Chapter 7

AVIATION MAINTENANCE IN UNUSUAL ENVIRONMENTS

Often, maintenance procedures used in one environment will not be appropriate for another. Commanders must be aware of the unique implications of performing aircraft maintenance in unusual environments. They must ensure that adequate preparations are made before operating in such areas.

SECTION I – DESERT, JUNGLE, MOUNTAIN, AND COLD WEATHER

GENERAL

7-1. Operations may be conducted in many different types of environments. This includes desert (hot), jungle, mountain, or extremely cold climates. Conducting aircraft maintenance in these types of environments can be challenging. In general, commanders must look at factors such as the following:

- Modifications to normal repair part stockage levels. These include increased numbers of filters, bearings, and seals when operating in wind and sand environments.
- Mobility restriction. For example, mountains, heavy foliage, ice, and so forth.
- Effect on personnel and equipment performance. These include altitude, excessive heat, cold, and so forth.
- Communications restrictions.
- Special shelter requirements.
- Modifications to normal scheduled and preventive maintenance.
- Specialized equipment and clothing requirements.

DESERT OPERATIONS

7-2. Sand, heat, wind, blowing dust, long lines of communication, and poor roads present many unique maintenance problems in desert operations. This is not business as usual. All aviation functions must adapt to survive in the desert environment.

EFFECTS OF SAND AND DUST

7-3. Dust and sand can easily cause failure of such items as cyclic and collective electrical switches, digital entry keyboards, radio tuning knobs, and circuit breakers. Sand erosion causes wear on rotor heads, leading edges of rotor blades, Teflon bearings, and all turbine engine blades. Blowing sand gradually degrades optical instruments and windscreens by pitting and scratching. Sand, dirt, and dust accumulation on oil cooler surfaces creates loss of cooling efficiency in an environment where that ability is paramount. Sand mixed with oil forms an abrasive paste. Lube fittings and bearing seals require frequent inspection. If they are missing, sand will enter the housing and cause bearing failure. Heat soaking of sensitive electronic "black boxes" will produce increased failures and demands on aircraft cooling systems.

PREVENTATIVE MAINTENANCE

7-4. Preventative maintenance is vital in the desert. It entails the need for more frequent inspections, daily cleaning, and engine flushing. Maintenance practices should emphasize measures to keep sand from contaminating systems and equipment. As much as possible, all maintenance should be done in a shelter. This will help prevent sand from entering the internal working parts of larger assemblies.

7-5. Protective covers should be used at all times. Optics can be protected in flight by stowing during landing, take-off, and FARP operations. Windscreens, blade covers, nose covers, and engine inlet covers should be installed when aircraft are not in use. Covers should have a tight fit to avoid flapping. Sand on the underside of a vibrating cover can scratch the windscreen. Use of covers combined with smart parking orientation will alleviate some "heat soaking" problems. A climatic heat aircraft protective system is a camouflage screen designed to protect the aircraft. This system will not weather a full-fledged blowing dust storm.

7-6. On those systems which have a pressurized air system for cooling, extra filtration and decreasing cleaning intervals will solve most problems.

7-7. ULLS and TACCS automation hardware will require added preventative maintenance emphasis to keep them operational. The two worst enemies of a computer, heat and dust, are everywhere in the desert.

MAINTENANCE SHELTERS

7-8. There are currently two shelter options over and above organic shelters. The unit maintenance tent is a canvas structure built on a metal frame. This shelter, available through normal supply channels, can accommodate one small aircraft. The second option is a large area maintenance shelter commonly called a "clam shell", which is a commercial hangar that has many available options. This shelter, available through AMCOM, can accommodate several large aircraft. Both tents are mobile, but they require a significant amount of cargo space and manpower commensurate with their respective sizes.

INCREASED MAINTENANCE

7-9. The two most significant areas of increased maintenance are rotor blades and turbine engines. These items will multiply the maintenance workload many times depending on the unit's basing and flying techniques. Engine problems occur on all aircraft and include auxiliary power units. Operations Desert Shield/Desert Storm reported six accidents directly related to engine failure or loss of power. Different systems are more or less susceptible to the effects of sand.

Engines

7-10. Many systems rely on an inlet particle separator system to reduce engine wear. Keep in mind that these systems are not efficient at idle RPM. Ground runs must be kept at an absolute minimum. Filtration kits for all aircraft are now available through AMCOM readiness directorate. Since none of these systems are 100 percent effective, new hot-end flush procedures were developed. Instead of compressor cleaning, emphasis is on the power turbine section. Sand can accumulate in the blades of the power-generating wheels.

This sand will eventually glaze, which inhibits cooling and heat expansion. In-flight health indicator check procedures are available but require training and close monitoring as a predictive tool.

Rotor Blades

7-11. Rotor blades require one of two current solutions. Blade painting requires relatively high repetition and inspection. Blade taping requires skilled application and an increase in rotor track and balance effort. Both solutions are short-term and require diligence by the crew during preflight and postflight inspections.

Bearings

7-12. Teflon™ bearings also will see a rise in failures. Two current strategies include water flushing and protective dust boots. These procedures and kits are available through AMCOM.

Aircraft Survivability Equipment

7-13. The AN/ALQ 144 is very susceptible to main bearing failure in a sandy environment. ASE should be covered whenever the aircraft is not in use.

INCREASED SUPPORT

7-14. AVUM requirements for assistance from AVIM units may increase. The QC mission broadens to train all flight crew personnel in the additional inspection requirements. Flying crews will also be training on desert flying techniques that will complement the maintenance effort.

7-15. Increased AVUM mobility requirements will place greater emphasis on AVIM contact team support. The distance between AVUM and AVIM units will increase, however, creating problems in communications and in locating units. Contact teams must have a GPS receiver.

REVERSE CYCLE

7-16. Maintenance personnel will consume much more water and should be more closely supervised during the heat of the day. Productivity will decrease as the environment becomes harsher. Reverse-cycle maintenance may be a solution to adverse daylight conditions.

7-17. Many lessons learned are available from units that have participated in NTC rotations, Bright Star exercises, and Operations Desert Shield and Desert Storm. Remember that there is sand in the desert. It is not business as usual. For more information on desert operations, refer to FM 3-97.3(90-3).

JUNGLE OPERATIONS

EFFECTS OF HEAT AND MOISTURE

7-18. In jungle operations, lenses and dials quickly fog with internal moisture. Electrical connections corrode quickly and battery life is shorter than normal. Weapons tend to rust quickly and must be cleaned and oiled more often than in other areas. Canvas rots and rubber deteriorates much faster. An aggressive corrosion-prevention program should be initiated. All parts and systems are susceptible to corrosion. Avionics are particularly sensitive to moisture, condensation, and corrosion.

MAINTENANCE

7-19. Preventive maintenance practices must be given greater emphasis, and scheduled maintenance must be performed more often than in temperate climates. Higher maintenance requirements, combined with transportation difficulties, may require units to carry increased loads of repair parts. PLLs must reflect the increased turnover of those parts that deteriorate or wear out faster in the jungle.

MOVEMENT

7-20. Several factors greatly influence the type of transportation that can be used and the way maintenance is performed. These factors include the absence of adequate trails, roads, and waterways; the density of natural growth; the number of rainy seasons; the security of routes; and the general nature of the terrain in a jungle environment. AVUM units should request on-site AVIM maintenance to the most feasible extent. Air delivery of AVIM MSTs to the AVUM location will be used whenever practical. Aircraft may be required to deliver repair parts and evacuate materiel.

INCREASED SUPPORT

7-21. When units are widely dispersed, AVIM units may have to augment the AVUM maintenance effort and perform more extensive maintenance than in normal operations. This is due to difficulties in evacuating materiel for backup and overflow maintenance.

FIELD SITES

7-22. Because of the jungle terrain, fewer good sites are available for maintenance operations. Considerable engineer effort may be required to prepare suitable locations. Therefore, maintenance units may be unable to deploy as often as they would in more favorable terrain. In areas where monsoon rains occur, maintenance sites must be selected carefully. These limitations may force maintenance units to locate with other types of units. This simplifies the problems of security from ground attack for such areas and is likely to be necessary in areas of large-scale guerrilla activity. However, such concentrations present good targets for air attack and require provisions for air defense. For more details on jungle operations, refer to FM 3-97.5(90-5).

MOUNTAIN OPERATIONS

LIMITATIONS OF MOUNTAIN OPERATIONS

7-23. Maintenance in mountain operations can be very difficult. Rugged terrain and abrupt changes in elevations limit the reliability of roads and suitable areas for unit locations. High altitudes and weather affect the performance of troops and equipment. Personnel must be trained to adapt to high altitudes, and equipment may need adjustment to operate efficiently at higher elevations.

MAINTENANCE

7-24. Aircraft may be needed to move repair parts and contact teams on site and to evacuate unserviceable items. AVIM units must be located as close as practical to the AVUM units they support. Maintenance support is critical in mountain areas. Therefore, the commander making area assignments must provide units with sufficient space to perform their maintenance functions. For more details on mountain operations, refer to FM 3-97.6(90-6).

COLD WEATHER OPERATIONS

EFFECTS OF COLD WEATHER

7-25. The terrain and climate of northern regions, and other areas similar in terrain and climate, complicate military operations. Operations in snow, ice, and extremely cold conditions require special training, personnel acclimation, and operational techniques.

7-26. Trafficability is one of the biggest problems in northern operations. This is especially true during spring breakup and in summer when the ground thaws and the ice in streams and lakes melts. With few roads in such regions, track-laying vehicles of the low-ground-pressure type may provide the only means of cross-country mobility. Mud, muskeg, swamp, marsh, and open water hamper all ground movement in spring and summer. Therefore, thorough ground reconnaissance is necessary for overland movement. Extreme cold improves trafficability, although tracked vehicles and sleds may be required for movement. Weather conditions in winter may limit the use of aircraft.

7-27. Extreme climatic conditions hamper on-site maintenance operations and curtail personnel effectiveness. Therefore, maintenance performed on site, as well as recovery of disabled equipment, will take more time and effort. Evacuation of unserviceable items from using units to support maintenance is also more difficult.

SPECIAL EQUIPMENT

7-28. Northern operations require a considerable amount of specialized equipment, such as tracked vehicles, sleds, heated shelters, and heated shop facilities. Every item of equipment is affected by extreme cold and snow in the winter and by mud and water in the summer. Extreme conditions increase wear and tear on equipment and increase the quantity and variety of parts required for maintenance. For more details on operations in northern regions, refer to FMs 3-05.70(31-70) and 3-05.71(31-71).

SECTION II – NIGHT AIRCRAFT MAINTENANCE

DOCTRINE

7-29. Battle doctrine calls for around-the-clock aviation operations. These operations, in turn, need fully productive, 24-hour-per-day aircraft maintenance capabilities. Maintenance done at night on aircraft that have flown all day allows those same aircraft to be assigned to missions early the next day. This avoids their being “stacked up” in maintenance with night-flying aircraft for the first part of the day.

LIGHT DISCIPLINE

7-30. Light discipline is, of course, imperative to night maintenance activities on the battlefield. The closer to the MBA a unit operates, the more restrictive light suppression precautions must be. Units operating relatively close to the MBA need to perform night maintenance inside closed blackout shelters. The approach would be with self-powered light under lightweight portable blackout enclosures that can be easily moved from one location to another. Units should perform forward night maintenance inside large (full-aircraft) lighted blackout shelters only if sufficient internal lighting can be provided without using noise-producing power generators.

MISSION, ENEMY, TERRAIN, TROOPS-TIME AVAILABLE AND CIVILIAN CONSIDERATIONS

7-31. Units operating toward the rear will normally have more latitude concerning the distance from which they must consider enemy detection. Rigid blackout provisions will still apply to all “inside” white light work, but certain tasks will be allowable outside, with subdued lighting devices. The degree of detection avoidance on the battlefield will be determined on a situation-by-situation basis. Generally, units operating farthest to the rear will be those whose prime mission is performing maintenance functions (AVIM). Due to the large task volume, some of the workload will have to be handled outside available shelters.

7-32. METT-TC will play a major role in determining the extent of night maintenance that can be used safely and effectively. In the open-desert-type Mideast terrain, the faintest light may be visible from a long distance. That same light would not be detected from a comparable distance in the forested, hilly European scenario.

7-33. Certain tasks are difficult to perform at night under light-discipline conditions. For example, maintenance jobs that require rotor blade turning or engine run (rotor track, fuel control adjustment, and so forth) must be done outside. Sometimes these require significant area lighting. Then, adequate light discipline could not be imposed, and tasks would have to be delayed until daylight.

7-34. A single all-encompassing, definitive concept for night aircraft maintenance operations is not feasible. Each organization must establish and alter its plan for implementing night operations as it meets specific environmental conditions and threat changes on the battlefield. For example, as a unit moves forward into open terrain, its night maintenance considerations will differ considerably from when it moves rearward into a closed environment.

PREPARATION

7-35. Baseline criteria must be developed to help determine the amount of light discipline required in various tactical situations. A number of factors will influence the determination: estimated enemy detection capabilities, terrain, weather, level of maintenance, type of aircraft requiring maintenance, and so forth.

EFFECTS ON PERSONNEL AND MAINTENANCE

PRODUCTION CONTROL

7-36. Systematic PC procedures must be developed to ensure safe, efficient continuity of work on a 24-hour basis. The assignment of work and flow of managerial paperwork and records must be as accurate and efficient under multishift operations as under single-shift (daytime) maintenance.

QUALITY CONTROL

7-37. QC procedures for night maintenance must be especially rigid. The potential for “missing something” increases as the adequacy of the work environment diminishes and the fatigue level of night workers increases. Of particular concern are the visual restrictions associated with working in subdued (red, green) lighting as opposed to white light. Also, it is a fact that workers who are on night shift generally perform only about 70 percent as well as day workers because of the mental fatigue associated with disruptions in the body's internal clock (a condition called shift lag). QC tasks requiring maintenance operational checks or test flights may have to wait until daylight for sign-off. Procedures and criteria for the NAMP must be developed. The main concern is that quality and SOF standards are maintained at the same level as for daytime maintenance.

WORK SCHEDULE

7-38. For night maintenance, units are staffed for 12-hour operations. Aviation units with AVUM capabilities should organize personnel resources in teams that will allow around-the-clock maintenance capability. As a rule, the day shift maintenance effort should equal approximately 80 percent of the AVUM potential effort. Night maintenance should represent 20 percent of the unit's effort. AVIM units have greater night maintenance potential because they are further to the rear. Light and noise disciplines are still major considerations, but they are less significant than for AVUM units. AVUM platoons/companies should request AVIM augmentation or MSTs for extended maintenance operations. AVIM units must provide support consistent with the combat mission and needs of their supported AVUM units.

TRANSITION BETWEEN SHIFTS

7-39. The chances of something "falling through the crack" increase when a wide range of maintenance tasks are interrupted and passed for completion to work crews other than those who started them. This particularly holds true at AVIM level. Administrative controls, such as detailed coordination meetings between shift supervisors, must be inherent to units using 24-hour maintenance operations. Supervisors must avoid any tendency to rush or circumvent such requirements so that personnel can "get on with the work." The transition from day to night shift must be handled efficiently.

PHYSIOLOGICAL FACTORS

7-40. Obviously, vision is reduced during night operations, but numerous other human factors can affect night maintenance. A comprehensive, detailed human factors indoctrination program must be developed for supervisors and repairers. Adjustment periods should be established, to the extent possible, to allow newly assigned personnel to adapt to night work. A sudden reversal of normal sleep patterns can result in an unavoidable tendency to become drowsy while performing critical maintenance tasks. Personnel working at night often suffer from fatigue-related difficulties making decisions and performing even simple mental tasks more difficult. Also, because of general feelings of tiredness and sluggishness, they perceive routine jobs to be more taxing than usual, and as a result, they may tend to save tough jobs for the daytime crew. This is particularly true during low-intensity operations, and many other examples could be cited. Physiological factors that must be considered in night aircraft maintenance are the following:

- The eyes normally require about 40 minutes to fully adapt to darkness.
- Adjustment to a new work schedule requires about 1 day for each hour of shift change.
- Forward shift rotations (days to evenings to nights) allows faster adjustment than backward rotations (nights to evenings to days).
- Because the body's clock is set by exposure to the daylight, most night workers never fully adjust.

- Fatigue affects a repairer's night vision, muscular actions, and mental abilities.
- A loss of depth perception and color distinction is experienced at night.
- Smoking either three cigarettes in rapid succession or 20 to 30 cigarettes a day reduces night vision by approximately 20 percent.
- The danger of FOD increases at night.
- Diet affects night vision. Individuals should eat only highly nutritious foods.

SECTION III – NUCLEAR, BIOLOGICAL, AND CHEMICAL OPERATIONS

NUCLEAR, BIOLOGICAL, AND CHEMICAL THREAT

7-41. This section addresses the different types of NBC operations, their effects on the unit's mission, and proper decontamination procedures for personnel and equipment. Threat forces around the world have inventories of NBC munitions and agents. Some threat vehicles and aircraft possess overpressure systems, filtration devices, and detection systems to protect their crews. Aircraft maintenance personnel are often dispersed to locations where NBC detection devices are not available and where qualified medical help may not be readily available. Their missions could be severely affected by chemical and biological agents.

7-42. The use of chemical or biological agents against U.S. maintenance facilities and units will allow threat forces to isolate vital materiel from the battlefield with little risk of tactical exposure to their own forces. Aviation unit commanders and staff planners at every level must deal with the impact that NBC operations and attacks will have on their unit. They must consider ways to resume operations at the earliest opportunity. Decontamination of unit personnel, equipment, supplies, and operating areas is an arduous, time-consuming task that requires careful, realistic planning. For more detailed information on decontamination procedures, refer to FM 3-11.5(3-5).

AIRCRAFT DECONTAMINATION

7-43. Aircraft frequently operate in small elements (usually of three to six aircraft) with little or no organic ground support. Organic decontamination capability for the aircraft is very limited. Currently, only one M-11 decontamination apparatus and two 1 1/3-quart cans of DS2 are authorized as on-board decontamination equipment. (This decontaminant can be used only on a very small portion of the aircraft surface because it is highly caustic and will destroy most aircraft materiels.) Standard decontaminants and decontamination procedures currently in use will ruin many types of aviation equipment and materiels. See FM 3-11.5(3-5), Chapter 7 for decontaminants that are approved for use on selected parts of aircraft.

M17 SANATOR

7-44. Decontamination efforts can be greatly assisted by the M17 (SANATOR) heater/pump found in chemical companies, Aviation Battalion/Brigade HHCs, and AVIM Battalions. This equipment will quickly wash all aircraft and vehicles. The most significant planning consideration is water storage capacity. The M17 is fielded with a 1,580-gallon collapsible water tank. New systems are upgrading this storage capacity to 3,000 gallons.

7-45. The U.S. Army Edgewood Research Development and Engineering Center and the U.S. Army Chemical School are developing detailed procedures on the best-suited decontaminates for paint for each type of aircraft surface—plastic, fiberglass, or composite.

CONTAMINATION AVOIDANCE

7-46. Any type of decontamination is costly. Resources must be diverted from fighting the enemy to decontaminating the aircraft. Therefore, repair personnel must know and practice contamination avoidance first. Contamination avoidance saves time and other resources that would otherwise be used up in decontamination. Simple, common sense measures can be used to avoid contamination or at least reduce its extent. (See FM 3-11.3(3-3) for information on contamination avoidance.) The following are measures that avoid contamination:

- Know what areas are contaminated and avoid these, if possible.
- If aircraft must land in contaminated areas, pick landing zones that will have a reduced splash effect.
- Limit the spread of contamination into the aircraft from outside. For example, ground crews at the FARP should conduct arming and refueling without requiring the aircrew to exit the aircraft.
- Contaminated crews should conduct inspections without touching or shaking items. Many inspection points can be inspected visually.
- Increase the use of covers when not flying. Use engine covers, flyaway gear, and hatches. If possible, provide overhead cover for parked aircraft.
- Limit the number of aircraft that must operate in a contaminated area or use aircraft already contaminated.
- When carrying contaminated personnel or casualties, lining the troop compartment with plastic is a field expedient way to limit the spread of contamination. A plastic curtain can be fastened between the troop compartment and the flight compartment with tape or velcro to limit contamination transfer. The aircraft's heater can be used with the curtain to create an overpressure in the pilot's compartment. This will limit vapors from entering the compartment.
- Apply M9 paper to the landing gear of the aircraft. FARP personnel should always check the M9 paper before servicing the aircraft. Another piece of M9 paper can be placed on the windscreen where the aircrew can see it.

DECONTAMINATION PROBLEMS FOR AVIATION EQUIPMENT

7-47. When aircraft are contaminated, the mission becomes very difficult and crew efficiency steadily degrades. Decontamination can stop the degradation, but, aside from being costly, special problems occur when decontaminating aviation equipment. The decontamination method as well as the extent of decontamination depends on the specific activities of the aircraft. Most activities require operational decontamination. Surfaces are washed with decontaminants to remove gross contamination from agents that are harmful through skin contact. Some of the agent will probably have soaked into the surface, however. Even after decontamination, these surfaces will still give off agent vapors, and the decontamination agent itself will exude from the materiels. Individuals should avoid any contact of bare skin with such surfaces. If they absorb the agent through the skin, they could become casualties. Complete decontamination of aircraft components is necessary to allow maintenance personnel to work on the aircraft without wearing cumbersome protective gear.

DECONTAMINATION SITES

7-48. Operational aviation decontamination is normally done in the FARP and AVUM areas. To a limited extent, they are also done in divisional and nondivisional (corps) AVIM areas. Thorough decontamination of aircraft components will be done at divisional and nondivisional (corps) AVIM areas. The procedures at each activity will specify where the decontamination support will come from, if it is required. For example, divisional chemical company personnel and their equipment might be required to support divisional AVIM areas.

IMPACT ON MAINTENANCE

PLANNING

7-49. Maintenance personnel must be prepared to provide maintenance support on the integrated battlefield. To accomplish this, individual soldiers must be trained to survive an initial nuclear or chemical attack and to continue the mission in a toxic environment under great physical and mental stress. The long-term problems caused by contamination make it doubly important that maintenance units protect themselves. When possible, maintenance activities should occupy protected areas, such as underground garages or concrete buildings, to provide cover from liquid chemical agents and shielding from radioactive contamination. Pressurized shelters like the M20 will protect soldiers doing component maintenance. The M20 will use an existing shelter as a skeleton and conform to its shape and size. Units should establish SOPs for contaminated aircraft and equipment maintenance procedures as follows:

- Inspection and contaminated maintenance collection point procedures.
- Procedures for performing unit-level immediate decontamination or requesting deliberate equipment decontamination from an NBC defense company.
- Procedures for repair without electronic test equipment (in the event equipment is destroyed by blast or EMP).
- Responsibilities and procedures for establishing and operating a contaminated-equipment holding area.

CONTAMINATION HAZARDS

7-50. The following are some special hazards that can occur when working on contaminated equipment:

- Petroleum products tend to trap chemical contaminants.
- An aircraft that is safe for an operator to use without MOPP 4 protection may be unsafe for a mechanic to repair.

- Chemical contaminants may collect in bolt threads, hydraulic fluids, and closed assemblies. A mechanic might break open a component, for example, and be exposed to lethal concentrations of hazardous vapors. Casualties could be high unless all repairs and preventive maintenance on previously contaminated aircraft are done in MOPP 4.
- Oil, grease, and dirt seriously degrade the protective qualities of the chemical protective suit. Mechanics must keep themselves as clean as possible. Extra protective suits should be on hand to replace dirty ones.
- Wet-weather gear helps keep protective suits clean but increases heat buildup and will eventually be penetrated. The combination of protective gear and wet-weather gear provides good (although hot) protection from a combination of toxic chemicals, grease, and oil contamination. Fuel handlers' aprons and field-expedient rubber sleeves can provide some added protection with less heat buildup.

CONTAMINATION CONTROL

7-51. Contamination must not be spread. Contaminated equipment must not be taken into a clean shop. Maintenance teams should make every effort to repair contaminated equipment in a contaminated MCP. Repaired, but contaminated, equipment must be returned to contaminated units, whenever possible. Even if equipment has gone through unit immediate decontamination, it can still be hazardous to handle. A previously contaminated unit will already be conducting periodic contamination checks and will be able to use the equipment safely because of the precautions being taken.

7-52. Contaminated equipment and tools must be stored at a location downwind of clean areas. Every effort must be made to control the spread of contamination. Contaminated aircraft and equipment should not be evacuated for repairs. If AVIM maintenance is required, a MST will be sent forward to effect repairs in the contaminated MCP. AVIM maintenance units should treat all customer equipment as contaminated until inspection proves otherwise.

7-53. Contaminated tools and equipment will be used to repair contaminated equipment. Since it is difficult to decontaminate equipment well enough to eliminate risk to mechanics, it may be impractical to decontaminate tools and equipment used to repair contaminated equipment. Segregate tools and equipment that are used to repair contaminated equipment from uncontaminated tools. Protection from contaminated equipment must be provided. At present, the Army's ability to detect contamination in the field is limited. Toxic vapor trapped by oil or held inside a closed assembly may appear at some point during the maintenance process. Because decontamination cannot guarantee safety for unprotected mechanics, the aviation maintenance officer must decide which MOPP level the mechanics should use. This is a tactical decision. Mechanics should use MOPP levels consistent with the threat and the mission.

Safeguards

7-54. Safeguards must be taken to protect people both inside and outside contaminated areas. Chemical agent detection equipment should be operated while contaminated equipment is being repaired. The testing must be a continuous process. Vapor hazards may not be present in open terrain, but as soon as the aircraft is moved into an area where air does not circulate, significant toxic vapors may concentrate.

7-55. If contamination is detected after an assembly is opened, it can be decontaminated quickly by flushing with jet fuel, diesel fuel, or motor gasoline. The unserviceable component must then be marked and taken to the contaminated holding area. In that area, it can weather or undergo a thorough decontamination. For repairable assemblies, personnel should either wait until the assembly no longer gives off vapor or replace it with a new assembly. The fuel used for flushing must also be marked as contaminated. It should be dumped in the contaminated sumps at the decontamination site or disposed of per unit SOP.

7-56. Maintenance personnel repairing equipment contaminated with radiation should wear dosimeters and be closely monitored for exposure. They must never exceed exposure levels. When the highest acceptable levels are reached personnel should be replaced, mission permitting. The amount of radiological contamination that personnel can be exposed to varies. It depends on operational exposure guidance and the tactical situation. Priorities for monitoring equipment should go first to the recovery teams, then to inspection point MSTs, and then to the MCP.

Aircraft Marking

7-57. Mark aircraft and equipment to protect others. Aircraft and equipment that are contaminated or that have been decontaminated to low-risk levels for operators and crews could still present a serious hazard to mechanics. They need to know that the equipment has been contaminated. Contaminated aircraft must be identified with standard triangular contamination signs on all four sides and at the operator’s controls. Write the type and date of contamination on the signs, which should be easily visible from the outside of the aircraft. For nonpersistent agents, signs may not be removed until decontamination has been verified by a detailed inspection. Contamination signs on aircraft and equipment contaminated with persistent agents will not be removed even after decontamination.

MAINTENANCE SUPPORT OPERATIONS

7-58. Contaminated equipment maintenance should be performed from a clean area. Work within a clean area can be done at reduced MOPP and with greater efficiency. When NBC attacks have occurred within the support area, the unit must assume that all equipment is contaminated, and the aviation maintenance unit must set up separate inspection points and MCPs. All aircraft, personnel, and supplies must pass through an inspection point before they enter the maintenance area. Here, inspectors in MOPP 4 can use heaters or torches to warm equipment while they check it for contamination. The vapor hazard from liquid contamination may be undetectable at 65°F (18°C) in the open yet become lethal at 80°F (26°C) or when brought into closed areas. Some biological contamination, including toxins, may not be detectable. You must assume it is present if the equipment came from an area known to have been contaminated. Radiacmeters will easily detect radiological contamination.

DISPOSITION OF CONTAMINATED EQUIPMENT

7-59. The inspection team must segregate the equipment. Uncontaminated equipment can go straight to the maintenance area. Contaminated vehicles and equipment must be marked with contamination signs. A decision must then be made on the disposition of each item. If the equipment is contaminated and repairs can be performed in MOPP 4, the item may be sent through decontamination or left to weather. If weathering is the choice, the marked equipment must be placed in a holding area where it can decontaminate itself. Waiting for equipment to weather before repair may be a luxury a commander cannot afford. It may take weeks in cool weather. The next choice is to perform unit restoration decontamination before any repairs are made. Priority equipment must be decontaminated first, but setting priorities is often not easy. For instance, you may have four attack helicopters equipped with antitank weapons. If they are lightly contaminated, perhaps all four could be decontaminated and repaired in the time it would take to decontaminate and repair one heavily contaminated utility helicopter. Decisions like this require coordination between maintenance and operational staffs.

7-60. Decontamination should be done only if it is cost-effective. When a persistent agent is involved, every effort should be made to replace a contaminated component with the next higher assembly that can be done in MOPP 4. Contaminated equipment or components should be marked and placed in the holding area to await disposition instructions from higher headquarters.

CONTAMINATION CONTROL

7-61. Uncontaminated teams should not perform on-site maintenance and generally should not attempt recovery of contaminated equipment. Unserviceable contaminated equipment and aircraft should be recovered to the decontamination site or contaminated MCP by other contaminated vehicles or aircraft.

7-62. Both AVUM and AVIM maintenance activities will send teams forward to repair or recover aircraft and equipment if it is unknown whether they are contaminated. The teams must be in MOPP 4 and must test the equipment for contamination. If contamination exists, the maintenance team must decide whether repairs can be made in MOPP 4. If they cannot, the equipment must be decontaminated. Any surfaces the maintenance team must touch to repair or recover the aircraft must be given an operator's spraydown with an approved decontamination apparatus. This will not reduce the level of MOPP needed but offers some additional protection and limits spread. Maintenance teams must carry extra on-board decontaminants for this purpose. The objective is to limit transferring liquid contamination from the equipment being repaired to the maintenance or recovery team or their equipment.

7-63. After equipment and tools have been used for contaminated maintenance, they should remain contaminated. Use rags to wipe off only the gross contamination. Dispose of the rags in a sump, or bury them and mark the location. Maintenance teams may go through a MOPP gear exchange or detailed troop decontamination, but the team's equipment and tools should be left alone. A fresh team can use the contaminated tools on other contaminated equipment. For extended repairs, a fresh team relieves a contaminated team, which moves back and undergoes detailed decontamination. After a rest, the newly decontaminated team rotates forward and relieves the contaminated team.

7-64. Support from a contaminated area is limited to the amount of time that soldiers can operate in MOPP 4. This severely restricts the maintenance support from a contaminated area. It may be possible to extend the length of time the unit can continue to support from the contaminated location by scheduling periodic withdrawal of personnel to a clean area for complete personnel decontamination and a rest period at a reduced MOPP level. For continued effectiveness, however, the unit must leave the area, go through a detailed equipment and decontamination process, and set up shop in a clean area. Time limits may dictate that only the most critical repairs continue while a portion of the unit moves to a clean area. The limited organic transportation capability may require that some unit and customer equipment be left behind. After reorganization at the clean area, this equipment may be recovered or repaired using the procedures described for supporting from a clean area.

CONTAMINATION AVOIDANCE

7-65. Contamination avoidance should be the keystone of the support strategy in an NBC environment. Unit NBC defense personnel should monitor the NBC situation by maintaining contact with higher headquarters and their counterparts in supported units. Before dispatch of MSTs, as much information as possible must be obtained relating to the threat along the route of march and at the support location. The location and availability of complete equipment decontamination stations must be carefully monitored. These facilities are operated under the supervision of elements of the division’s chemical company. Combat elements usually have priority of support. See FM 4-93.3(63-3) for more details.