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Maintenance

**ADVANCED COMPOSITE MATERIALS
MISHAP RESPONSE**

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This instruction establishes responsibilities, unit capabilities, and procedures necessary for Advanced Composite Materials (ACM) mishaps in the McChord 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.

SUMMARY OF REVISIONS

This document is substantially revised and must be completely reviewed.

All references to LG organizational structure were changed to MXG due to Wing reorganization.

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 respirability 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 (15,000 pounds). (See **Attachment 3** for locations)

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 oper-

ations. (See [Attachment 2](#) for appropriate personal protective equipment (PPE) for burning/smoldering composite materials).

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 un-threatened 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, sensitization, 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 (i.e. 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, if available, to remove advanced composite contaminants from their outer clothing, work gloves, boots, headgear, and equipment. If unavailable, efforts shall 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 fibers.

1.9. Wrap and seal disposable protective clothing in protective plastic bags after use and discard as routine waste. Severely contaminated clothing will be labeled and discarded in accordance with paragraph [4.2.](#), otherwise, launder non-disposable clothing separately. The 62d Medical Operations Squadron (MDOS) Bioenvironmental Engineering (BEE) will determine if other special handling or cleaning procedures are required.

2. Initial Response Requirements.

- 2.1. The First-Responder(s) will be the 62d 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 (See [Attachment 3](#) for C-17 aircraft locations).
 - 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. 62d Security Forces will enforce an initial 2,000-foot clearance zone centered on the burning/smoking mishap site. Restrict personnel and traffic from entering.
 - 2.2.1. 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°F. Only fire fighters equipped with Self-Contained Breathing Apparatus (SCBA) are authorized within the 2,000-foot 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 ft above ground level (AGL) and 1,000 ft horizontally of the site.
- 2.4. The appointed On-Scene Commander (OSC), if available, or without an OSC, the Senior Fire Official, will establish control at the mishap site until fires are extinguished and composites cooled below 300°F. When the mishap scene is deemed fire safe by the Senior Fire Official and the 62 Maintenance Squadron (MXS) Crash Recovery Team (CRT) has contained damaged advanced composite material surfaces (in accordance with paragraphs [3.1.-3.6.](#)), the OSC, if available and present at the time, will assume control. The OSC or Senior Fire Official will ensure all responding personnel within the clearance zone wear appropriate Personal Protective Equipment (See [Attachment 2](#)).
- 2.5. The OSC or Senior Fire Official will consult with the 62 MDOS BEE, and determine when to eliminate the 2,000-foot 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, etc.).
- 2.6. 62d Security Forces will rope/cordon off the mishap area as established by the OSC/BEE and establish a single entry/exit point. Only sufficiently protected individuals are authorized into the immediate mishap site/cordoned area ([Attachment 2](#)).
- 2.7. The OSC or Senior Fire Official will inspect for and identify specific aircraft hazards while consulting with the crew chief, weapons system manager, reference documents, contractor, or aircraft specialists. Note 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 OSC. Ensure appropriate PPE is utilized ([Attachment 2](#)).

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

3.1. 62 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 62 MXS CRT will deploy to mishap site with a fixant or "hold-down" solution, consisting of either acrylic floor wax and water mixed in a 10:1 water to wax ratio, or Polyacrylic Acid (PAA-Carboset XL-11). The CRT will maintain an adequate supply of fixant solution(s) and spray equipment.

3.2.1. Fire must be completely extinguished and the composites cooled to below 300°F (149 °C) before fixant application. Fire fighting equipment will be available during fixant application, and aircraft break-up and recovery.

3.2.2. CRT team members will apply (preferably spray) a heavy coating of the fixant solution to all burned composite materials 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.

3.3. The 62 CES Hazardous Materials Response Team (HRMT) will use soil-tackifiers (i.e. Polychem, J-Tack, Terra Tack) 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. 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.

3.5. Apply masking 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.

3.6. Improved hard surfaces (i.e. concrete, asphalt) will be vacuumed (with electrically protected HEPA vacuums) or washed down with a detergent and water solution. 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 62 MXG hazardous materials and waste contractor, TekStar Inc. (main office in Bldg 745) will be contacted to assist with cleanup, sampling, and turn-in of the advanced composite parts/material that do not require accident investigation, evaluation, repair, or not needed. Samples of the composite material will be provided to 62 MDOS BEE 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 any 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. TekStar Inc. will coordinate composite waste disposal through 62 CES/CEV.

4.3. For an open terrain mishap area; the surface will be sprayed with a final foam application and plowed 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.

4.4.2. For internally ingested smoke; visually and electronically (i.e. "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. 62 MXG HMRT members, 62 MXS CRT members, and 62 MDOS BEE personnel will:

5.1.1. View 14-minute training video titled Mishap Response for Advanced Composites. Video may be viewed at the 62d Maintenance Operations Squadron (MOS) Maintenance Training Flight (SW corner of Hangar 1).

5.1.2. Be medically cleared for respirator use, and receive initial and annual training and fit testing to maintain respirator certification.

5.1.3. Direct all technical advanced composite materials questions to the 62 MXS Structural Maintenance Section (Bldg. 745, Phone 982-5375/DSN 382-5375).

5.1.4. Direct all disposal concerns/questions to TekStar Inc.(Phone: 982-5856 / DSN 382-5856)

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

AFMAN 32-4013, *Hazardous Material Emergency Planning And Response Guide*, 1 August 1997

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

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

62 AW CAP, *Contingency Action Plan*, 15 June 2003 TO 00-105E-9, *Emergency Rescue and Mishap Response Information*, Revision 8, 30 September 2002

Abbreviations and Acronyms

ACM—Advanced Composite Mishap

ACPO—Advanced Composites Program Office

AGL—Above Ground Level

BEE—Bio-Environmental Engineering

CES—Civil Engineering Squadron

CRT—Crash & Recovery Team

HEPA—High Efficiency Particulate Air

HMRT—Hazardous Material Response Team

MOS—Maintenance Operations Squadron

MXS—Maintenance Squadron

OSC—On Scene Commander

PPE—Personal Protective Equipment

SCBA—Self Contained Breathing Apparatus

Terms

Fixant—Hold-down solution, consisting of either acrylic floor wax/water mixed in a 10:1 water to wax ratio, or Polyacrylic Acid (i.e. PAA-Carboset XL-11)

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 suit with booties
- A2.2.3. Leather 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 Para. **3.2.**
- A2.5.2. Fixant spray equipment (Garden Sprayer or Insecticide Sprayer)
- A2.5.3. Plastic sheeting <0.006" thick
- A2.5.4. <2" Masking Tape
- A2.5.5. 55 gallon drums, and **thick** (>0.006) plastic bags (Hazardous Waste Disposal)

Attachment 3

C-17 COMPOSITE LOCATIONS

