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Maintenance**



**ADVANCED COMPOSITE MATERIALS
MISHAP RESPONSE**

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This instruction implements AFD 21-1, *Air and Space Maintenance*, and is used in conjunction with AFMAN 32-4004, *Emergency Response operations*, AFOSH STD 48-137, *Respiratory Protection Program* and TO 00-105E-9, *Emergency Rescue and Mishap Response Information*. This instruction establishes responsibilities, unit capabilities, and procedures necessary for advanced composite material (ACM) (see [Attachment 1](#)) mishaps in the Elmendorf AFB area of responsibility to include all host and transient aircraft. All agencies involved with response, containment, and disposal operations will ensure compliance with this instruction to ensure a cooperative, coordinated, and safe response to an ACM mishap situation. This publication does not apply to the US Air Force Reserves or Air National Guard units and members. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does imply endorsement by the Air Force. Refer recommended changes and questions about this publication to the office of primary responsibility (OPR) using the AF Form 847, *Recommendation for Change of publication*. Route the AF Form 847 through the appropriate chain of command. Official records created as a result of this publication will be maintained in accordance with AFMAN 37-123 and AFI 33-364 under the disposition authority of the Air Force Records Information Management System (AFRIMS), Records Disposition Schedule (RDS), Table 32-39, Rule 03.00 (at: https://afrims.amc.af.mil/rds_series.cfm) or other disposition authority from the applicable (21 or 32 Series) tables.

1. Advanced Composite Materials Specific Concerns:

1.1. Carbon fibers are very light, become easily airborne, and are respirable. Plume dissipation under windy conditions increases dispersion area. Fire exposed carbon fibers break into shorter lengths and smaller diameters, increasing the probability for respirable and ease of transport. Inhaled carbon fiber particulate cannot be expelled efficiently. Absorbed pyrolysis products on carbon fibers allow toxic debris to enter the body, causing decreases in respiratory efficiency and increases passageway irritation. The combined effect of inherently sharp and stiff individual carbon fibers promotes easy dermal penetration. Partially pyrolyzed fibers easily break into smaller

segments. Rubbing of exposed skin areas increases the affected area. Typical exposure requires medical attention for dermatitis. C-17A aircraft contain over 8% carbon/graphite epoxy materials by weight. F-15 aircraft contain 10% carbon/graphite epoxy materials by weight. F-22 aircraft contain 24% carbon, boron, Kevlar® 49 (a trademark of the Lockheed-Martin Corporation), fiberglass epoxy materials by weight.

1.2. Initial response personnel face the probability of an aircraft fire. As the composite material burns, gases, vapors, and solid particles are released into the smoke plume. Fire fighting personnel will be exposed to toxic gases and fibers in the smoke or fibers present on parts when performing rescue operations (see Attachment 2 for appropriate personal protective equipment (PPE) for burning/smoldering composite materials). The 3rd Aerospace Medicine Squadron, Bioenvironmental Engineer is the approval authority concerning PPE requirements.

1.3. Recovery/containment personnel will be exposed to fibers and respirable dusts as aircraft parts are moved around the site or modified by cutting, breaking, twisting, or hammering (see Attachment 2 for protection from broken/splintered composites).

1.4. If personnel, other than those at the accident site, have been exposed to adverse material hazards, the base medical staff will be consulted for evaluation and tracking. Advise the unthreatened populace in affected or fallout areas to:

- 1.4.1. Shelter in place.
- 1.4.2. Remain in-doors.
- 1.4.3. Shut external doors and windows.
- 1.4.4. Turn off forced air intakes.
- 1.4.5. Await further notification.

1.5. When practical, remove contaminated outer garments of victims/response personnel at the scene to protect the medical staff. Advise the local medical staff of any ill effects they believe are related to their exposure to the advanced composite materials. Symptoms of ill effects include, but are not limited to:

- 1.5.1. Respiratory tract irritation, reduced respiratory capacity, and difficulty breathing.
- 1.5.2. Eye irritation.
- 1.5.3. Skin irritation, rashes, or infections.

1.6. Avoid excessive walking, working, or moving at the mishap site to minimize dust disturbance and creating airborne particulate fibers. All contaminated footwear will be cleaned to limit the spread of debris in the area and inside support vehicles.

1.7. Clean sites (that is, tent or trailer) for donning/removal of PPE will be set up. When exiting the mishap site, personnel will use a high efficiency particulate air (HEPA) filtered vacuum, to remove advanced composite contaminants from their outer clothing, for example, Tyvek® suit, work gloves, boots, headgear, and equipment. If unavailable, efforts will be made to wipe or brush off as much contamination as possible.

1.8. No eating, drinking, or smoking is permitted within the established cordoned area. Personnel must be advised to wash hands, forearms, and face prior to eating, drinking, or smoking. Personnel will shower (in cool water) prior to going off-duty to preclude injury from loose fiber.

1.9. Wrap and seal disposable protective clothing in plastic bags after use and discard as routine waste. Severely contaminated clothing will be labeled and discarded in accordance with paragraph 4.2, this instruction, otherwise, launder non-disposable clothing separately. The BEE will determine if other special handling or cleaning procedures are required for personal clothing based on level of exposure.

2. Initial Response Requirements:

2.1. The First-Responders will be the 3 Civil Engineering Squadron (CES) Fire Department. The Senior Fire Official will conduct an initial survey to inspect for:

- 2.1.1. Signs of fire damaged composites.
- 2.1.2. Presence of loose/airborne fibers and particulates.
- 2.1.3. Prevailing weather conditions/directions.
- 2.1.4. Degree of site exposed to fire/explosion/impact
- 2.1.5. Local/proximal equipment/asset damage and danger.
- 2.1.6. Exposed personnel.

2.2. Security Forces will enforce an initial 2,000 feet clearance zone centered on the burning/smoking mishap site. Restrict personnel and traffic from entering. Evacuate areas in the vicinity of the mishap site affected by direct and dense fallout from the fire/explosion generated smoke plume, along with easily mobile, critical equipment. Alter/move aircraft and flight operations exposed to the immediate fallout area as soon as safely practical. Restrict all unprotected personnel from assembling downwind of the crash site.

2.3. Extinguish fire and cool composite materials to below 300 degrees Fahrenheit. Only fire fighters equipped with Self-Contained Breathing Apparatus (SCBA) are authorized within the 2,000 feet clearance zone of a burning/smoking mishap site until the Senior Fire Official declares the area fire safe.

- 2.3.1. Avoid high-pressure water break-up and dispersal of composite material structures.
- 2.3.2. Do not use helicopters or low flying aircraft to control/suppress the fire. No flight, hovering, or taxiing within 500 feet above ground level (AGL) and 1,000 feet horizontally of the site.

2.4. The Senior Fire Official will establish control at the mishap site until fires are extinguished and composites cooled below 300 degrees Fahrenheit. When the mishap scene is deemed fire safe by the Senior Fire Official and the 3 Equipment Maintenance Squadron (EMS) crash recovery team (CRT) has contained damaged advanced composite material surfaces (in accordance with paragraphs 3.1.-3.4. this instruction), the Senior Fire Official will turn over command to the Incident Commander (IC). The IC will ensure all responding personnel within the clearance zone wear appropriate Personal Protective Equipment (PPE) (see Attachment 2).

2.5. The IC will consult with the 3 AMDS BEE, and determine when to eliminate the 2,000 feet clearance zone and designate the cordoned area. As a guide, the cordoned area will be defined as more than 25 feet away from damaged composite parts, although it may vary depending upon environmental conditions (rain, dry, high winds, remote site, and so forth).

2.6. The 3rd Security Forces will rope/cordon off the mishap area as established by the IC and establish a single entry/exit point. Only sufficiently protected individuals are authorized into the immediate mishap site/cordoned area (see Attachment 2).

2.7. The IC will inspect for and identify specific aircraft hazards while consulting with the crew chief, weapons system manager, reference documents, contractor, or aircraft specialists. Direct composite and other hazardous materials to mishap response personnel.

2.8. Access to the crash site to conduct a more thorough survey will be coordinated with the IC. Ensure appropriate PPE is used (see Attachment 2) or as required by the BEE.

3. Containment. All affected agencies must ensure compliance with the following:

3.1. The 3 CES Fire Fighters will secure burned/mobile composite material fragments and loose ash/particulate residue with fire-fighting foam or a fine water mist until a hold-down fixant material can be applied to immobilize the fibers. Initial actions will concentrate on debris containment.

3.2. The 3 EMS CRT will deploy to mishap site with a fixant or "hold-down" solution, consisting of either acrylic floor wax and water mixed in a 50% water to wax ratio, or Polyacrylic Acid (PAA-CarboSet® XL-11 (a trademark of the Hillyard Clean Assist Corporation)). The CRT will maintain an adequate supply of fixant solutions and spray equipment. For example, an F-16 mishap involving impact damage and fire is to take two five-gallon backpack sprayers for the initial spray and use the extra wax for subsequent treatments. As the wreckage is moved or recovered more application is required.

3.2.1. Fire must be completely extinguished and the composites cooled to below 300 degrees Fahrenheit before fixant application. Fire fighting equipment will be available during fixant application, and aircraft break-up and recovery.

3.2.2. CRT members will apply (preferably spray) a coating of the fixant solution to all burned composite materials (if possible, excluding investigative debris) and to areas containing scattered/settled composite debris. Completely coat the material until wet to ensure the particulate fiber/dust is immobilized. Immediately flush/clean fixant-application equipment with a diluted solvent to avoid clogging.

3.2.3. If fixant cannot be used, or further protection is needed, carefully wrap the coated parts and/or material with plastic sheet/film or place in a plastic bag that is minimum of 0.006 inches (6 mils) thick. Seal and secure the damaged materials with tape.

3.2.4. Apply masking/duct tape over the non-fire/crash damaged composite parts/material. These parts/materials may be required for investigative purposes. Place the damaged composite part/material in a plastic bag if possible and label as required. Pad all sharp projections from damaged composite parts to prevent accidental injuries.

3.3. The 3 CES Hazardous materials response team (HMRT) will use soil-tackifiers to hold materials on sand or soil. Solution will be sprayed onto the ground at a rate of 0.5 gal/sq.yd.

3.4. Improved hard surfaces (that is, concrete, asphalt) will be vacuumed (with electrically protected HEPA vacuums) or washed down with a detergent and water solution by 3 CES HMRT. The waste will be collected via plastic or burlap coated trenches or drainage ditches. Sweeping operations will be avoided, as they will disperse the particulate debris.

4. Clean-Up and Disposal of Exposed Advanced Composites:

4.1. Conduct material disposal according to local, state, and federal guidelines. The 3 MXG hazardous materials and waste contractor, Environmental Compliance Consultants (Building 4314) will be contacted to assist with clean-up, sampling, and turn-in of the advanced composite parts/material that do not require accident investigation, evaluation, repair, or rendered useless. Samples of the composite material will be provided to 3 CES/CEV for analysis to determine whether or not waste materials are classified as hazardous waste. Ensure the safety investigation board (SIB) releases the parts before disposal is authorized.

4.2. If possible, a HEPA vacuum will be used to clean up the local area. Ensure composite materials to be disposed of are de-militarized, netted, and double wrapped in plastic for disposal purposes. All crash debris, vacuum bags, coveralls, gloves, and other contaminated materials will be properly disposed of and labeled appropriately with the following: **"Carbon Fiber Debris. Do not incinerate. Do not sell for scrap. Dispose of in approved landfill. Composite Waste."** Any required hazard warnings will also be added. Environmental Compliance Consultants will coordinate composite waste disposal through 3 CES/CEV.

4.3. For an open terrain mishap area; 3 CES HMRT will spray surface with a final foam application and plow under after all necessary/possible material collection actions have been completed.

4.4. If aircraft were subjected to the smoke and debris of the mishap, the following will be undertaken:

4.4.1. Vacuum the air intakes with an electrically protected vacuum cleaner (HEPA).

4.4.2. For internally ingested smoke; visually and electronically (that is, "sniffer") inspect all compartments for debris and vacuum thoroughly.

4.4.3. Prior to flying, perform electrical checks and engine run-up.

5. Training:

5.1. The 3 CES HMRT members and 3 EMS CRT members' personnel will:

5.1.1. Complete computer based training entitled Mishap Composite Awareness, accessed at <https://hillnet.hill.af.mil/aco/index.html>. A copy of the completed certificate of training will be kept on file and training will be tracked on a locally developed training log.

5.1.2. Be medically cleared for respirator use, and receive initial and annual training, and complete fit testing to maintain respirator certification in accordance with AFOSH Std 48-137, Respiratory Protection Program.

5.1.3. Direct all technical advanced composite material questions to the 3 EMS Crash Recovery (Hangar 2, Phone DSN 552-2017/552-2017) or 3 EMS Structural Maintenance Section (Hangar 2, Phone DSN 552-2803/552-2803).

5.1.4. Direct all disposal concerns/questions to Environmental Compliance Consultants (Phone: 907-644-0428, Fax: 907-677-9328).

6. Forms Adopted:

6.1. **Adopted:** AF Form 847, *Recommendation for Change of Publication*.

THOMAS L. TINSLEY, Brigadier General, USAF
Commander

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

AMAN 32-4004, *Emergency Response Operations*, 1 December 1995

AFMAN 37-123, *Management of Records*.

AFI 33-364, *Records Disposition*.

TO 1-C-17-3-1, *Structural Repair Standard Practices*, 1 October 1997

TO 1-C-17A-3-8, *Disabled Aircraft and Special Maintenance*, 1 March 1998

TO 1-F-15A-3-1, *Structural Repair Standard Practices*, 15 October 1994

TO 1-F-15A-3-8, *Disabled Aircraft and Special Maintenance*, 15 October 1994

TO 00-105E-9, *Emergency Rescue and Mishap Response Information*, Revision 11, 1 February 2006

Abbreviations

ACM— Advanced Composite Mishap.

ACPO— Advanced Composites Program Office.

AFRIMS— Air Force Records Information Management Systems.

AGL— Above Ground Level.

BEE— Bio-Environmental Engineering

CES— Civil Engineering Squadron.

CEV— CES/Environmental Flight.

CRT— Crash Recovery Team.

EMS— Equipment Maintenance Squadron.

Fixant— Hold-down solution, consisting of either acrylic floor wax/water mixed in a 50% water to wax ratio, or Polyacrylic Acid (that is, PAA-Carboset® XL-11).

HEPA— High Efficiency Particulate Air.

HMRT— Hazardous Material Response Team.

IC— Incident Commander.

MOS— Maintenance Operations Squadron.

MXS— Maintenance Squadron.

PPE— Personal Protective Gear.

RDS— Records Disposition Schedule.

SCBA— Self Contained Breathing Apparatus.

Attachment 2**ADVANCED COMPOSITE MATERIALS PERSONAL
PROTECTIVE EQUIPMENT (PPE) GUIDELINES****A2.1. Burning or Smoldering Advanced Composites:**

- A2.1.1. Self Contained Breathing Apparatus (SCBA).
- A2.1.2. Full protective clothing (NFPA Standards 1971 and 1976).
- A2.1.3. Do not use rubber gloves.

A2.2. Handling Broken or Splintered Advanced Composites:

- A2.2.1. Full-face respirator with dual cartridge (high efficiency particulate air (HEPA) and organic vapor cartridge).
- A2.2.2. Coated, hooded Tyvek® (a trademark of the Tyvek Corporation) suit with booties.
- A2.2.3. Leather or Kevlar® work gloves (outer).
- A2.2.4. Disposable or reusable nitrile gloves (inner).
- A2.2.5. Hard-soled work boots (steel toe and shank required).

A2.3. Initial 2,000 Foot Clearance Zone/Cordoned Area:

- A2.3.1. Full-face respirator with dual cartridge (high efficiency particulate air (HEPA) and organic vapor cartridge).
- A2.3.2. Coated, hooded Tyvek® suit with booties.
- A2.3.3. Disposable or reusable nitrile gloves.
- A2.3.4. Hard-soled work boots (steel toe and shank required).

A2.4. Advanced Composite Materials Mishap Decontamination Equipment:

- A2.4.1. Electrically Protected (HEPA) Filtered Vacuum (Site and Personnel Clean-up).
- A2.4.2. Portable eyewash unit.
- A2.4.3. Tent or Trailer for Decon (if possible).

A2.5. Advanced Composite Materials Containment Equipment:

- A2.5.1. Fixant solution (Liquid PAA or Acrylic Floor wax solution). See paragraph 3, this instruction.
- A2.5.2. Fixant spray equipment (Garden Sprayer or Insecticide Sprayer).
- A2.5.3. Plastic sheeting, 0.006" thick.
- A2.5.4. Two inch masking tape.
- A2.5.5. Fifty-Five gallon drums and (.006") **thick** plastic bags (Hazardous Waste Disposal).