FOD

Foreign Object Debris

By EGA Master

A world developing exponentially fast pushes the most demanding industries to call for more efficient tool control and safety systems.

That is why EGA Master has developed a wide range of tool control systems to avoid risks such as FOD.

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WHAT IS FOD?

Foreign object debris (FOD) at airports includes any object in an inappropriate location that may damage equipment or injure staff. FOD includes a wide range of materials: loose hardware, pavement fragments, catering supplies, building materials, stones, sand, suitcases and even wildlife. The FOD can be found at terminal gates, loading platforms, taxiways, runways and boarding platforms.

The **three main areas** that require special attention are:

Runway FOD: It refers to various objects (dropped from aircraft or vehicles, broken ground equipment, birds, etc.) that are present on a runway and that may adversely affect a moving aircraft (during takeoff and landing). The runway FOD has the greatest potential to cause damages.

Taxiway and/or platform FOD: While this type of FOD may seem less harmful than the previous one, it should be noted that the jet generated by the reactors can easily throw small objects onto the track.

Maintenance FOD: It refers to various objects, such as tools, materials or small parts used in maintenance activities (e.g. aircraft maintenance, construction work, etc.) and may cause damage to aircraft.

The three main areas that require special attention are: runway FOD, taxiway or platform FOD and maintenance FOD

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WHAT EFFECTS CAN FOD HAVE?

FOD can cause damages in several ways, the most important being:

- Damaging aircraft engines if swallowed.
- Cracking aircraft tires.
- Blocking aircraft mechanisms that prevent them from operating properly.
- Injuries to people after being propelled by the jet of the reactors.

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FOD TAXONOMY

The nature of FOD is also varied. FOD can be composed of any material and can be of any color and size.

In an airport study conducted over a year (French Study information paper on automatic FOD detection systems - EUROCONTROL Workshop, 9-10 June 2008), more than 60% of the FOD elements collected were made of metal, followed by 18% that were rubber. Dark-colored items made up almost 50% of the FOD collected.

The typical FOD includes the following:

- Aircraft parts and engines (nuts, bolts, washers, safety cables, etc.).
- Aircraft parts (fuel caps, landing gear fragments, hydraulic bars, metal sheets and tire fragments).
- Hand tools.
- Catering supplies.
- Airline elements (nails, staff badges, pens, pencils, luggage tags, soft cans, etc.).
- Platform items (paper and plastic catering scraps and cargo pallets, luggage pieces and debris).
- Runway and taxiway materials (concrete and asphalt pieces, rubber gaskets and paint chips).
- Construction waste (pieces of wood, stones, fasteners and other metal objects).
- Plastic and/or polyethylene materials.
- Natural materials (plant fragments, wildlife and volcanic ash).
- Snow or ice in winter.

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WHAT FACTORS CONTRIBUTE TO FOD?

- Poor maintenance of buildings, equipment and aircraft.
- Inadequate staff training.
- Stressing the staff that lead to a worse inspection.
- Climate (e.g., FOD can be generated by strong winds; or its detection may be hampered by adverse weather).
- Presence of uncontrolled vehicles (e.g. contractors) at the aerodrome.

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HOW TO COMBAT FOD?

A successful FOD management program generally contains four main areas, each of which contains significant elements, as described below:

Prevention

- Awareness (existence of FOD program and management support)
- Training and education (implementation of the FOD program)
- maintenance

Detection

- Operations (human inspections and use of detection equipment)
- Equipment

Elimination

- Equipment
- Operations

Evaluation

- Data collection and analysis
- Continuous improvement (trends, comments, incident investigation)

Means to combat FOD include the following activities:

- Regular and frequent inspection of the aerodrome, including aircraft maneuvering areas and adjacent open spaces.
- Suspension of runway operations after notification to the competent authority of FOD "on" or "near" the track until the FOD has been removed and the track has been inspected as necessary.
- Regular and frequent inspection of aerodrome buildings and equipment and immediate repair or recall of items that can create FOD.
- Inspection of the parking door to make sure it is FOD-

A successful FOD management program generally contains four main areas; prevention, detection, elimination and evaluation

free, including ground equipment, and ice, snow, or other material capable of reducing braking action.

- Removing FOD as soon as it is identified.
- Use of constant inspection systems (explained in the following chapter).
- Implementation of a FOD control program (explained in the following chapter).

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CONSTANT INSPECTION SYSTEMS

Constant inspection systems use a combination of radar and electro-optical sensors that facilitate the detection of FOD 24/7 in any weather conditions.

These systems are used in some of the world's busiest airfields, including Heathrow, Vancouver, Dubai, Doha and others.

The benefits of this system on conventional vehicle inspections are:

- Constant monitoring, including night and low visibility conditions.
- FOD detection is faster and more reliable.
- More efficient traffic flow (uninterrupted by inspections).
- Reduced risk of track incursions (by inspection vehicle, for example, due to driver error).
- Reduced risk of bird strokes (optical sensors recognize birds).

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FOD CONTROL PROGRAM

1. CONSCIOUSNESS

A. Existence and status of the program

A first step in implementing a successful FOD management program is to ensure that staff know about the existence of the program. The FOD management system of an airport must be visible in all areas of the operation of the airport. FOD safety exercises will occur more efficiently if all airport staff are actively encouraged to identify potential FOD hazards, act to eliminate them, and propose solutions to mitigate those hazards. Some organizational communication means are:

- FOD seminars.
- FOD letters, notices and newsletters.
- Sharing learned lessons.
- FOD bulletin boards, security reporting mailboxes, and electronic reporting via websites or email.
- Methods of exchanging security-related information with other airport operators through regional offices or professional organizations.
- FOD program promotional materials: t-shirts, caps, etc.
- Discussing FOD at employee staff meetings.

B. FOD policy and management support

An effective FOD program should have management's full support. Management's commitment to FOD prevention must be formally expressed in the organization's policy. The declaration will serve to formally establish the FOD management program. Publishing this policy statement in visible places will help reinforce the organization's commitment to FOD prevention and remind employees of their FOD management duties. Key elements of an airport's FOD policy are:

- A summary of the methods and processes that the organization will use to achieve desired security outcomes.

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- The organization's policy regarding accountability and responsibility.

The FOD program manager

A. Airport operators must appoint a responsible staff member to manage the airport's FOD programs and problems. The designated person can be a fully dedicated FOD administrator or may have other tasks (e.g. operations manager, security manager, etc.).

B. The responsibilities of the FOD Manager should be clearly defined along lines of communication identified within the organization. In addition, the FOD manager should be allowed to report to the highest levels of management (e.g. airport president, CEO, etc.) to ensure proper consideration of all reports, recommendations and issues.

C. The FOD manager should periodically communicate the status of the FOD program to airport staff and ensure that the learned lessons from hazardous case investigations or experiences, both internally and from other organizations, are widely distributed. There must always be an open and available line between the FOD Manager and the airport/air carrier staff.

The FOD Committee

A. Several airports of different sizes and complexities have found it useful to establish a FOD committee. Note: The level of authority or power of the FOD committee will be different for each airport, as it is established by the executive direction of the airport.

B. The composition of the committee is the airport's choice, but it is typical that the members of the committee include all those with a direct relationship with FOD (such as those in a position to produce or eliminate FOD): air carriers, operations and public safety personnel, representatives of contractors, etc. The FOD manager usually chairs the committee.

Airport operators must appoint a responsible staff member to manage the airport's FOD programs and problems

C. One of the most important functions of the FOD committee is to serve as a resource for the FOD manager. In addition, the determination of potentially dangerous FOD situations can be established by the FOD committee, as well as perform an evaluation of data collected from FOD..

Safety Culture

An effective FOD management program requires more than just implementing rules and procedures to follow. It requires the support of management to establish the attitude, decisions and methods of operation of the policies that demonstrate the prevalence of safety for the organization. In effective safety cultures, there are clear reporting lines, clearly defined duties and easy-to-understand procedures.

The staff must fully understand its responsibilities and know what to report, to whom and when. Critical aspects of a safety program are appropriate personal attitudes and corporate commitment to enable and facilitate the removal of unsafe elements.

An airport FOD control program is most effective when addressing four main areas:

Training

All airport and airline personnel must be trained in the identification and disposal of FOD, including possible consequences of ignoring it. FOD training for flight crews include procedures identified in the Flight Crew Operation Manual, pre- and post-flight inspection procedures. Training includes procedures for identifying and removing FOD at its source and should be strengthened through the use of posters and signs.

Continuous training is needed to help maintain a FOD awareness.

Inspection

It must be carried out by the staff of the airlines, airport and aircraft managements agencies. Airline staff, when feasible,

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must join airport staff in daily inspections. This practice helps to increase familiarity with local airfield conditions and promotes effective communication between the airport and airlines.

The International Civil Aviation Organization (ICAO) requires a daily, daylight inspection of the areas of aircraft manoeuvre for the elimination of FOD. In addition to performing these inspections at the beginning of the day or shift, staff in the boarding area should look for FOD during their normal shifts.

Ongoing construction works require more frequent inspections. It may be necessary to assign dedicated personnel to continuously inspect the FOD during major construction activities.

Flight crews must inform air traffic control and station operations of any FODs they observe on runways and taxiways. Aircraft operators and handling agents must

Airline staff, when feasible, must join airport staff in daily inspections

designate persons to inspect aircraft parking posts prior to movement.

Maintenance

• **Sweep:** This can be done manually or with a sweeper, which is the most effective equipment to eliminate the FOD. The sweeper removes debris from cracks and pavement joints. It should be used in all areas except those that can only be reached with a manual broom. All areas exposed to the air created by the engines, including the aircraft maneuvering areas, the doors and the areas adjacent to them, should be routinely swept. Areas where the ground support teamwork should be swept periodically.

• **Magnetic bars:** These can be suspended under vehicles to collect metallic material. However, the bars should be cleaned regularly to prevent the collected waste from falling again, by creating new FOD. Vehicles operating in the

boarding area should be inspected periodically to ensure that they do not have loose parts that can be detached.

• **Soundtracks:** Rumbling strips can detach the FOD from the bottom of the vehicles. The strips, which are between 3 and 5 meters long, are portable and can be in transitions from the ground zone to the air zone, or adjacent to the construction areas of the air zone.

• **FOD containers:** Must be placed in all doors for collecting debris. Containers must be emptied frequently to prevent them from overflowing and becoming a FOD source. In addition, airport staff can use bags at the waist to collect debris. Assessing waste collected in containers and bags helps identify their sources and indicate where personnel and equipment should be deployed for more effective control.

Other means of preventing FOD damage include wind barriers and nets to restrict FOD movement in the air, fences to prevent animals from entering the airfield and well-maintained paved surfaces. If the damaged pavement cannot be repaired immediately, the aircraft must use an alternative route.

Coordination

Airports with a FOD committee tend to control FOD more successfully than those without it.

At airports served by several airlines, they must have their own representatives and an airport user committee to coordinate FOD control efforts between them.

Both construction activities in the land and air area as well as scheduled maintenance, should be communicated to airport users as soon as possible. Pre-construction planning of the airport should include a means of controlling and containing the FODs generated by the construction. This is especially important in highly windy environments where waste is more likely to be transported into the air. Access to and from construction sites should avoid using aircraft

operation areas. Contractors must fully understand the requirements and penalties incorporated in their contracts with respect to FOD control and elimination.

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STANDARD NAS 412
TOOL CONTROL MEASURES

1. **Inventory:** Analyze the tools that are stored and transported to the workplace to eliminate all unnecessary tools that may be the cause of FOD.
2. **Count and identify:** Count sets/kits and identify them with the name or number of the operator, to ensure that the tools are counted before and after use (tool listing, storage and return distribution systems, control software...)
3. **Use containers** to transport the necessary tools exclusively.
4. **Unique tagged location for each tool.** Inventory tool control and automatic mapping systems are recommended.
5. **Service and condition:** procedures to check and ensure the proper condition of tools and equipment, safely eliminating those that are broken, worn or in non-optimal conditions.
6. **Missing Tool Report:** An anonymous reporting system must be established to ensure tool loss reporting.
7. **Responsibility and control of tools:** appropriate use of containers, tool inventory process, tool use inspection procedures, ensuring availability and cleaning, control of elements and equipment and procedures for lost items/ tools; marking, bicolor trays or panels, control and usage log.
8. **Tool status control and cleaning.** An inspection should be carried out before and after using the tools, checking any rebars, part loss, loose parts, fractures or chips.
9. **Limit tools quantity to the minimum required for the job.** Avoid migrating tools between areas. The tools must comply with the return-to-warehouse process before being moved to a new area.
10. **Employing workstations** for tool storage and control.

11. **Control consumables** (tapes, glue-sticks, compounds, etc.)

12. When visual inspection cannot be carried out with minimal handling of the product on which it is worked, **other inspecting systems such as mirrors, UV flashlights, borescopes, magnifying glasses should be used...**

13. In disassembly and rework processes: **classify, count and store the parts in properly identified containers.**

14. **Immediately report any lost tool/item,** in addition to executing the procedure that prevents the product or aircraft from flying until the resolution of the incident.

15. **Use of automatic supply machines** (vending, kanban, etc.)

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EGA GROUP ANTI-FOD SYSTEMS

TOOLS CONTROL SYSTEM

As it has been said throughout this report, tool control is essential in many applications, especially on those where "forgotten" tools create high safety risks and decrease safety such as airplane repair, wind turbine maintenance, construction at height, among others.

Due to what is said above, EGA Master offers as a solution an exclusive and customized tools control system to avoid the loss of tools:

The EGAWARE sotfware controls which tool is taken from or returned to the stock

1. EGAWARE Software

EGA Master offers a unique stock control system, that will control which tool is taken from or returned to the stock.

A. The user logs in with its username and password.

B. The worker picks up the tool that he will work with.

C. The worker scans the barcode.

D. The software detects that the tool has been taken.

E. The worker returns the tool and scans the code again.

F. The software detects that the tool has been returned.

2. Smart opening system for drawers

Avoid mistakes in the tool selection, increasing efficiency and therefore, productivity.

Each door is assigned a radio frequency card that is passed through the RFID reader of each roller cabinet allowing the opening and locking of the drawers.

Laser technology that detects errors such as a drawer that has not been completely closed.

LEDs in the drawers facilitate the visual recognition of the status of each drawer (open / locked).

3. Foam trays and tools customization

If our standard sets do not match with customer's tool sets requirements, we can be informed about its personal selection, and we will customize foam trays manufacture.

Such trays can bicolor and are perfectly adapted to the tools and allow you to visualize immediately the missing tool.

The smart opening system for drawers avoids mistakes in the tool selection

We also LASER MARK tools with customer's company's or center's logo or name in order to improve its tracking and to reduce expensive loses.

ANTIDROP SYSTEMS TO WORK AT HEIGHTS

In order to minimize risks caused by FOD, EGA Master manufactures a whole range of ANTIDROP® products and solutions that have been designed to control and prevent object dropping when working at height.

These products have been designed to allow a comfortable, productive and efficient use of tools while assuring workers' and equipment safety against object dropping.

On the one hand, we offer belts and retractable lanyard with carabiner.

1. Belts and wrist bands

They are designed to fit the worker´s body, to enable user freedom and provide maximum tool fixing points, and to make internal hooks safely to retain tools while the operator is climbing or moving location.

2. Lanyards

They are designed for maximum safety and to give an optimum working freedom. The many systems provide all the necessary solutions for a safe and comfortable use at heights, and at the same time, they ensure a better shock absorption.

3. Premium tools for industrial use

On the other hand, we offer different ranges of ANTIDROP® premium tools for industrial use: non-sparking, insulated 1000V, ESD, non-magnetic. These have attached a thermo-shrink system and retention ring, following DROPS recommendations. Such system is much effective and safe, and also it avoids damages on the properties of the tool.

It is true that most of the tools can be turned in ANTIDROP®, we discourage to put sleeves oneself. It is not economic nor safe, since one must put it registering temperature, time, diameter of sleeve and length of sleeve. And then, TEST it.

If the tests succeed, then for that particular code the design parameters are settled, and the rest of ANTIDROP® tool units of that code are manufactured according to these parameters.

Without having made TESTS to the design parameters, they can never assure that the outcome will perform properly in the first fall. They can't assure safety; if they make the tests, it will cost them much more than buying complete ANTIDROP® tools.

The thermo-shrink system is much effective and safe, and also it avoids damages on the properties of the tool

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CONCLUSION

FOD is a great-risk-field where taking the convenient measures is required: both training, organizational measures, culture and proceedings, as well as means that make easier the task of avoiding FOD radically.

In EGA Group, we are committed in helping you making it real, in the safest and most efficient way.

Be Safe…Be Efficient

By EGA Master