NAMIBIA CIVIL AVIATION AUTHORITY

Advisory Pamphlet (AP)

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FOREIGN OBJECT DEBRIS (FOD) CONTROL

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1. INTRODUCTION

1.1. Introduction

NAMCARs, Part 139 requires an aerodrome operator to establish the Foreign Object Debris (FOD) control procedure to reduce the FOD hazards for the safety of aircraft operations at the aerodrome. The establishment of an FOD control procedure should enable the aerodrome operator to prevent, detect, remove, and evaluate FOD. A successfully implemented FOD control procedure will ensure that processes are in place for personnel with access to the movement area to possess the necessary competencies in FOD control and the necessary equipment are available for the removal, containment and disposal of FOD from the movement area. Within the FOD control procedure, data and information about FOD shall be collected and analysed regularly to identify sources and trends.

1.2. Purpose

This Advisory Pamphlet (AP) provides guidance to Aerodrome Operators on the Foreign Object Debris (FOD) control procedure to meet the requirements of the NAMCARs, Part 139 and the associated Technical Standards.

1.3. Applicability

This advisory pamphlet is applicable to all aerodrome operators.

1.4. Description of Amendments

There are no amendments.

2. REQUIREMENTS AND REFERENCES

2.1. Regulatory reference

- NAMCARs, PART 139.08.15,1(a) and NAMCARs, PART 139.17.3

2.2. Reference documents

- Namibia Civil Aviation Regulations (NAMCARs) 2018

3. OPERATIONAL PRACTICES

3.1 FOD Prevention

3.1.1. Awareness

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

Aerodrome operators should designate an individual to manage the aerodrome's FOD control procedure and clearly define his/her responsibilities.

In addition, the FOD control programme should be actively supported by the senior management of all organizations operating on the movement area. Aerodromes operators should consider establishing an FOD committee to assist in the management of the FOD control 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 and contractor representatives.

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.

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

a) safety of aircraft, personnel and passengers as they relate to FOD;
b) overview of the FOD control programme in place at the aerodrome;
c) causes and principal contributing factors of FOD;
d) the consequences of ignoring FOD, and/or the incentives for preventing FOD;
e) practicing clean-as-you-go work habits and the general cleanliness and inspection standards of work areas;
f) FOD detection procedures, including the proper use of detection technologies (if applicable);
g) requirements and procedures for the regular inspection and cleaning of movement areas;
h) FOD removal procedures;
i) proper care, use, and stowage of material and component or equipment items used around aircraft while in maintenance or on aerodrome surfaces;
j) control of debris in the performance of work assignments (e.g. loose items associated with luggage, ramp equipment and construction materials);
k) control over personal items and equipment;
l) proper control/accountability and care of tools and hardware;
m) how to report FOD incidents or potential incidents; and
n) continual vigilance for potential sources of FOD.

3.1.3. FOD prevention measures

The active prevention measures to reduce the generation of FOD, commensurate with the identified safety risks, should be detailed in an aerodrome's FOD control programme.

The following are the FOD preventative measures to be considered:

1. Sources of FOD

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

FOD can accumulate both on and underneath Ground Support Equipment (GSE) stored on the apron. Jet blast can then blow FOD onto the movement area or on an aircraft. The outboard engines of aircraft can move debris from the runway edge and shoulder areas, where it tends to accumulate, back toward the centre of the runway or taxiway.

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.

FOD is often more common when aerodromes begin construction activities, but it may also be prevalent in winter conditions as ageing pavement infrastructure may be influenced by weathering (freeze and thaw cycles) and begin to crack or break apart.

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. Rainwater and drainage can stream mud, pebbles, and other small items along the path of least resistance.

The activities listed below may become sources of FOD on an aerodrome. For each activity, mitigation measures are identified.

2. Aircraft Servicing

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.

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.

3. Aircraft Maintenance

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.

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. 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.

5. Construction

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.

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.

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.

The Aerodrome operator should ensure that contractors fully understand and will comply to the requirements, the procedures should include measure to ensure that contractors comply. 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:

a) requiring contractors to cover all loads;
b) requiring contractors to secure any loose items that could easily blow away or control dust with the spraying of water;
c) ensuring the proper functioning of storm drains throughout the construction;
d) specifying whether any mechanical FOD removal devices will be required;
e) specifying how monitoring for FOD hazards will be accomplished; and
f) requirements for inspecting and removing FOD from tires prior to traversing operational areas.

6. Aerodrome Maintenance Operations

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.

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.

The areas listed below are typically prone to generating FOD.

- **Pavements**

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.

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

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.

- **Other aerodrome surfaces**

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.

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

3.2 FOD Detection

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.

Detection of FOD shall be included as part of the inspection procedure. 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. 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 take appropriate action if a risk is identified.

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.

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.

Below are the provisions on FOD detection processes, systems and equipment.

3.2.1. FOD Detection Operations

While operational areas are inspected as described in other parts of the regulations, additional inspections shall be carried out in construction areas and immediately after any aircraft or ground vehicle accident or incident, as well as following any type of material spill, to ensure that all FOD has been detected and removed.

In addition to the typical inspections, personnel on the movement area should employ a clean-as-you-go technique, by looking for FOD during the course of their regular duties. When inspections occur at night, after the runway is closed or before the runway is opened, additional lights/lighting systems on vehicles are beneficial to better detect FOD.

Vehicles should only be driven on clean, paved surfaces, when possible. If a vehicle must be driven on unpaved surfaces, the driver has a responsibility to ensure the vehicle's tires do not transport FOD (e.g. mud or loose stones) back onto the pavement.

3.2.2. Methods and Techniques of FOD Detection

- **Manual detection**

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 control programme, the FOD officer may find it appropriate to involve aircraft operators. For example, flight crews should report any FOD they observe on runways and taxiways of the aerodrome. 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.

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. 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).

- **Detection technologies**

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. If an aerodrome chooses to implement these new FOD detection technologies, responsibilities and procedures should be established ensure that appropriate and timely action is taken if FOD is detected.

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 air traffic control (ATC) tower.

3.3 FOD Removal

Detected FOD should be removed as soon as practicable after detection. 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.

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.

3.3.1. FOD Removal Equipment

The FOD removal equipment currently 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.

- **Mechanical systems**

Power sweepers: The sweeper removes debris from cracks and pavement joints and is typically used throughout the movement area.

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

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.

- **Non mechanical systems**

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.

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, aluminium alloys and certain stainless steel elements.

- **FOD containers**

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.

"Closed-type" containers are preferable 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. FOD containers should also have posters stating that hazardous materials may not be deposited in them, as appropriate.

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.

Other means for containing FOD include: FOD fencing or netting to restrict movement of airborne FOD; fencing to prevent animals from entering the aerodrome.

3.3.2. Removal Operations

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

a) assigning an airside sweeper(s) to work with maintenance crews and/or respond as required to reports of FOD;
b) deploying personnel with garbage bags 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 areas.

3.4 FOD Evaluation

All FOD identified and collected on the aerodrome should be recorded, analysed and evaluated in line with the aerodrome operator's Safety Management System (SMS), and/or Quality Assurance System (QAS) where applicable. 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 to identify trends and problem areas as well as to focus efforts of the FOD control programme. The FOD control programme should be periodically reviewed and updated based on the data and trends identified through the evaluation of FOD collected on the aerodrome.

FOD removal operations should comply with the following FOD Detection, Removal and Evaluation provisions:

3.4.1. FOD reporting

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:

a) aircraft and engine fasteners (nuts, bolts, washers, safety wire, etc.);
b) aircraft parts (fuel caps, landing gear fragments, oil sticks, metal sheets, trapdoors and tire fragments);
c) mechanics' tools;
d) catering supplies;
e) personal items (personnel badges, pens, pencils, luggage tags, drink cans, etc.);
f) apron items (paper and plastic debris from catering and freight pallets, luggage parts, and debris from ramp equipment);
g) runway and taxiway materials (concrete and asphalt chunks, rubber joint materials and paint chips);
h) construction debris (pieces of wood, stones, fasteners and miscellaneous metal objects);
i) plastic and/or polyethylene materials;
j) natural materials (plant fragments, inanimate wildlife and volcanic ash); and

k) contaminants from weather conditions (snow, ice).

3.4.2. FOD Recording

It is important that the organization maintain a record of the measures taken to fulfil the objectives of the FOD control procedure. 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.

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

3.4.3. Continuous Improvement

As part of SMS and QAS, the FOD control procedure should be periodically analysed and reviewed to ensure its effectiveness.

This review provides a means for systematically assessing how well the organization is meeting its FOD control objectives. The evaluation provides a review of the existing effectiveness of the programme and, if required, results in recommendations for enhanced FOD control. In addition to supporting the aerodrome operator's existing responsibilities for self-inspection and correction of discrepancies, an effective FOD control programme review should:

a) 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;
b) verify that the aerodrome is meeting identified performance indicators and targets;
c) communicate all findings to staff and lead to implementation of agreed-upon corrective procedures, mitigation strategies and enhanced training programme; and
d) promote safety in the overall operation of the aerodrome by improving coordination between aerodrome staff, aircraft operator personnel and other aerodrome stakeholders.