inspections

At least monthly, all ramp areas controlled by the airline should be inspected for conditions, such as deteriorating pavement. Any area found to be in poor condition should be immediately repaired. All employees should be encouraged to report any problem areas immediately upon discovery.

7. Airport Runway and Taxiway Inspections

When possible, direct a representative of your organization to accompany the airport operations authority on runway and taxiway inspections at least weekly. Maintain a log of the date, time, and objects found during the inspection, and the name of the person who accompanied the airport operations official.

8. Overhaul Inspections

During the entire overhaul process, be aware of loose objects, hardware, tools and equipment left lying around the work areas. Be especially vigilant when “turning over” job tasks between shifts and other maintenance personnel. Some best practices include:

- Upon completion of any final machine operation, clean or flush the component to assure it is free of debris, and immediately cap or seal any exposed opening to deny foreign object entry.
- Protect hardware from splatter during brazing, soldering and welding operations.
- Inspect and remove extraneous materials as part of any re-assembly step. Conduct a foreign object inspection and remove debris.
- Inspect production tooling to assure it is clean, undamaged and free of foreign material prior to installation and build-up of components or assemblies. Inspect work areas, especially work stands, ladders and test equipment, for loose objects.

9. Test Cell Inspections

The test cell inspection facility should be inspected daily to ensure that there is no deterioration of the structure that could cause FOD. Before and after each engine run-up, a FOD inspection should be performed:

- Prior to any engine run-up, the test area should be inspected for debris.
- Visually inspect the engine before testing. Remove loose objects. Tape or clamp instrumentation lines to help eliminate vibration failure.
- Ensure test cell equipment, tools and accessories are maintained and used in a manner to protect the engine from damage or contamination through chipping, cracking, peeling, etc.
- Upon completion of each engine test run, ensure no objects or tools are left in the engine or surrounding area.

10. Engine Run-up Area Inspections

Before each run-up, the area should be inspected for FOD, especially pavement deterioration and any ice or snow. The area should be protected from wind-blown debris. All loose equipment should be kept well away from operating engines.

11. Equipment Design

Companies may reduce FOD by taking FOD generation into account when designing equipment. Equipment may contain areas that may collect FOD, such as boxes or dead spaces. The type of switch, knob or lug nut used on a piece of equipment may be more susceptible to breaking off and becoming FOD than another design. Requiring engineering and purchasing departments to consider potential FOD sources when they involved in designing, specifying or purchasing a piece of equipment can help in FOD prevention.

12. Ground Support Equipment (GSE)

GSE contributes to FOD when loose nuts and bolts fall off equipment. This type of FOD causes tire cuts or can be ingested into engines.

- Maintain equipment. Ensure all nuts and bolts are tight. Consider lock washers and products such as “locktite” in problem areas.
- Ensure loose tools are not left in or on equipment.
- Use proper torques to help prevent parts from loosening and becoming FOD.
- Ferrous FOD control devices such as magnets must be routinely cleaned.

2-2-2. FOD Awareness Training and Reporting

FOD awareness training should be conducted for all employees who work in or around all FOD Critical Areas.

Basic training subjects to be included in the program are:

- Housekeeping – “back to the basics”; a clean area is less likely to contribute to FOD; “Clean As You Go” techniques
- Material, tool and equipment control
 - How to store, ship and handle material and equipment (example: accounting for tools, such as a screwdriver (or a fork), that could be ingested into an engine or penetrate a tire
 - Rules on personal items and proper clothing - loose hats, for example, can be ingested by engine intakes

- Inspections – what and where to look for FOD sources
- How to report FOD incidents – including near occurrences

Periodic FOD awareness campaigns should be organized to keep FOD issues fresh in employees' minds

1. Maintenance Personnel

All maintenance personnel must be trained to conduct safe and FOD-free maintenance. Work cards should stress FOD awareness and prevention strategies for the task(s) being performed. Workers should be encouraged to suggest improved task procedures to prevent the introduction of FOD.

All personnel should be encouraged to report a lost component or tool immediately, without fear of reprisal. Questions should be directed to work area management or the safety representative.

2. Cargo and Ramp Personnel

All new employees should receive specific training on FOD prevention. All employees should receive recurrent FOD training at least annually. The training should address:

- Maintaining work areas and all Ground Support Equipment FOD free.
- Conducting FOD inspection of cargo ramp areas and vehicle cabs prior to each shift.
- Cleaning FOD magnets daily if they are installed on equipment.
- Reporting any observed FOD damage to Maintenance.
- Prohibiting personal items, such as kneepads and hearing protection, to be left where they may become FOD.

Posters, Topics of Discussion, and other resources should be utilized to maximize FOD awareness and damage prevention with all affected personnel. Team Leaders and Station Management should ensure FOD removal and damage prevention are regular discussion items at briefings and department meetings.

3. Flight Crew

All flight crew should be aware that FOD can be ingested into aircraft engines during high power applications when the mass flow rate of air into the intake can cause low density/high drag material (plastics, grass, gravel, etc.). Certain types of FOD can also adhere to hot tires after landing and taxi (bar code baggage tags, etc.). FOD may become temporarily embedded in a tire tread and dislodged by centrifugal force at high tire rotation speeds.

- Make FOD checks part of all pre-flight and post-flight aircraft walk-arounds.
- Encourage the careful use of high aircraft engine power during taxi.
- Encourage the limited use of thrust reversers.
- Encourage flight crews to maintain a safe distance from aircraft taxiing ahead of them in order to minimize the potential for FOD being lifted up or blown up into their aircraft by the other aircraft's thrust.
- Encourage flight crews to provide detailed FOD event reports.

4. In-Flight Crew

Initial and recurrent service training should include FOD awareness training. Flight attendants should be encouraged to report to their Captain, Ramp Operations or Maintenance any observed FOD and any observed FOD damage. Flight attendants should maintain their work areas FOD free and should not place items that could become FOD on loading bridges or the ramp.