

FED. SUPPLY CLASS

FOREIGN OBJECT DAMAGE (FOD)

PREVENTION GUIDANCE DOCUMENT

STANDARD PRACTICE



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1. INTRODUCTION

This National Aerospace Standard (NAS) has been written with one overriding goal in mind, "To provide the reader with clear and precise, practical information on Foreign Objects (FO) and Foreign Object Debris (FOD) detection and elimination to help create a climate of Foreign Object Damage (FOD) Prevention."

AS9146 is the national standard which contains FOD Prevention Program requirements for Aviation, Space, and Defense organizations. NAS412 is a performance-based guidance document. The end state, safe FOD free aerospace vehicles, is the important thing. The "How's" in this document should be viewed as guidance, benchmark solutions, and recommendations, and not as requirements. The only requirement is to seek a FOD Prevention culture to the maximum extent possible. NAS412 provides guidance on key aspects of a proven successful FOD Prevention Program. Some of the guidance in this document will not be applicable to all programs. What is applicable to a particular FOD Prevention Program depends on the risks to that product and how those risks are mitigated. A FOD Prevention culture will follow the creation and implementation of an effective FOD Prevention program. And, while written for aerospace, the information has application in many fields, like the shipbuilding, automotive, and food industries.

If you are a novice to FOD Prevention, this document will provide the guidance you will need to help create a successful program. If you are an experienced FOD Prevention professional this document will provide you with information on advanced FOD Prevention methods.

1.1 Scope

This guidance document suggests general practices and establishes standard terms for the prevention of Foreign Object Damage (FOD) to aerospace products and operating environments. Aerospace products include aircraft, missiles, launch vehicles, unmanned aerospace systems, satellites, engines, manufactured parts associated with aerospace products, etc. Operating environments include fabrication, manufacturing, assembly, test, hangars, ramp, airport operations, launch, flight, etc.

1.2 Purpose

This document provides guidance for the prevention of Foreign Object Damage (FOD) to aerospace products being designed, developed, manufactured, assembled, operated, repaired, modified, refurbished and maintained. This document is designed to reduce the risk from Foreign Objects (FO) /Foreign Object Debris (FOD) to products or systems.

The objective of this document is not only to promote aerospace safety and the preservation of private and national assets, but to give the reader clear guidance to effectively implement programs compliant to published national standards and government instructions relative to FOD Prevention.

An effective FOD Prevention Program identifies potential problems, mitigates risks, promotes awareness, provides effective employee training, and uses industry best practices and lessons learned for continued improvement. Users are encouraged to apply the contents of this document to suit their particular product or program. This document is a guide to the implementation of a FOD Prevention program. However, to implement activities or controls to achieve the appropriate level of risk protection some activities and controls need to happen as defined by the company. These important activities and controls will indicate a "should" expectation.

2. RESOURCE DOCUMENTS

IAQG Supply Chain Management Handbook website <http://www.sae.org/iaqg/handbook/scmhtermsfuse.htm>

IAQG Supply Chain Management Handbook: See SCMH 3.4: Foreign Object Damage (FOD) Prevention Program - Requirements for Aviation, Space, and Defense Organizations.

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AS9100, Quality Management Systems - Requirements for Aviation, Space and Defense Organizations (Series)

AS9146, Foreign Object Damage (FOD) Prevention Program – Requirements for Aviation, Space, and Defense Organizations

The Combined Instruction Contractor's Flight and Ground Operations, DCMA INST 8210.1(Series), AFI 10-220, AR 95-20, NAVAIRINST 3710.1 (Series), COMDTINST M13020.3 (Series)

FAA Advisory Circular 150/5200-30, Airport Winter Safety and Operations

FAA Advisory Circular 150/5220-24, Airport Foreign Object Debris (FOD) Detection Equipment

FAA Advisory Circular 150/5210-24, Airport Foreign Object Debris (FOD) Management

3. DEFINITIONS

Definitions as they apply to this document.

- 3.1 5S Methodology. A workplace organization and housekeeping method that describes how to use work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new standard for the organization.
- 3.2 Accountability. Methods or processes used to establish traceability or tracking of tooling, tools, production aids, consumables or items.
- 3.3 Aerodrome. A defined area on land or water (including any buildings, installations, and equipment) intended to be used wholly or in part for the arrival, departure, and surface movement of aircraft.
- 3.4 Best Practice. A process or technique that exceeds the standard or requirement and is extremely effective.
- 3.5 Clean As You Go. Practice of cleaning the immediate work area of the product at appropriate intervals to eliminate the accumulation or migration of Foreign Objects (FOs) that may potentially become entrapped within the product [i.e., Foreign Object Debris (FOD)] or cause damage (i.e., FOD).
- 3.6 Consumables. Supplies, materials, and miscellaneous items required for product and operations processes that are expected to be consumed during work performed or discarded after useful function (examples include, but are not limited to: glue, paint, sealant, rags, sandpaper, brushes, applicators). Material Consumables are items that are generally thrown away after each use (examples include, but are not limited to: paper towels, ear plugs, gloves, respirator cartridges, acid brushes, cotton swabs, abrasives, tape, safety wire, sanding discs, sealant, and knife blades).
- 3.7 Control. To reduce or prevent the unintentional spread of, to verify, or regulate.
- 3.8 Expendables. Commodities or items used during the manufacturing process that after extended usage or reconditioning become non-functional (examples include, but are not limited to: plastic knives, apex tips, insertion/removal tools, rivet sets, drill bits, reamers, clamps, clevos, end mills, counter sinks, counter bores, and some safety supplies).
- 3.9 Foreign Object (FO). An alien substance or article (examples include, but are not limited to: tools, consumables, hardware, product protective devices, personal items, product process debris, operations debris, environmental debris) that could potentially enter and/or migrate into/on the product or system becoming FOD and potentially cause FOD, if not removed and controlled. Some potential sources of FO include:
 - 3.9.1 Manufacturing by-products and materials;

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- 3.9.2 Solder balls, screws, nuts, washers, insert tangs, component lead ends, wire and sleeve clippings, pieces of electronic components, flux, excess solder, tin whiskers;
- 3.9.3 Dust/dirt from bench tops, equipment, and facility infrastructure;
- 3.9.4 Finger oils or lotions, fibers from clothing, hair;
- 3.9.5 Consumables, expendables, hardware, personal items, shop and production aids;
- 3.9.6 Pests, wildlife, and their by-products.
- 3.10 Foreign Object Damage (FOD). Any damage attributed to foreign object debris (FOD) that can be expressed in physical or economic terms, which could potentially degrade the product or system's required safety and/or performance characteristics.
- 3.11 Foreign Object Debris (FOD). Any foreign object (FO) that has entered and/or migrated into/on the product or system, and could potentially cause FOD, if not removed or controlled.
- 3.12 Foreign Object Occurrence. The condition where a foreign object has been discovered and has entered and/or migrated into/on the product or system. A foreign object occurrence should be recorded but typically does not trigger an investigation until there is reoccurrence or has the potential to become FOD/FOD Incident.
- 3.13 FOD/FOD Incident. The discovery of foreign object debris (FOD) that has invaded a product or system and caused or has the potential to cause damage, impairment, or restriction to the operation or service life of a product, major assembly, component, or system.
- 3.14 FOD Prevention Area. A designation assigning the appropriate risk based level of control for each applicable area in the FOD Prevention Program.
 - 3.14.1 FOD Awareness Area(s). Product area(s) with product(s) or system(s) in which the application of housekeeping cleaning processes and inspections will help prevent migration and ensure that no foreign objects will be passed on or impact testing or development.
 - 3.14.2 FOD Control Area(s). Product area(s) with product(s) or system(s) that should have limited exposure to foreign objects due to the potential for migration, entrapment, or damage to non-critical aspects, operation, or development of the product or product systems.
 - 3.14.3 FOD Critical Area(s). Product area(s) with product(s) or system(s) that require isolation from exposure to foreign objects due to the potential for migration, entrapment, ingestion, damage, or failure to critical aspects, operation, or development of the product or product systems.
 - 3.14.4 General Housekeeping Area(s). Production, non-production, test, or development area(s) in which application of housekeeping will ensure that foreign objects will not migrate to additional areas, contaminate the product, or affect testing or development.
- 3.15 FOD Prevention Area Focal. Site, Program, Product, or Function personnel assigned to provide guidance, support FOD Prevention initiatives, and ensure coverage with sufficient authority, time, budget and organizational freedom to identify and implement FOD Prevention measures.
- 3.16 FOD Prevention Committee. A group of cross functional representatives within an organization established to assist the FOD Prevention Program Leader and promote FOD Prevention.
- 3.17 FOD Prevention Program Leader. The person with the responsibility and authority for establishment, implementation, and maintenance of the FOD Prevention Program.

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- 3.18 Hardware. Bill of Materials (BOM) parts used in operations (examples include, but are not limited to: standards, fasteners, nuts, rivets, washers, screws, bolts, spacers, cotter keys, wire terminals, wire splices).
- 3.19 Housekeeping. A process to maintain general cleanliness and ensure all work areas are orderly and free of potential FOs at appropriate intervals.
- 3.20 Manager. An individual in charge of a certain group of tasks or people. A manager is responsible for making significant decisions on what the unit does, its purpose, functions and role, and for making commitments and decisions that require the expenditure of significant unit resources.
- 3.21 Operations. Product related activities and services through all stages of production, maintenance, and service execution (examples include, but are not limited to: design and development, manufacturing, assembly, test, packaging, shipping).
- 3.22 Personal Items. Items owned by individuals or distributed by the organization for personal use (examples include, but are not limited to: badge, stamps, keys, cell phones, wallets, personal protective equipment, food, drink, tobacco products, tool chits, pens, pencils, jewelry, PDAs, MP3 players, watches, lighters, coins, etc.).
- 3.23 Production Aids. Tooling, tooling details, tooling fixtures, and tooling assemblies, non-flight hardware used to assist operations.
- 3.24 Production Support Equipment. Ladders, lifts, air hoses, lights, power cords, mats, steps, fans, trash receptacles, FO bags, vacuums, mobile placards or stands, etc.
- 3.25 Shop Aids. A non-custom, commercially available, COTS, non-certified item used to assist operations.
- 3.26 Supervisor. Individual in the first-line management who monitors and regulates employees in their performance of assigned or delegated tasks.
- 3.27 Test Cell/Stand. A facility/stand used to characterize and test a product or system.
- 3.28 Test Kit. A combination of instruments, tools or equipment needed for servicing or testing of product or system.
- 3.29 Tether. A lanyard (examples include, but are not limited to: wire, rope, cable) of sufficient strength attached to the tool/tooling equipment and to the user or fixed secure object. The tether should be of a length to eliminate damage from tool free swing. NOTE: A tether device, if not regularly examined may itself be a foreign object. Fraying of the tether material and the hardware (rings, snaps, etc.) can all become FOD/FOD.
- 3.30 Tool Container. A storage medium (examples include, but are not limited to: tool box, cabinet, tool kit, shadowbox, shadow board).
- 3.31 Tooling. A set of specialized equipment used for a particular purpose in the operations environment or the performance of a particular task (examples include, but are not limited to: dies, fixtures, gauges, jigs, and molds).
- 3.32 Tools. A device used in the performance of a maintenance, manufacturing, or assembly/disassembly task, or operation (examples include, but are not limited to: screwdriver, pliers, wrench, etc.).
- 3.33 Trained. Instructed in the necessary knowledge and skills to perform assigned duties and responsibilities.

4. PROGRAM ADMINISTRATION

The FOD Prevention Program should have key administrative elements as part of an overall systems approach to ensure effectiveness in preventing the potential for FOD. The subsections that follow are key elements of the FOD Prevention Program. Each of the following should be included in program administration.

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4.1 Executive Commitment

The success of an effective FOD Prevention program is heavily dependent on the level of commitment exhibited by the company's executive leadership. At a minimum, company/business unit executive management should fulfill the following responsibilities:

- 4.1.1 Set expectations for the FOD Prevention Program and lead by example.
- 4.1.2 Designate a FOD Prevention Program Leader that has sufficient authority, resources, and organizational freedom to implement FOD Prevention measures and guide policy.
- 4.1.3 Ensure all affected personnel receive FOD Prevention education and training.
- 4.1.4 Ensure a culture of FOD Prevention is every employee's responsibility through employee engagement. The key to a successful FOD Prevention Program is the early involvement of all employees.
- 4.1.5 Executive Leadership can foster employee engagement by ensuring the following:
 - 4.1.5.1 Lead by example by being visible in the production areas and participating in the routine assessment process.
 - 4.1.5.2 Encourage employees to recommend FOD Prevention improvements.
 - 4.1.5.3 Encourage open communication by listening to employee concerns, and taking appropriate action.
 - 4.1.5.4 Attend production meetings at the line or cell level to promote the FOD Prevention message.
 - 4.1.5.5 Provide an environment where employees are encouraged to report foreign object occurrences/escapes without fear of reprisal.
 - 4.1.5.6 Promote a culture where employees feel empowered to implement and improve FOD Prevention processes within the parameters of company policy.
 - 4.1.5.7 Provide vital feedback for process improvement. Workers need specific information about what is wrong before they can be expected to improve processes. Let workers know when they are doing well or when they are not.
 - 4.1.5.8 Establish/implement a reward/recognition system to acknowledge positive contributions to FOD Prevention.

4.2 FOD Prevention Program Leader

The FOD Prevention Program Leader is the person designated by Executive Leadership, with the responsibility and authority for establishment, implementation, and maintenance of the FOD Prevention Program. The FOD Prevention Program Leader has the following responsibilities including, but not limited to:

- 4.2.1 Develop the organization's overarching FOD Prevention Program.
- 4.2.2 Establish FOD Prevention Area Designation requirements (see Section 3.14 and Section 5 Area Designation).
- 4.2.3 Approve FOD Prevention Area designation risk mitigation level.
- 4.2.4 Develop and implement the Lost Tool/Item process.
- 4.2.5 Review and assess the FOD Prevention Program procedures and make necessary revisions.
- 4.2.6 Ensure assessments are performed to gauge effectiveness of the FOD Prevention program.

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- 4.2.7 Provide oversight to ensure preventive, investigative, analysis, root cause and corrective action processes exist and ensure corrective actions are adequate to mitigate further occurrences.
- 4.2.8 Ensure an appropriate data collection system is in place and metrics are produced to enable analysis and corrective actions.
- 4.2.9 Develop, implement, and maintain FOD Prevention training curricula commensurate with FOD risk assessment results. The training curricula may include additional courses with enhanced FO detection "hands on" exercises and/or comprehension exams based on FOD Prevention Area requirements.
- 4.2.9.1 The organization should consider provisions ensuring anyone entering designated FOD Prevention Areas has received required FOD Prevention training or is escorted by trained personnel. This includes personnel not typically assigned to the designated area (examples include, but are not limited to: customer, visitors, contractors, infrastructure maintenance).
- 4.2.10 Serve as the company/business unit subject matter expert for all FOD Prevention matters.
- 4.3 FOD Prevention Committee
- An organization may consider the establishment of a FOD Prevention Committee to assist the FOD Prevention Leader in the implementation and administration of the FOD Prevention Program. The committee representatives should be selected from cross functional activities within the organization (examples include, but are not limited to: Production, Manufacturing Engineering, Quality, Management, Design Engineering, etc.). Responsibilities of the FOD Prevention committee should include:
- 4.3.1 Promotion of a culture of FOD Prevention within all areas of the organization.
- 4.3.2 Review and assess the FOD Prevention Program and procedures to identify opportunities for improvement and recommend necessary revisions.
- 4.3.3 Assisting in the development of unique FOD Prevention techniques and assigning responsibilities for publication of special FOD Prevention instructions.
- 4.3.4 Reviewing results of FOD/FOD incident investigations and root cause/corrective actions.
- 4.3.5 Reviewing the quantity, types, and location of FO/FOD found and how they were found to address systemic or repeat occurrences.
- 4.3.6 Providing input for FOD Prevention training curricula.
- 4.4 FOD Prevention Area Focal
- The purpose of the FOD Prevention Area Focal is to engage in the work environment to oversee and promote a FOD Prevention culture. FOD Prevention Area Focals may be Site, Program, Product, or Function personnel assigned to provide guidance, support initiatives, and ensure coverage with sufficient authority, time, budget and organizational freedom to identify and implement FOD prevention measures. Responsibilities include but are not limited to:
- 4.4.1 Working with all functions and areas to implement and validate the effectiveness of the established FOD Prevention Program within their area, independently or as directed by the FOD Prevention Program Leader.
- 4.4.2 Acting as a member of the company FOD Prevention Committee (if established).
- 4.4.3 Acting as a point of contact for training and program implementation.
- 4.4.4 Recommending FOD Prevention Area designation categorization.

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4.5 Managers/Supervisors

Communication of the policy and employee interaction by Managers/Supervisors is essential to the success of a FOD Prevention Program. The purpose of this section is to describe the responsibilities of this key role in the FOD Prevention Program. Managers/Supervisors duties include but are not limited to:

- 4.5.1 Ensuring the FOD Prevention Program policies are followed.
- 4.5.2 Ensuring all area FOD Prevention and Tool Control procedures are followed as applicable.
- 4.5.3 Ensuring all area FO/FOD and Lost Tool/Item report and investigation requirements are followed as applicable.
- 4.5.4 Assisting in investigations and root cause corrective action of FOD/FOD incidents.
- 4.5.5 Implementing corrective action to prevent future occurrences for FOD/FOD incidents.
- 4.5.6 Ensuring all visitors in designated FOD Prevention Areas adhere to FOD Prevention requirements.
- 4.5.7 Communicating area FOD Prevention needs to proper manager or FOD Prevention Leader.
- 4.5.8 Assuring FOD Prevention training is current and does not lapse.
- 4.5.9 Reviewing and assessing metrics for process compliance and improvement (see Sections 4.7.3 and 4.7.4).

4.6 Quality Management System

The organization's Quality Management System is essential to the success of a FOD Prevention Program. The purpose of this section is to describe how the FOD Prevention Program is directly tied to the Quality Management System. Elements of the Quality Management System should consider the following:

- 4.6.1 Initiating and tracking FO/FOD non-conformances within the Quality Management System. Use of non-conformance records provides a source of data for the FOD Prevention Program Leader to assess, analyze and track FOD Prevention Program data trends.
- 4.6.2 Requesting Root Cause Corrective Action when FO/FOD data trends exceed established goals or the product is at risk of FOD.
- 4.6.3 Auditing the FOD Prevention Program for compliance.
- 4.6.4 Ensuring personnel understand FOD Prevention Program requirements and are trained in the methods and techniques of FO detection.

4.7 Measuring Performance

The purpose of Measuring Performance is to evaluate effectiveness of the FOD Prevention Program based on internal, customer, statutory, and regulatory requirements. FOD Prevention Program performance measures should be developed, tracked, and maintained to ensure program effectiveness and visibility to all appropriate levels of the organization.

- 4.7.1 Measurement methods examples may include, but are not limited to: problem areas/trends, inspection/audit results, Mishap reports, Area assessment results, Customer feedback, Lost or found tool and items reports, Supplier FOD Prevention data, FO/FOD occurrences (types and locations).
- 4.7.2 Reporting methods examples may include, but are not limited to: charts/graphs reflecting both current and past performance, trend analysis to reflect areas of opportunity and illustrate gaps, customer comments/concern/

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