SIERRA LEONE CIVIL AVIATION AUTHORITY

ADVISORY CIRCULAR

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Foreign Object Debris (FOD)

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1 GENERAL

Sierra Leone Civil Aviation Authority Advisory Circulars contains information about standards, practices and procedures that the Authority has found to be an Acceptable Means of Compliance (AMC) with the associated Regulations.

An AMC is not intended to be the only means of compliance with a Regulation, and consideration will be given to other methods of compliance that may be presented to the Authority. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

Information considered directive in nature is described in this AC in terms such as "shall" and "must", indicating the actions are mandatory. Guidance information is described in terms such as "should" and "may" indicating the actions are desirable or permissive, but not mandatory.

1.1 Purpose

This advisory circular (AC) provides procedures and processes pertaining to the management and control of Foreign Object Debris (FOD) at aerodromes, including the establishment of FOD control programmes to address the prevention, detection, removal and evaluation of FOD, as well as related training and awareness activities.

1.2 Applicability

This Advisory Circular applies to all aerodrome operations (existing, new, international and domestic), including airport modification/expansion projects.

1.3 References

(a) SLCAR's Part 14A – Aerodrome Design and Operations

(b) ICAO Doc 9981 – PANS Aerodromes

1.4 Status of this Ac

This is the first AC to be issued on this subject.

1.5 Definitions

Air Operations Area (AOA) - All airport areas where aircraft can operate, either under their own power or while in tow. The AOA includes runways, taxiways, apron areas, and all unpaved surfaces within the airport's perimeter fence.

Airport Apron (or Ramp) - A surface in the AOA where aircraft park and are serviced (refueled, loaded with cargo, and/or boarded by passengers).

Clean-as-you-go - The practice of cleaning one's surroundings before, during, and after a shift, especially when working with items that may become FOD.

Foreign Object Debris (FOD) - Any object, live or not, located in an inappropriate location in the airport environment that has the capacity to injure airport or air carrier personnel and cause damage to aircraft.

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 downgrade the product's safety or performance characteristics.

Note - For the purposes of this AC, and to reduce confusion and ensure consistency in language and terminology, "FOD" will only refer to the phrase "foreign object debris."

Hazard - A condition, object or activity with the potential for causing damage, loss, or injury.

2 INTRODUCTION

2.1 General

(a) The presence of foreign object debris (FOD) on the movement area poses a significant hazard/threat to the safety of aircraft operations. FOD has the potential to damage aircraft during critical phases of flight, which can lead to catastrophic loss of life and airframe, and increased maintenance and operating costs. FOD hazards can be reduced through the implementation of an FOD management programme, which would normally include FOD prevention, detection, removal and evaluation.

(b) It is important that all personnel with access to the movement area understand their role in the prevention of FOD. FOD control should be a module of the initial training given to personnel with access to the movement area.

(c) It is also necessary to have an established process to regularly clear the movement area of FOD. Removing FOD is the responsibility of everyone. It may be controlled by ensuring that all personnel with movement area access, in particular inspection/maintenance personnel and ground handlers, are aware of situations which may potentially cause FOD.

2.2 Scope

The FOD program as described herein, should be composed of four main areas: prevention; detection; removal; and evaluation. Each of the four areas contains strategies and practices that can help reduce FOD at airports.

The guidance in this AC is particularly applicable to aerodrome owners and operators, air carrier station managers, and general aviation operators, who will then communicate to apron crews, maintenance technicians, and aircraft servicing personnel, the safety hazards posed by FOD.

2.3 FOD Fundamentals

FOD Hazards - FOD can severely injure airport or air carrier personnel or damage equipment. Types of potential damage include: cutting aircraft tires - being ingested into engines; or becoming lodged in mechanisms affecting flight operations. Personnel injuries or even death can occur when jet blast propels FOD through the airport environment at high velocities.

2.3.1 Sources of FOD

(a) FOD is derived from many sources and can be generated from personnel, aerodrome infrastructure (pavements, lights and signs), the environment (wildlife) and the equipment operating at the aerodrome (aircraft, aerodrome operations vehicles, maintenance equipment, fuelling trucks, other aircraft servicing equipment and construction equipment).

(b) FOD can accumulate both on and underneath ground support equipment (GSE) stored or staged on the apron. Jet blast can then blow these FODs onto the movement area or on an aircraft. The outboard engines of four-engine aircraft can move debris from the

runway edge and shoulder areas where it tends to accumulate, back towards the centre of the runway or taxiway.

(c) Helicopters that manoeuvre over freshly mowed or loose-dirt airside areas can also move FOD onto runways, taxiways and ramps. In addition, the high velocity outwash vortices from a helicopter, which may also send FOD to a distance of approximately three times the diameter of the rotor, can propel lightweight GSE or materials staged nearby.

(d) FOD is often more common when aerodromes begin construction activities. Meteorological conditions may also move FOD. For example, wind can blow dry debris, such as sand or plastic bags, from relatively non-critical areas onto the flight area. Rain water and drainage can stream mud, pebbles and other small items along the path of least resistance.

2.3.2 FOD Taxonomy

The exact nature of FOD is also varied. FOD can be composed of any material and can be of any color and size. Typical FOD includes the following:

(i) aircraft and engine fasteners (nuts, bolts, washers, safety wire, etc.);

(ii) aircraft parts (fuel caps, landing gear fragments, oil sticks, metal sheets, trapdoors, and tire fragments);

(iii) mechanics' tools;

(iv) catering supplies;

(v) flight line items (nails, personnel badges, pens, pencils, luggage tags, soda cans, etc.);

(vi) apron items (paper and plastic debris from catering and freight pallets, luggage parts, and debris from ramp equipment);

(vii) runway and taxiway materials (concrete and asphalt chunks, rubber joint materials, and paint chips);

(viii) construction debris (pieces of wood, stones, fasteners and miscellaneous metal objects);

(ix) plastic and/or polyethylene materials;

(x) natural materials (plant fragments and wildlife)

2.4 An Aerodrome FOD Management Program

2.4.1 Regulatory Requirements

(a) The SLCAR Part 14A (Aerodrome Design and Operations), Chapter 10.2.1 states, “The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas shall be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme with the objective of avoiding and eliminating any loose objects/debris that might cause damage to aircraft or impair the operation of aircraft systems.”

(b) Hence, the need for an airport operator to manage FOD at an aerodrome is essential as required in section 4.12 of the SLCAR Part 14C (Certification of Aerodromes).

2.4.2 Program Areas

(a) A successful FOD management program should typically contain four main areas, each containing significant elements, as outlined in figure 2-1 below:

(i) Prevention

(1) Awareness (existence of the FOD program and management support)

(2) Training and education (implementation of the FOD program)

(3) Maintenance

(ii) Detection

(1) Operations (manual inspections and use of detection equipment)

(2) Equipment

(iii)Removal

(1) Equipment

(2) Operations

(iv)Evaluation

(1) Data collection and analysis

(2) Continuous improvement (trending, feedback, incident investigation)

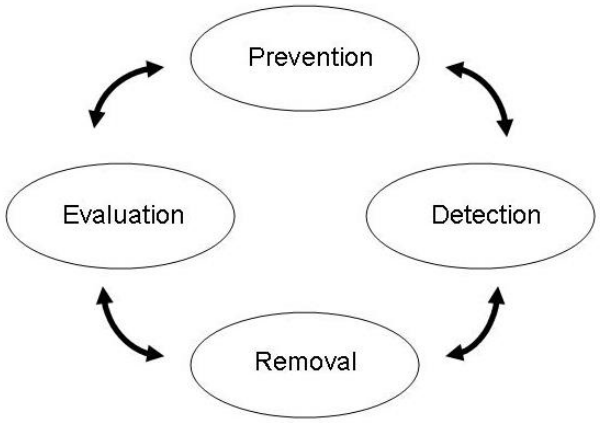

Figure 2-1: Relationship between the four main areas in a FOD program

3 OPERATIONAL PRACTICES

3.1 FOD Prevention

3.1.1 Awareness

(a) Aerodrome operators shall ensure that all personnel involved in aerodrome operations at the aerodrome are aware of the existence of the FOD control programme. Aerodrome personnel should be encouraged to identify potential FOD hazards, act to remove observed FOD, and propose solutions to mitigate related safety risks.

(b) Aerodrome operators should designate an individual to manage the aerodrome's FOD management programme and clearly define his/her responsibilities.

Note - *This designated individual can be a dedicated FOD manager or can have other duties (e.g. operations manager, safety manager).*

(c) The FOD management programme should be actively supported by the senior management of all organizations operating on the movement area.

(d) Aerodrome operators should consider establishing an FOD committee to assist in the management of the FOD programme, including the determination of potentially hazardous FOD situations and evaluation of collected FOD data. The committee may include stakeholders in a position to produce or remove FOD, such as ground handlers, aircraft operators, aerodrome operations, contractor representatives, etc. Further guidance is contained in section 4.1 of this AC.

Note - *the work of the FOD committee could be included in an already established safety-related committee (e.g. apron safety committee).*

3.1.2 Training and education

The primary objectives of the FOD training programme are; to increase employee awareness of the causes and effects of FOD damage and to promote active employee participation in eliminating FOD during the performance of daily work routines. Details on Training and Education is found in section 4.2 of this AC. A typical FOD training syllabus is included in Appendix 1 of this AC.

3.1.3 FOD prevention measures

Active prevention measures to reduce the generation of FOD, commensurate with the identified safety risks, should be detailed in the aerodrome's FOD management programme. Details of these measures are included in Chapter 4 of the AC.

3.2 FOD Detection

(a) Detecting FOD is an important activity at an aerodrome. This process involves not only the timely detection of any FOD, but also the identification of its potential source and location. Provisions on FOD detection processes, systems and equipment are included in Chapter 5 of this AC.

(b) Detection of FOD shall be included as part of the inspection regime.

Note - *See SLCAA-AC-AGA015 Rev01 - Aerodrome Inspection Programme, for the establishment of appropriate inspection procedures.*

(c) The inspection of an aircraft stand should be carried out prior to the arrival and departure of an aircraft, in order to detect and remove any FOD present. Aerodrome operators shall establish procedures for handling FOD matters in cooperation with the appropriate ATS unit.

(d) An aerodrome operator shall determine the most efficient way to notify all personnel involved in aerodrome operations at the aerodrome to remove the detected FOD, and notify the ATS unit to take appropriate action if a risk is identified.

(e) Although not all types of FOD will necessitate an immediate runway closure, a prompt decision is needed in all situations to assess the safety risk posed by FOD. Aerodrome operators should establish procedures for handling such matters in cooperation with the appropriate ATS unit.

(f) When using continuously operating FOD detection technologies on a runway, a decision on the appropriate action to be taken shall be made as soon as an object is detected. If the location or characteristics of the FOD does not present an immediate safety risk, the object should be removed as soon as the operational schedule permits. If the location or characteristics of the FOD presents an immediate safety risk, provisions in the FOD management programme shall clearly indicate that a hazard exists and allow for an action to be taken that may lead to the temporary suspension of runway operations.

3.3 FOD Removal

(a) Detected FOD should be removed as soon as practicable after detection.

Note - *Removal of FOD can be achieved through various means including manual or mechanical methods.*

(b) Provisions in the FOD management programme shall allow for an immediate removal of detected FOD which may pose an immediate safety risk to operations. The removal of FOD should be included in the tasks of all personnel operating on the aerodrome.

Note - Further information on FOD removal operations is contained in Chapter 6 of this AC.

3.4 FOD Evaluation

(a) All FOD identified and collected on the aerodrome should be recorded, analysed and evaluated. When appropriate, an investigation should be carried out to identify the source of the FOD. The sources of FOD, including its location and the activities generating FOD on the aerodrome, should be identified and recorded. This information should be analysed in order to identify trends and problem areas as well as to focus efforts of the FOD management programme.

(b) The FOD management programme should be periodically reviewed and updated based on the data and trends identified through the evaluation of FOD collected on the aerodrome. The FOD evaluation processes are included in Chapter 7 of this AC.

4 FOD PREVENTION

4.1 Awareness

4.1.1 Program Existence and Status.

A first step in implementing a successful FOD management program is making sure that applicable personnel are aware of the program's existence. An airport's FOD management system should be visible in all aspects of the airports operation. Improvements in FOD safety will occur most efficiently if all airport personnel are actively encouraged to identify potential FOD hazards, act to remove observed FOD, and propose solutions to mitigate those hazards. Some examples of organizational communication are:

(i) FOD seminars;

(ii) FOD letters, notices and bulletins;

(iii) FOD lessons-learned;

(iv) FOD bulletin boards, safety reporting drop boxes, and electronic reporting through web sites or email; and

(v) A method to exchange safety-related information with other airport operators.

(vi) Airport FOD program promotional materials, such as t-shirts, stickers, FOD disposal cans, and smaller give-away items.

(vii) FOD discussion at employee staff meetings.

4.1.2 FOD Policy and Management Support.

An effective FOD program must also have the full support of the operator's management. Management's commitment to FOD prevention should be formally expressed in a statement of the organization's FOD policy. The statement will serve to formally establish the FOD management program. Posting this policy statement in conspicuous locations will help reinforce the organization's commitment to FOD prevention and help remind employees of their FOD management duties. Some key elements of an airport's FOD policy are:

(i) An outline of the methods and processes that the organization will use to achieve desired safety outcomes.

(ii) The organization's policy concerning responsibility and accountability.

4.1.2.1 The FOD Program Manager.

(a) Airport operators should designate an accountable staff member to manage the aerodromes FOD programs and issues. This designated individual can be a dedicated FOD manager or can have other duties (e.g., operations manager, safety manager, etc.).

(b) The responsibilities of the FOD Manager should be clearly defined along the identified lines of communication within the organization. Additionally, the FOD manager should be allowed to report to the highest levels of management (e.g. accountable manager, chief executive officer (CEO), etc.) to assure appropriate consideration of all reports, recommendations, and issues.

(c) The FOD manager should regularly communicate the status of the FOD program to airport staff and ensure that lessons learned from hazardous occurrence investigations and case history or experiences, both internally and from other organizations, are distributed widely. An open line of communication should always be available between the FOD Manager and the airport/air carrier staff.

(d) An expanded discussion of the suggested duties and responsibilities of the FOD manager are provided in Appendix 2.

4.1.2.2 The FOD Committee.

(a) An FOD committee should be established at an aerodrome.

Note - The level of authority or power of the FOD committee will be different for each aerodrome, as it is set by the airport's executive management.

(b) The composition of the committee is under the airport's discretion, but typical committee members include those stakeholders with a direct relationship to FOD (such as those in a position to produce or remove FOD), including - tenant representatives, air carriers, airport operations, public safety staff, contractor representatives, etc. The FOD manager would typically chair the committee.

(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 hazardous FOD situations can be performed by the FOD committee, as well as performing an evaluation of collected FOD data.

4.1.3 Safety Culture

An effective FOD management program requires more than the implementation of rules and procedures to be followed. It requires the support of management to establish the attitude, decisions, and methods of operation at the policy-making level that demonstrate the organizations priority to safety. In an effective safety culture, there should be clear reporting lines, clearly defined duties and well understood procedures. Personnel should fully understand their responsibilities and know what to report, to whom and when. Though it is an intangible aspect of a safety program, proper personal attitudes and corporate commitment enable or facilitate the elimination of unsafe acts and conditions that are the precursors to accidents and incidents.

4.2 Training and Education.

4.2.1 Audience

Each individual with access to the AOA should understand their role in the prevention of FOD. These personnel include: airport operations; construction; aircraft maintenance and permanent/seasonal servicing staff (e.g. catering, fuel, cabin cleaning, baggage and cargo handling, waste disposal, etc.) and any other contractors. A formal orientation/indoctrination program familiarizing new employees with safety, security, communications, and vehicle operations should include FOD management training. This training can supplement the general FOD awareness training incorporated into the driver training curriculum (or training for apron walking privileges).

4.2.2 Features

The FOD manager provides current information and continual training relating to FOD issues relevant to the specific operations of the airport. The provision of appropriate training to all staff, regardless of their level in the organization, is an indication of management's commitment to an effective FOD management program. FOD training and education programs typically contain the following features:

(i) A documented process to identify training requirements;

(ii) A validation process that measures the effectiveness of training;

(iii) Recurrent training and education (to help maintain awareness);

(iv) Human (and organizational) factors.

4.2.3 Training Objectives

The primary objectives of the FOD training program will be to increase employee awareness of the causes and effects of FOD damage and to promote active employee participation in eliminating FOD during performance of daily work routines. The FOD manager should emphasize FOD management through employee motivational programs as well as by conducting training courses to emphasize FOD prevention through efficient design, product discipline, maintenance, and flight line activities. The following subject matter should be included as applicable, in the FOD manager's FOD prevention program:

(i) Overview of the FOD management program in place at the airport;

(ii) Safety of personnel and air carrier passengers;

(iii) Causes and principal contributing factors of FOD;

(iv) The consequences of ignoring FOD, and/or, the incentives of preventing FOD;

(v) Practicing clean-as-you-go work habits, and the general cleanliness and inspection standards of work areas (including the apron and AOA);

(vi) Proper care, use, and stowage of material and component or equipment items used around aircraft while in maintenance or on airport surfaces;

(vii) Control of debris in the performance of work assignments (e.g. loose items associated with luggage, ramp equipment, and construction materials);

(viii) Control over personal items and equipment;

(ix) Proper control/accountability and care of tools and hardware;

(x) Requirements and procedures for regular inspection and cleaning of aircraft and apron areas;

(xi) How to report FOD incidents or potential incidents;

(xii) Continual vigilance for potential sources of hazardous foreign objects;

(xiii) FOD Detection procedures, including the proper use of detection technologies (if applicable); and

(xiv) FOD Removal procedures.

4.2.4 Training Documentation

Training requirements and activities should be documented for each area of activity within the organization. To the extent possible, a training file should be developed for each employee including management, to assist in identifying and tracking employee training, training requirements, and verifying that the personnel have received the planned training. Any training program should be adapted to fit the needs and complexity of the airport in question.

4.3 Maintenance Programs

4.3.1 Aircraft Servicing

(a) Aircraft operators, ground handling agents and other aerodrome stakeholders generate much of the FOD found on the apron, service roads, baggage make-up areas, and areas near flight kitchens. Refueling, catering, cabin cleaning, and baggage/cargo handling can produce broken materials.

(b) These stakeholders should establish procedures to inspect GSE or other vehicles for signs of wear and tear that can lead to FOD hazards. Procedures to inspect the baggage loading and unloading areas every time an aircraft is serviced should be established. Baggage pieces, including bag tags and wheels, can break off luggage and either fall onto the apron or collect in the cargo door sill of the aircraft. They can then also be knocked out of the sills and onto the apron at the next stop/destination.

4.3.2 Aircraft Maintenance

(a) These activities, which may be performed on the apron, require a variety of small objects such as rivets, safety wire, bolts and nuts, washers etc. that become FOD when they are inadvertently left behind.

(b) All tools should be accounted for as a matter of practice. Aids in the control of these items include; checklists, shadow boards and cut-out tool tray liners. All items should be contained in a spill-proof tote bag, tray or toolbox.

4.3.3 Air Cargo

In an air cargo area, there is a high potential for blowing debris such as cargo strapping and plastic sheeting. Procedures to contain such debris, possibly by installing (and monitoring) fencing where appropriate may help to control the environment. Of course, FOD trapped by such fences should be removed regularly.

4.3.4 Construction

(a) Specific FOD prevention procedures should be established and employed for each construction project. These procedures should be based on the proximity of the construction activities to the operational areas, but in general should stress containment and regular clean-up of construction debris.

(b) Aerodrome preconstruction planning should include a means for controlling and containing FOD generated by the construction. This is especially true in high-wind environments where debris is more likely to become airborne.

(c) The designated routes of construction vehicles on the movement area should be planned, so as to avoid or minimize crossing in critical areas of aircraft operations. If high-risk crossings cannot be avoided, subsequent provisions such as an increased frequency of FOD inspections could be implemented.

(d) Contractors should fully understand and comply with the requirements and penalties incorporated in their contracts regarding the control and removal of FOD. To enforce these requirements, aerodrome operators may consider drafting FOD control guidance for all construction projects taking place within the movement area. Standard and project-specific FOD provisions could then be included into the contract documents for construction projects. These items may include:

(i) requiring contractors to cover all loads;

(ii) requiring contractors to secure any loose items that could easily blow away or control dust with the spraying of water;

(iii) ensuring the proper functioning of storm drains throughout the construction;

(iv) specifying whether any mechanical FOD removal devices will be required;

(v) specifying how monitoring for FOD hazards will be accomplished; and

(vi) requirements for inspecting and removing FOD from tires prior to traversing operational areas.

4.3.5 Aerodrome Maintenance Operations

(a) Mowing and other maintenance operations routinely disturb the vegetation and soil in areas adjacent to those travelled by aircraft. Procedures to remove this debris, such as the use of an assigned aerodrome sweeper or personnel on foot using shovels to repair vegetation and soil, should be implemented.

(b) Aerodrome lighting, pavement, and marking maintenance operations may generate concrete/asphalt debris as well as increase the potential for dropped repair parts, tools, and other items stored on the maintenance vehicles. Corrective procedures may include the use of aerodrome sweepers and the inspection of the worksite after maintenance is completed.

(c) The areas listed below are typically prone to generating FOD.

4.3.5.1 Pavements

(a) Deteriorating pavement can exhibit spalling or cracks. For example, pieces of concrete can break loose from pavements or FOD can develop from fatigued corner cracks.

(b) The service roads which cross taxiways may generate FOD from the vehicles using them, especially in the case of construction operations.

(c) Special attention should be paid to the cleaning of cracks and pavement joints, as tests have shown they are the main sources of foreign object ingestion.

(d) Asphalt and concrete pavements may be the most common source of FOD on an aerodrome, and therefore, effective pavement maintenance practices are important for the prevention of FOD.

4.3.5.2 Other aerodrome surfaces

(a) Movement area grass and ditches may collect and hold large amounts of light debris such as paper, cardboard, plastic and various containers that can originate from aprons, cargo ramps and hangar ramps. This debris can blow back into areas used by aircraft, unless collected in a timely manner.

(b) Unpaved areas adjacent to pavements may require stabilization, as appropriate, to prevent FOD from jet wash.

(c) FOD fences may collect debris on windy days. This FOD should be collected before the wind increases or changes direction and the debris blows back on to areas used by aircraft.

5 FOD DETECTION

5.1 General

While proper FOD awareness is fundamental for any successful FOD program, the act of detecting FOD is one of the critical FOD operations that occurs at an airport. This process involves not only the identification of potential FOD causes and locations, but also the timely detection of any FOD on airport surfaces. Whether detection occurs manually, through regular inspections, as a result of pilot reports, or through the use of advanced detection technologies, the outcome is equally important.

5.2 Runway Closures.

A highly sensitive question involved in the use of continuously operating FOD detection technologies arises once an object is detected. If the location or characteristics of the FOD present no immediate safety hazard the object should be removed as soon as the operational schedule permits. If the location or characteristics of the FOD present an immediate safety hazard, provisions in the FOD management program should clearly indicate that a hazard exists and allow for an airport supervisor to take action and temporarily cease operations and, in the case of aircraft or airport equipment source of the FOD, notify the equipment operator. This is an appropriate issue, for example, for an airport's FOD committee to study and provide further guidance to airport management and operations staff.

5.3 FOD Detection Operations

5.3.1 Inspection Areas

While detailed inspection guidance is provided in SLCAA-AC-AGA015 Rev01 - Aerodrome Inspection Programme, additional information can be helpful for airport personnel conducting FOD inspections. Sections 5.3.1.1 to 5.3.1.7 below are areas and operations that are typically prone to having FOD.

5.3.1.1 Movement Areas (runways and taxiways).

(a) The portion of the runway used by aircraft for take-off is where departing aircraft are most susceptible to FOD damage.

(b) Deteriorating or neglected pavement can exhibit spalling or cracks. For example, pieces of concrete can break loose from pavements or FOD can develop from fatigue corner cracks and airfield markings. FOD associated with building materials, debris falling from construction vehicles or blown from the airport apron onto aircraft maneuvering areas. Broken pieces of pavement can collect at the edge of the airport apron and be carried onto the aircraft maneuvering area by the tires of vehicular GSE.

(c) Service roads that cross taxiways should be monitored closely to prevent the vehicles using these roads from moving FOD onto the taxiways (especially in the case of construction operations, as addressed in the airport's Safety During Construction Plan).

(d) Shoulders. Unpaved areas adjacent to pavement should be stabilized to prevent FOD.

(e) Pavement Joints. Special attention should be paid to the cleaning of cracks and pavement joints as tests have shown that these are the main sources of foreign objects which are ingested.

(f) Turf Areas. Turf grass and ditches collect and hold large amounts of light debris such as paper, cardboard, plastic, and various containers that trash often originate in terminal aprons, cargo ramps, and hangar ramps. This trash can blow back into areas travelled by aircraft unless collected in a timely manner.

(g) Fence-lines. Fences can collect trash on windy days. This FOD should be collected before the wind increases or shifts direction and the trash blows back on to areas travelled by aircraft.

5.3.1.2 Airport Apron

Anywhere on the aircraft apron where ground vehicles operate.

5.3.1.3 Aircraft Servicing Operations.

(a) Refueling, catering, cabin cleaning, and baggage and cargo handling can produce broken materials.

(b) Baggage pieces, including bag tags and wheels, can break off luggage and either fall onto the apron or collect in the door sill. Items collected in the door sill can damage the door or prevent it from properly closing. They can also be knocked out of the sills and onto the apron at the next station.

(c) Other areas where FOD is likely to collect include the ground at both ends of the conveyor, and the area between the baggage cart and the conveyor belt.

5.3.1.4 Air Cargo Operations.

(a) High potential for blowing debris such as plastic cargo wrappers.

(b) Fencing used to contain debris should be cleaned regularly.

5.3.1.5 Construction Operations.

(a) The proximity of construction activities to operational areas presents a risk of debris.

(b) Regular and thorough cleaning of the construction site, including the construction haul routes, is expected. Particular attention should be paid to construction vehicle routes that cross or are adjacent to active pavements.

5.3.1.6 Aircraft Maintenance Activities.

(a) These activities, which may be performed on the apron, require a variety of small objects, such as rivets, safety wire, and bolts that become FOD when they are inadvertently left behind.

(b) All tools should be accounted for as a matter of practice. Aids in the control of these items include checklists, shadow boards, and cut out tool tray liners.

5.3.1.7 Other activities

All vehicles should be driven on clean, paved surfaces when possible. If a vehicle must be driven on unpaved surfaces, the operator should check the vehicle tires for foreign objects immediately after returning to the pavement.

5.3.2 Methods and Techniques.

Operational areas must be inspected at least once each day, with additional inspections being made in construction areas and immediately after any aircraft or ground vehicle accident or incident or any spill of material which may cause slippery conditions. In addition to performing these inspections at the beginning of the day or shift, personnel in the AOA should practice a clean-as-you-go technique of looking for FOD during their normal shifts in the course of their regular duties. Inspections occurring at night, taking place after the runway is closed or before the runway is opened, should also occur frequently. During night time inspections, personnel and vehicles should be equipped with additional lights/lighting systems to better detect FOD.

5.4 Methods and Techniques of FOD Detection

5.4.1 Manual detection

(a) When conducting an inspection on a runway, inspection techniques will be determined by runway availability and type of operation. Ongoing construction requires more frequent inspections. It may even be necessary to assign dedicated personnel to continually inspect for FOD during major construction activities. As part of the FOD management programme, the FOD manager may find it appropriate to involve aircraft operators. For example, flight crews should report any FOD they observe on runways and taxiways to the ATS unit and station operations. Aircraft operators and ground handling agents may also be asked to designate individuals to inspect apron areas prior to aircraft movement to and from the gate.

(b) A runway inspection will involve passage along the length of the runway to observe and remove FOD. The most effective method involves two or more passages to reduce the width of the inspection zone. When there is time to do only one pass on the runway, inspection personnel, whenever practical, should drive in the opposite direction that aircraft are landing on the runway with high intensity flashing beacon and headlights on at all times. This practice will enable self-inspection personnel to see approaching aircraft and improve visibility of the vehicle to pilots. Inspection personnel should also drive the stub taxiways between the runway and parallel taxiway because these areas are commonly overlooked.

(c) Encouraging the participation of the aerodrome's stakeholders in inspections will reinforce the concept that FOD control is a team effort and demonstrates the aerodrome operator's commitment to a debris-free environment. Aircraft operator personnel, when feasible, may join the aerodrome staff in movement area inspections. This practice helps increase familiarity with local aerodrome conditions, and promotes effective communication between the aerodrome and aircraft operators.

(i) An effective and clever operations is the promotion of all-hands "FOD walks." These walks should be conducted as part of an airport's FOD management

campaign. Walks involve the coordination and invitation of airport and air carrier staff (e.g. ground handling agents, air carriers, Aircraft Rescue and Fire Fighting (ARFF) and apron personnel), external partners, and other community volunteers to participate in manually collecting airport FOD.

(d) Periodic FOD inspections on foot should be carried out to increase the effectiveness of detection, and to inspect areas inaccessible by vehicle (such as grass areas).

5.4.2 Detection technologies

(a) Recent technological developments have expanded the capabilities of FOD detection through automation. Advanced technologies are now available for automated FOD detection, including capabilities for continuous monitoring on runways and other aircraft movement areas to supplement the capabilities of aerodrome personnel.

(b) If an aerodrome chooses to implement these new FOD detection technologies, responsibilities and procedures should be established with the ATS unit to ensure that appropriate and timely action is taken if FOD is detected. They should ensure that the personnel monitoring these systems either have the authority (or the ability to quickly contact those in authority) to take appropriate and timely action if FOD is detected.

(c) The aerodrome operator should have considerable flexibility in terms of how to implement continuous detection systems at the aerodrome. The user interface may be located in the aerodrome's operation or maintenance centre, and/or in the ATC tower. Regardless of the configuration, an airport will determine the most efficient way to notify airport/air carrier personnel to remove the detected FOD, as well as the ATC staff to divert aircraft if a significant risk is presented.

(d) Dead wildlife is more appropriately handled as a component of a FOD management program, while live wildlife is a component of a wildlife hazard management program. An overlap of these two programs therefore occurs whenever wildlife is struck by aircraft and/or their remains serve as an attractant to other wildlife. In addition, elements of certain wildlife programs can create FOD, e.g. the introduction of cracker shell casings. Certified/Licensed Aerodromes that have a Wildlife Hazard Assessment Plan may therefore need to review their plan as it relates to the aerodrome FOD program.

5.4.3 Manual Detection

(a) When conducting an inspection on a runway, inspection techniques will be determined by runway availability and type of operations. Ongoing construction requires more frequent inspections. It may be necessary to assign dedicated personnel to continually inspect for FOD during major construction activities. As part of the FOD management program, the FOD manager may find it appropriate to reach out to air carriers and flight crews to leverage the airport's current FOD management efforts. For example, flight crews could be asked to report to ATC and station operations any FOD they observe on runways and taxiways. Air carrier and aircraft handling agents may also be asked to designate individuals to inspect apron areas prior to aircraft movement to and from the gate.

(b) A runway inspection will involve passage along the length of the runway to observe and remove FOD. The most effective method involves two or more passages to reduce the width of the inspection zone. When there is time to do only one pass on the runway, inspection personnel, whenever practical, should drive in the opposite direction that aircraft are landing on the runway with high intensity flashing beacon and headlights on at all times. This practice will enable self-inspection personnel to see approaching aircraft and improve visibility of the vehicle to pilots. Inspection personnel should also drive the stub taxiways between the runway and parallel taxiway because these areas are commonly overlooked.

(c) Encouraging the participation of airport tenants in inspections will reinforce the concept that FOD prevention is a team effort and demonstrate the airport operator's commitment to a debris-free environment. As such, air carrier personnel, when feasible, should join the airport staff in daily movement area inspections. This practice helps increase familiarity with local airfield conditions, and promotes effective communication between the airport and air carriers. The placement of convenient and conspicuous FOD containers is a helpful reminder of the need to be vigilant in preventing the occurrence of FOD.

(d) An effective and clever operation currently in place at airports worldwide is the promotion of all-hands “FOD walks”. These walks are typically conducted as part of an airport’s FOD management campaign. Walks involve the coordination and invitation of airport and air carrier staff (e.g. ground handling agents, air carriers, Aircraft Rescue and Fire Fighting (ARFF) and apron personnel), external partners, and other community volunteers to participate in manually collecting airport FOD. These events can be promoted with offering food and water to participants, and various prizes (i.e. airport clothing) to those who collect the most FOD.

6 FOD REMOVAL

6.1 Background

Once FOD is detected, the next step is removing it from the aerodrome environment. For the removal of an isolated item on a runway, the manual approach may be the most efficient. The use of FOD removal equipment may be beneficial however, especially in areas where a greater concentration of FOD may be expected, such as cargo areas and near construction sites.

6.2 FOD Removal Equipment

The types of FOD removal equipment available may be divided into two categories: mechanical and non-mechanical. The equipment varies in size from small push units to large systems that are truck-mounted. FOD containers are also important for the management of FOD. This AC does not limit the equipment that an airport operator may use for FOD removal.

6.2.1 Mechanical systems

These technologies use powered devices in mechanical systems that remove or retrieve FOD items and contain retrieved FOD for proper disposition. Equipment in this category varies in size, and is found in sizes from small push units to large area systems that are truck mounted. Types of mechanical removal systems include:

(a) ***Power sweepers***: Sweeper removes debris from cracks and pavement joints and is typically used throughout the movement area.

Note - *For all brush systems, operators are cautioned that bristles can detach from brooms and produce FOD. Brushes made with metal bristles or spines are not recommended to be used for FOD removal purposes. Plastic or a combination of plastic/metal bristles may be appropriate, but the user should consult the equipment manufacturer for specific recommendations. Regardless of the equipment used, a thorough check of the pavement should be conducted at the conclusion of the sweeping procedure*

(b) ***Vacuum systems:*** These systems perform FOD removal functions in a manner similar to the power sweepers described above. The systems may also perform in conjunction with mechanical brooms or other recirculation air units.

(c) ***Jet air blowers:*** These systems move FOD and other debris by directing a stream of high velocity air towards the pavement surface. When used in the aerodrome environment, it is recommended that these systems incorporate a debris collection mechanism so that FOD will not simply be relocated to another area.

6.2.2 Non mechanical systems

(a) ***Friction mat sweepers*****.** A rectangular assembly towed behind a vehicle that employs a series of bristle brushes and friction to sweep FOD into sets of capture scoops, which are covered by a retaining mesh to hold collected debris.

(b) ***Magnetic bars (attached to vehicles)*.** These bars can be suspended beneath tugs and trucks to pick up metallic material. However, the bars should be cleaned regularly to prevent them from dropping the collected debris. Magnetic bars are not able to pick up the following types of common FOD materials: titanium, aluminum alloys and certain stainless steel elements and plastic.

(c) A best practice for removing FOD from tires is to stop a vehicle at a designated checkpoint, perform visual inspection, and then use a hand tool to manually remove detected debris.

6.2.3 FOD Storage System (FOD containers)

(a) Designated FOD containers should be conspicuously placed on the apron for the storage of debris. The containers should be well marked, properly secured, and frequently emptied to prevent them from overflowing and becoming a source of FOD themselves. In addition, airport personnel can wear waist pouches to collect debris.

(b) "Closed-type" containers are preferable in order to prevent the wind from dislodging the container's contents. Aerodrome operators should ensure that FOD containers do not blow over during periods of high winds. This can be accomplished by using heavy trash cans or securing the containers to the ground with a tether or a weight. FOD containers should also have placards stating that hazardous materials may not be deposited in them, as appropriate.

(c) **Locations**. Suggested locations for FOD containers include: near all entry points to the apron area, in hangars, aircraft maintenance areas, aircraft stands and baggage areas. Clearly identified storage locations increase the likelihood that collected debris will be deposited by personnel.

(d) Other means for containing FOD include: FOD fencing/wind barriers or netting to restrict movement of airborne FOD; fencing to prevent animals from entering the aerodrome.

(e) Evaluating the debris collected in containers and pouches can reveal its sources and indicate where personnel and equipment should be deployed for more effective control. Chapter seven (7) of this AC will provide more information on this practice.

6.3 Removal Operations

(a) While the exact actions of FOD removal operations are specific to each aerodrome, the following two examples represent the successful implementation of FOD removal:

(i) assigning an airside sweeper(s) to work with maintenance crews and/or respond as required to reports of FOD;

(ii) deploying personnel with garbage bags and litter sticks to pick up potential FOD in grassy areas and along fence-lines. This process is intended to pick up debris before it returns to the pavement ar,eas.

(b) The equipment described above may be used singularly or in combination. In either case, FOD managers are cautioned that personnel using particular FOD removal equipment may become complacent and completely rely on the equipment to remove

all pieces of FOD in their area of operation. Personnel must be constantly aware of the performance of their equipment, and should regularly check to make sure visually detected FOD is in fact collected by their equipment during FOD removal operations.

7 FOD EVALUATION

7.1 Data Collection and Analysis

(a) **Documentation.** The FOD manager will ultimately determine the documentation guidelines in a FOD management program. Certain small items, such as plastic wrappers or baggage tags, may simply warrant efficient collection and disposal. A consistent trend of small items, such as those coming from a particular entity or operation, or particularly large or hazardous FOD, may require detailed documentation for effective analysis and prevention efforts. It is recommended that airport personnel collect the following information, to the extent practicable, whenever FOD is collected:

(i) How the FOD object was detected

(ii) Date and time of FOD detection and retrieval

(iii) Description of FOD retrieved (category, size, color), and/or image (if available)

(iv) Location of FOD object

(v) Possible source

(vi) Name of personnel detecting / investigating FOD item

(vii) Airport operations and weather data during the FOD detection event

7.2 FOD Reporting

(a) FOD may be composed of any material. To record the location of the FODs, a suitable map of the aerodrome should be used. It is important to correctly describe the FOD, to allow for the proper identification of the source areas as well as the appropriate mitigation measures to be taken. FOD may include the following:

(i) aircraft and engine fasteners (nuts, bolts, washers, safety wire, etc.);

(ii) aircraft parts (fuel caps, landing gear fragments, oil sticks, metal sheets, trapdoors and tire fragments);

(iii) mechanics' tools;

(iv) catering supplies;

(v) personal items (personnel badges, pens, pencils, luggage tags, drink cans, etc.);

(vi) apron items (paper and plastic debris from catering and freight pallets, luggage parts, and debris from ramp equipment);

(vii) runway and taxiway materials (concrete and asphalt chunks, rubber joint materials and paint chips);

(viii) construction debris (pieces of wood, stones, fasteners and miscellaneous metal objects);

(ix) plastic and/or polyethylene materials; and

(x) natural materials (plant fragments, inanimate wildlife)

(b) Depending on the volume or significance of collected FOD, the FOD manager may decide that it is necessary to designate and train certain personnel to collect, tag, store, and report on the collected FOD for future data analysis efforts. An additional communication procedure may also need to be established, so that the person who first collects the FOD will notify the person responsible for reporting the FOD. In any case, a well-defined reporting procedure is an important aspect of any FOD management program.

(c) The FOD management program should include a visible FOD reporting system supported by management. The reporting system should permit feedback from personnel regarding FOD hazards and other safety-related concerns. The FOD management system should use this information to identify and address operational or administrative deficiencies.

(d) Depending on the potential hazard of FOD collected, a reoccurrence of FOD from the same source, and the personnel available at an airport, the FOD management program may contain provisions to notify the FOD source of an FOD occurrence. Notifying the source of FOD helps to correct the underlying safety deficiencies that caused multiple FOD events.

7.3 FOD Investigation

It is recommended that major FOD incidents (as determined or classified by the airport operator) are investigated by the FOD manager or other appropriate airport personnel. An investigation should try to determine the source of FOD and damage caused. When the investigation is completed and necessary corrective action has been implemented in accordance with the FOD management plan, final disposition of the incident should be entered into the airport's FOD reporting system.

7.4 FOD Database

(a) It is important that the organization maintains a record of the measures taken to fulfil the objectives of the FOD control programme. These records may be required in the event of a formal investigation of an accident or serious incident, and may also be used to identify any trends, repeats, unusual conditions, etc., in order for corrective action to be initiated.

(b) Records may also provide quantitative data for future safety risk assessments to support the analysis of operational history and improve operational capabilities.

7.5 Continuous Program Improvement

(a) The FOD control programme should be periodically analysed and reviewed to ensure its effectiveness.

(b) This review provides a means for systematically assessing how well the organization is meeting its FOD management objectives. The evaluation provides a review of the existing effectiveness of the programme and, if required, results in recommendations for enhanced FOD control. Management may choose to have an external organization evaluate the system (e.g., by a consultant or another airport

operator), or choose to perform the evaluation using airport/air carrier staff). In addition to supporting the aerodrome operator's existing responsibilities for self-inspection and correction of discrepancies, an effective aerodrome FOD management programme review should:

(i) systematically review the effectiveness of existing FOD control procedures used by aerodrome and aircraft operator personnel, including all available feedback from daily inspections, assessments, reports and other safety audits;

(ii) verify that the aerodrome is meeting identified performance indicators and targets;

(iii) communicate all findings to staff and lead to implementation of agreed-upon corrective procedures, mitigation strategies and enhanced training programmes; and

(iv) promote safety in the overall operation of the aerodrome by improving coordination between aerodrome staff, aircraft operator personnel and other aerodrome stakeholders.

APPENDIX 1 - FOD TRAINING

The following subjects should be included in the FOD training programme:

(i) safety of aircraft, personnel and passengers as they relate to FOD;

(ii) overview of the FOD control programme in place at the aerodrome;

(iii) causes and principal contributing factors of FOD;

(iv) the consequences of ignoring FOD, and/or the incentives for preventing FOD;

(v) practicing clean-as-you-go work habits and the general cleanliness and inspection standards of work areas;

(vi) FOD detection procedures, including the proper use of detection technologies (if applicable);

(vii) requirements and procedures for the regular inspection and cleaning of movement areas;

(viii) FOD removal procedures;

(ix) proper care, use, and stowage of material and component or equipment items used around aircraft while in

(x) maintenance or on aerodrome surfaces;

(xi) control of debris in the performance of work assignments (e.g. loose items associated with luggage, ramp

(xii) equipment and construction materials);

(xiii) control over personal items and equipment;

(xiv) proper control/accountability and care of tools and hardware;

(xv) how to report FOD incidents or potential incidents; and

(xvi) continual vigilance for potential sources of FOD.

APPENDIX 2 - SUGGESTED DUTIES AND RESPONSIBILITIES OF THE FOD MANAGER

1. GENERAL

Where appropriate, the aerodrome operator should designate a FOD Manager(s) that will develop and implement plans and programs to prevent, detect, and remove FOD on an airport. The FOD Program Manager may be a dedicated position, but will more likely than not, be an additional role assigned to someone currently serving in the airport operations staff. The FOD Manager(s) should be appointed by an Airport executive, or executive of the commercial business operating at the airport, and should have sufficient authority and organizational freedom to identify and implement FOD preventive measures whenever and wherever required.

The information presented in this section represents only one of many potential approaches to designating the duties and responsibilities of a FOD Manager. Airports should select/modify any items that would be most appropriate for their situation when developing their FOD program.

2. THE FOD MANAGER

The FOD Manager Should;

(a) Review and assess the airport's FOD management program and make necessary revisions.

(b) Conduct scheduled and unscheduled evaluations/inspections of work areas to assess the effectiveness of the FOD management program.

(c) Assure implementation of corrective actions for FOD prevention.

(d) Assure that FOD incidents are thoroughly investigated and that incident reports are accomplished.

(e) Assure that causes of FOD incidents are thoroughly analyzed to identify corrective measures.

(f) Notify affected contractor/tenant organizations and personnel of unique FOD prevention requirements.

(g) Develop techniques and assign responsibilities for publication of special FOD prevention instructions.

(h) Review results of the FOD incident investigations and evaluate the adequacy of corrective actions.

(i) Evaluate the amount and kind of foreign objects found and how they were found (e.g. during daily inspections, by pilots, airport operations staff, etc.).

(j) Review and approve FOD prevention training curricula, designate training personnel, and assure that airport/contractor/tenant personnel receive required training.

(k) Assure that written procedures provide for adequate records attesting to the current status and adequacy of the FOD management program.

(l) Manage any additional program activities, including the scheduling of the FOD committee meetings, as required.