

**BY ORDER OF THE COMMANDER
ARNOLD ENGINEERING
DEVELOPMENT COMPLEX**

**ARNOLD ENGINEERING
DEVELOPMENT COMPLEX
INSTRUCTION 21-111**



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**FOREIGN OBJECT DAMAGE
(FOD) PREVENTION PROGRAM**

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This publication implements the Foreign Object Damage (FOD) Prevention Program requirements of Air Force Instruction (AFI) 21-101, Air Force Materiel Command Supplement, Air Force Materiel Command Addendum A, *Non Standard Organization (NSO) Logistics Maintenance Management*. This instruction provides the minimum essential guidance and procedures to manage and implement the FOD Prevention Program. Prevention of FOD is the responsibility of everyone; therefore, this instruction applies to all Government, contractor, and test customer personnel working in, around, or traveling through Foreign Object (FO) Critical Areas and FO Awareness Areas at all locations of the Arnold Engineering Development Complex including the Geographically Separated Units (GSUs). This publication may be supplemented at any level, but all supplements must be routed to the Office of Primary Responsibility (OPR) listed above for coordination prior to certification and approval. Refer recommended changes and questions about this publication to the OPR listed above using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate chain of command. Requests for waivers must be submitted to the OPR listed above for consideration and approval. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of in accordance with Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS). The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. Major changes include change from Arnold Engineering Development Complex Operating Instruction (AEDCOI) to Arnold Engineering Development Complex Instruction (AEDCI), expanded responsibilities, expanded specific actions, and inclusion of the AEDC FO Critical Areas list.

1. Overview. FOD prevention is everyone's responsibility. All personnel directly or indirectly involved in any form of operations or maintenance must fully understand the importance of a strong and proactive FOD Prevention Program. Failure to practice FOD prevention impacts everyone and ultimately degrades test readiness. The success of the program requires positive attitude and actions by all personnel to eliminate FOD.

2. Responsibilities.

2.1. The AEDC Commander (AEDC/CC) shall ensure assets and resources are allocated to implement and execute this instruction.

2.2. The Executive Director (AEDC/CA) shall:

2.2.1. Establish an effective FOD prevention program.

2.2.2. Serve as the AEDC FOD Prevention Program Manager.

2.2.3. Ensure the Complex has qualified FOD monitors.

2.2.4. Chair the quarterly FOD Prevention Committee meeting.

2.2.5. As FOD Prevention Committee Chairman, approve FOD Prevention Program guidance; approve FO/FOD prevention processes, practices, procedures, and instructions including the FO Critical Area List; and approve recommendations to the Complex's resource allocation budgeting process (i.e., Capability Analysis & Risk Assessment (CARA)) for FOD Prevention Program budget needs.

2.2.6. Provide FOD reports to HQ AFMC/A4M as required by AFI 21-101 AFMCSUP ADDENDUM A paragraph 5.5.3.3.

2.2.7. Delegate in writing any responsibilities only to the Chief, Test Systems Sustainment Division.

2.2.8. Appoint Government FOD Prevention Program Manager(s).

2.3. Chief, Test Systems Sustainment Division (AEDC/TSS) shall:

2.3.1. Assume responsibilities of AEDC/CA in their absence or via written delegation of responsibilities.

2.3.2. Ensure compliance with this instruction.

2.4. Division Chiefs shall impound facilities per AEDCI 21-112 when a FOD or potential FOD event warrants.

2.5. Maintenance Superintendent (AEDC/TSS) shall:

2.5.1. Serve as recording secretary for FOD Prevention Council to include scheduling meetings, taking meeting minutes, and posting minutes for review.

- 2.5.2. Train Government FOD Prevention Program Monitor(s).
 - 2.5.3. Ensure proper reporting of FOD/Domestic Object Damage (DOD) investigation results.
 - 2.5.4. Assist in performing spot checks of FO Critical Areas.
 - 2.5.5. Prepare FOD reports as required by AFI 21-101 AFMCSUP ADDENDUM A, paragraph 5.5.3.3. for review by AEDC FOD Prevention Program Manager.
- 2.6. Government FOD Prevention Program Monitor(s) shall:
- 2.6.1. Review FOD prevention and reporting procedures.
 - 2.6.2. Perform and document spot check audits of FO Critical Areas using AEDC 890, *FOD Audit*.
 - 2.6.3. Perform housekeeping audits.
 - 2.6.4. Review FOD/DOD reports/events.
 - 2.6.5. Review recommended changes to the FOD prevention program and training.
 - 2.6.6. Review all FO/FOD and Domestic Object (DO)/DOD findings and monitor trends.
 - 2.6.7. Validate data used to evaluate compliance with the FOD program.
- 2.7. Government Asset Managers/Engineers shall:
- 2.7.1. Recommend designation of FO Critical Areas and FO Critical Area FOD prevention processes and procedures to the FOD Council.
- 2.8. Organizations that operate test cells, plants, utilities, and the airfield or have responsibility for a designated FO Critical Area shall:
- 2.8.1. Appoint FOD monitors.
 - 2.8.2. Support the FOD Prevention Committee.
 - 2.8.3. Ensure compliance with this instruction.
 - 2.8.4. Recommend to Government Asset Managers/Engineers designation of FO Critical Areas and FO Critical Area FOD prevention processes and procedures.
 - 2.8.5. Identify potential FO hazards in their assigned facilities.
 - 2.8.6. Inform all applicable organizations of potential FO hazards.
 - 2.8.7. Develop and maintain FOD prevention and reporting procedures per direction of the FOD Council.
 - 2.8.8. Institute FOD prevention as part of the quality control program. Perform and document spot check audits of FO Critical Areas using forms as applicable per documented processes and procedures.
 - 2.8.9. Investigate FOD/DOD reports/events to determine root cause
 - 2.8.10. Ensure proper reporting of FOD/DOD investigation results per para. 3.6.
 - 2.8.11. Recommend changes to the FOD prevention program and training.

2.8.12. Review all FO/FOD/DO/DOD findings and monitor trends.

2.8.13. Review lost tool reports.

2.8.14. Provide and maintain an electronic database that is accessible to the Government, and enter all required FO/FOD/DO/DOD information into the database.

2.8.15. Brief all personnel who must perform operations, maintenance, or transient through FO Critical Areas on the work area specific FOD awareness and prevention practices prior to permitting work to be performed.

2.9. FOD Prevention Committee shall:

2.9.1. Meet quarterly.

2.9.2. Be chaired by the AEDC/CA, or the Test System Sustainment Chief, or other designee.

2.9.3. Be comprised of the Test Systems Sustainment Division Chief, Test Operations Division Chief, Maintenance Superintendent, Government FOD Prevention Program Monitor(s), Government Asset Managers/Engineers, FOD Monitors, and leadership or their designees.

2.9.4. Review reports and trends; review and develop FOD Prevention Program guidance; review FO/FOD prevention processes, practices, procedures, and instructions including the FO Critical Area List; and review recommendations to the Complex's resource allocation budgeting process (i.e., Capability Analysis & Risk Assessment (CARA) for FOD Prevention Program budget needs.

2.10. AEDC Operations Center shall:

2.10.1. Notify the responsible FOD Monitor identified by the initial reporter of the FO/FOD/DO/DOD event, unless the FOD Monitor was the individual that initiated the report.

2.10.2. Notify Government FOD Program Managers of the FO/FOD/DO/DOD event.

2.10.3. Document reports received associated with FO/FOD/DO/DOD events in the AEDC Operations Center Log.

2.10.4. Initiate appropriate Quick Reaction Checklist and disseminate known information on the FO/FOD/DO/DOD as appropriate.

2.10.5. Initiate appropriate Quick Reaction Checklist and disseminate information on impoundments including release from impoundments.

2.11. All personnel shall:

2.11.1. Follow FO/FOD prevention practices per paragraph 3.5 and local work instructions/procedures.

2.11.2. Report FO/FOD/DO/DOD events to the Operations Center per paragraph 3.6.

2.11.3. Cease activities that may endanger or further endanger assets when tools or equipment are lost, FO/DO/FOD/DOD are discovered, and do not resume activities until cleared per paragraph 3.7.

3. Specific Actions

3.1. Classification

3.1.1. FO Awareness Areas are locations where there is the potential for damage to aircraft, test articles, test equipment, or test facilities from FO. All of the following are considered FO Awareness Areas at AEDC: all active test cells, test plants, test utilities, industrial areas, and airfields.

3.1.2. FO Critical Areas are locations where there is significant potential for damage to aircraft, test articles, test equipment, or test facilities from FO. FO Critical Areas are a subset of FO Awareness Areas and include the active runways, taxiways, and parking aprons and specific locations in test cells, plants, and utilities such as inlet ducting. See Attachment 3 for AEDC identified FO Critical Areas.

3.1.3. Foreign Object (FO) - Any object in a FO Critical Area possessing damage potential that is not domestic (see Domestic Object below) to aircraft, test articles, test equipment, or test facilities to potentially include objects that have become detached from the aforementioned items, such as a bolt or nut.

3.1.4. Foreign Object Damage (FOD) - Any damage to an aircraft, test article, test equipment, or test facility caused by external FO which may or may not degrade the required safety and/or operational characteristics of the aforementioned items.

3.1.5. Domestic Object (DO) - Any object in a FO Critical Area possessing damage potential that is domestic to aircraft, test articles, test equipment, or test facilities (the object is a part of the object that may be damaged). Example: igniter comes loose in engine

3.1.6. Domestic Object Damage (DOD) - Any damage to an aircraft, test article, test equipment, or test facility caused by DO which may or may not degrade the required safety and/ or operational characteristics of the aforementioned items.

3.1.7. Damage that is part of the test objective, or damage that is anticipated and accepted, as a possibility to occur as part of the test objective (documented in Statement of Capability, test plan, hazard analysis, etc.) should not be considered FOD or DOD unless it is unclear how the damage occurred. Examples of non-FOD/DOD: (1) erosion of test article during arc heater dust erosion testing (objective of test is to determine amount of erosion on test article due to dust and hot gas impingement), (2) damage to test article due to planned impact during ballistic range testing (objective of test is to assess lethality of impact). Examples of damage that may need to be considered FOD or DOD until an investigation determines otherwise: (1) damage to engine during engine icing test (damage from ice may be expected but investigation may be required to determine true cause), (2) damage to engine during durability testing (objective may be to run a part to failure but investigation may be required to ensure that FOD or unexpected DOD did not occur).

3.1.8. Non-Preventable damage. Damage caused or induced by the natural environment or wildlife (not controllable by humankind) such as hail, ice, lightning, or animals. Example: lightning strike to test article while being transported to test facility and there is not lightning reported in the area before or during transport.

3.1.9. Preventable damage. Damage caused by processes or objects controllable by humankind. Example: engine under test damaged from tool left in the test facility ducting.

3.1.10. FOD Event

3.1.10.1. FOD has occurred.

3.1.10.2. Further classification of the FOD event shall be either preventable or non-preventable. FOD events shall be treated as preventable until a specific determination of preventable or non-preventable can be made.

3.1.11. FO Event. FO found with potential to cause damage. Example: pen found in a space environmental chamber during inspection prior to pump down.

3.1.12. DOD Event

3.1.12.1. DOD has occurred. Damage shall be treated as FOD until a specific determination of FOD or DOD can be made.

3.1.12.2. Further classification of the DOD event shall be either preventable or non-preventable. DOD events shall be treated as preventable until a specific determination of preventable or non-preventable can be made.

3.1.13. DO Event. DO found with potential to cause damage. Example: loose engine part found during bore scope inspection.

3.2. Training.

3.2.1. All newly assigned AEDC military, Government civilians, and contractor personnel, who have reason to perform operations or maintenance work in FO Critical Areas or routinely travel through FO Critical Areas are required to complete the computer-based training for FOD prevention

3.2.2. All personnel typically assigned to perform maintenance or operations in FO Critical Areas are required to complete FOD prevention refresher training annually.

3.3. FO Critical Area identification. The boundaries of FO Critical Areas shall be clearly identified. FO Critical Areas shall be distinguishable from FO Awareness or other areas via the use of signage, painted boundaries, barrier ropes, etc. as appropriate to the area.

3.4. Documentation.

3.4.1. FOD hazards and prevention measures specific to each FO Critical area shall be documented in work instructions and hazard analyses as appropriate.

3.4.2. FO/FOD/DO/DOD events shall be documented in an electronic database accessible by the Government. Data shall include as a minimum:

3.4.2.1. Date of event

3.4.2.2. Date reported to the AEDC Operations Center

3.4.2.3. Point of contact

3.4.2.4. Mission Area

3.4.2.5. Process

- 3.4.2.6. Affected Asset
- 3.4.2.7. Foreign or Domestic Object
- 3.4.2.8. FO/DO source
- 3.4.2.9. Location discovered
- 3.4.2.10. Cause category (per Attachment 2)
- 3.4.2.11. Cause sub-category (per Attachment 2)
- 3.4.2.12. Final FO/DO/FOD/DOD classification
- 3.4.2.13. Assessed severity of equipment damage per risk matrix
- 3.4.2.14. Assessed probability of equipment damage per risk matrix
- 3.4.2.15. Assessed risk level
- 3.4.2.16. Impound imposed
- 3.4.2.17. Estimated cost of repair
- 3.4.2.18. Lost Test Time due to this Event if applicable

3.4.3. Inspections/Audits of FO Critical Areas shall be documented on appropriate forms.

3.5. FOD Prevention Practices.

3.5.1. In FO Awareness Areas:

- 3.5.1.1. Practice good housekeeping standards.
- 3.5.1.2. Implement “clean as you go” practices: (a) Clean the immediate area when work cannot continue, (b) Clean the immediate area when debris has the potential to migrate to an out of sight or inaccessible area and give the appearance of poor workmanship, (c) Clean the area prior to leaving it unattended, when work cannot continue, after work is completed or at the end of shift, whichever comes first, (d) If you see something, drop something, see or hear something drop, pick it up.
- 3.5.1.3. Smoking, food or drink in authorized areas only.
- 3.5.1.4. Follow requirements of AEDCI 21-113, *Tool Control*.
- 3.5.1.5. Rags are only permitted in one of three places at any time: in clean rag bins, in dirty rag bins or in-use (in-use means actively in-use – not lying about or used for long-term spill control).
- 3.5.1.6. Electrical connectors, tubing, ducting, pipes, ports, lines, and hoses which are stored, or disconnected permanently or to facilitate other maintenance will, at a minimum, be protected from having foreign objects introduced. Caps, plugs, and covers are the preferred method of preventing the introduction of foreign objects where practical; however, the use of plastic bags, cloth, tin foil, or other methods are acceptable if compatible with the type of system being protected. Consideration should be given to the visibility/detection of material used to protect items so that the material used does not itself become a foreign object. Streamers should be attached

to materials that have the potential to not be removed so that they are not inadvertently left installed during the installation process.

3.5.2. Additional requirements for FO Critical Areas:

3.5.2.1. The proper use of adhesives, tape, sealants, glues, and other materials used to temporarily affix objects to test articles or fixtures within the air stream of a testing facility shall be covered by written instructions and risks shall be assessed via hazard analysis.

3.5.2.2. While maintenance is being performed on aircraft, test articles, or any equipment item where FOD potential exists, properly plug or cap openings, ports, lines, hoses, electrical connections, and ducts to prevent FO from entering the systems, both installed or when removed for storage.

3.5.2.3. Where practical, entry areas to FO Critical Areas will be closed or otherwise protected when not actively being used to prevent the introduction of FO into the area.

3.5.2.4. Personal sanitation must be completed prior to entering FO Critical Areas (e.g. removing all possible FO from pockets or from your person to include, jewelry, watches, rings, coins, and personal items).

3.5.2.5. Use designated FOD prevention containers.

3.5.3. Additional AEDC airfield requirements.

3.5.3.1. Prior to aircraft operations, all airfield surfaces to include the runway, taxiways, and parking aprons will be inspected for FO.

3.5.3.2. All FO must be removed from all airfield surfaces prior to aircraft arrival, departure, engine run, or taxi.

3.5.3.3. Personal and vehicle FO sanitation must be accomplished prior to entering the active runway, taxiways and parking aprons on the airfield (e.g. removing objects from tires, or loose items from undercarriage or bed of vehicle).

3.6. Reporting.

3.6.1. When FOD/DOD is discovered, or when an event occurs that could potentially result in FOD/DOD (such as the known loss of a tool or part in a FO Critical Area), or when FO is found during an inspection in a FO Critical Area at the Arnold AFB site, the event shall be reported to the AEDC Operations Center immediately.

3.6.2. The initial report shall include as much of the following information that is available at the time of the report, and follow-on reports are required until the information below is completed to the fullest extent possible:

3.6.2.1. Name of person providing the report.

3.6.2.2. Date/time of event.

3.6.2.3. Assessed FO/FOD/DO/DOD Class.

3.6.2.4. Overall location of event; e.g. Airfield/Facility/Test Unit.

3.6.2.5. Object found or lost.

- 3.6.2.6. The activity being performed that resulted in the discovery; e.g. model inspection, duct inspection, bore scope, etc.
- 3.6.2.7. Article/equipment damaged.
- 3.6.2.8. Extent of damage.
- 3.6.2.9. Specific location of FO/FOD/DO/DOD.
- 3.6.2.10. Source of FO/DO, if known.
- 3.6.2.11. Point of contact (if other than the reporting person).
- 3.6.3. GSUs shall develop and follow local notification procedures.
- 3.6.4. Provide FOD reports to HQ AFMC/A4M as required by AFI21-101_AFMCSUP_ADDENDUM_A, Paragraph 5.8.3.3.
- 3.7. Return to Operations after FO/FOD/DO/DOD event. Resume ceased activities only if:
 - 3.7.1. Impoundment is **not** in effect, the source of the FO/DO is known, and the risk of continued operations is determined to be Low by the Government Test Engineer, or other designated Government authority.
 - 3.7.2. Activity is released from an impoundment by the Impoundment Authority.

RODNEY F. TODARO, Colonel, USAF
Commander

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

AFI 21-101, *Aircraft and Equipment Maintenance Management*, 21 May 2015

AFI21-101 AFMCSUP AFMCGM-02, *Aircraft and Equipment Maintenance Management*, 16 July 2015

AFI21-101_AFMCSUP_ Addendum A, *Non-Standard Organization (NSO) Logistics Maintenance Management*, 02 June 2014

AEDCI 21-112, *Impoundment*, April 2016

AEDCI 21-113, *Tool Control*, April 2016

Prescribed Forms

AEDC890, *FOD Audit*

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

AEDC—Arnold Engineering Development Complex

AEDC/CA— Executive Director

AEDC/TSS— Chief, Test Systems Sustainment Division

DO—Domestic Object

DOD—Domestic Object Damage

FO—Foreign Object

FOD—Foreign Object Damage

Terms

Domestic Object (DO)— Any object in a FO Critical Area possessing damage potential that is domestic to aircraft, test articles, test equipment, or test facilities (the object is a part of the object that may be damaged). Example: igniter comes loose in engine

Domestic Object Damage (DOD)— Any damage to an aircraft, test article, test equipment, or test facility caused by DO which may or may not degrade the required safety and/ or operational characteristics of the aforementioned items.

FO Awareness Areas— locations where there is the potential for damage to aircraft, test articles, test equipment, or test facilities from FO. All of the following are considered FO Awareness Areas at AEDC: all active test cells, test plants, test utilities, industrial areas, and airfields.

FO Critical Areas— locations where there is significant potential for damage to aircraft, test articles, test equipment, or test facilities from FO. FO Critical Areas are a subset of FO Awareness Areas and include the active runways, taxiways, and parking aprons and specific locations in test cells, plants, and utilities such as inlet ducting.

Foreign Object (FO)— Any object in a FO Critical Area possessing damage potential that is not domestic (see Domestic Object below) to aircraft, test articles, test equipment, or test facilities to potentially include objects that have become detached from the aforementioned items, such as a bolt or nut.

Foreign Object Damage (FOD)— Any damage to an aircraft, test article, test equipment, or test facility caused by external FO which may or may not degrade the required safety and/or operational characteristics of the aforementioned items.

Non—Preventable damage - Damage caused or induced by the natural environment or wildlife (not controllable by humankind) such as hail, ice, lightning, or animals. Example: lightning strike to test article while being transported to test facility and there is not lightning reported in the area before or during transport.

Preventable damage— Damage caused by processes or objects controllable by humankind. Example: engine under test

Attachment 2

FO/FOD CAUSE CATEGORIES

Table A2.1. FO/FOD Cause Categories.

Cause Category	Cause Sub Category
Component Failure	Abrasion
Contamination	Adhesive failure
Design	Air Loads
Fatigue	Brittle Failure
Human Error	Delamination
Icing	Facility Hardware
Impact	Fastener
Lost Item	Flaking Paint
Test Article	FOD Prevention Screen
Test Conditions	Found
Test Process	From prior FO event
Tool	High Cycle Fatigue
Unknown	Inattention to detail
	Irretrievable Tool
	Lost Tool
	Not Found
	Not Robust
	Over stressed component
	Poor Housekeeping
	Post Construction
	Post Maintenance
	Procedure inadequate
	Procedure not followed
	Thermal
	Tool Control
	Unknown
	Vibration
	Wear
	Welding operations

Attachment 3

LIST OF AEDC IDENTIFIED FO CRITICAL AREAS

A3.1. Note. *Attachment 3 is the list of AEDC identified FO Critical Areas. As stated in 2.2.5 and 2.9.4, the AEDC FO Critical Areas List will be approved by the FOD Prevention Committee. Since they Committee will review and approve all changes, Attachment 3 will be published separately from this Instruction.*