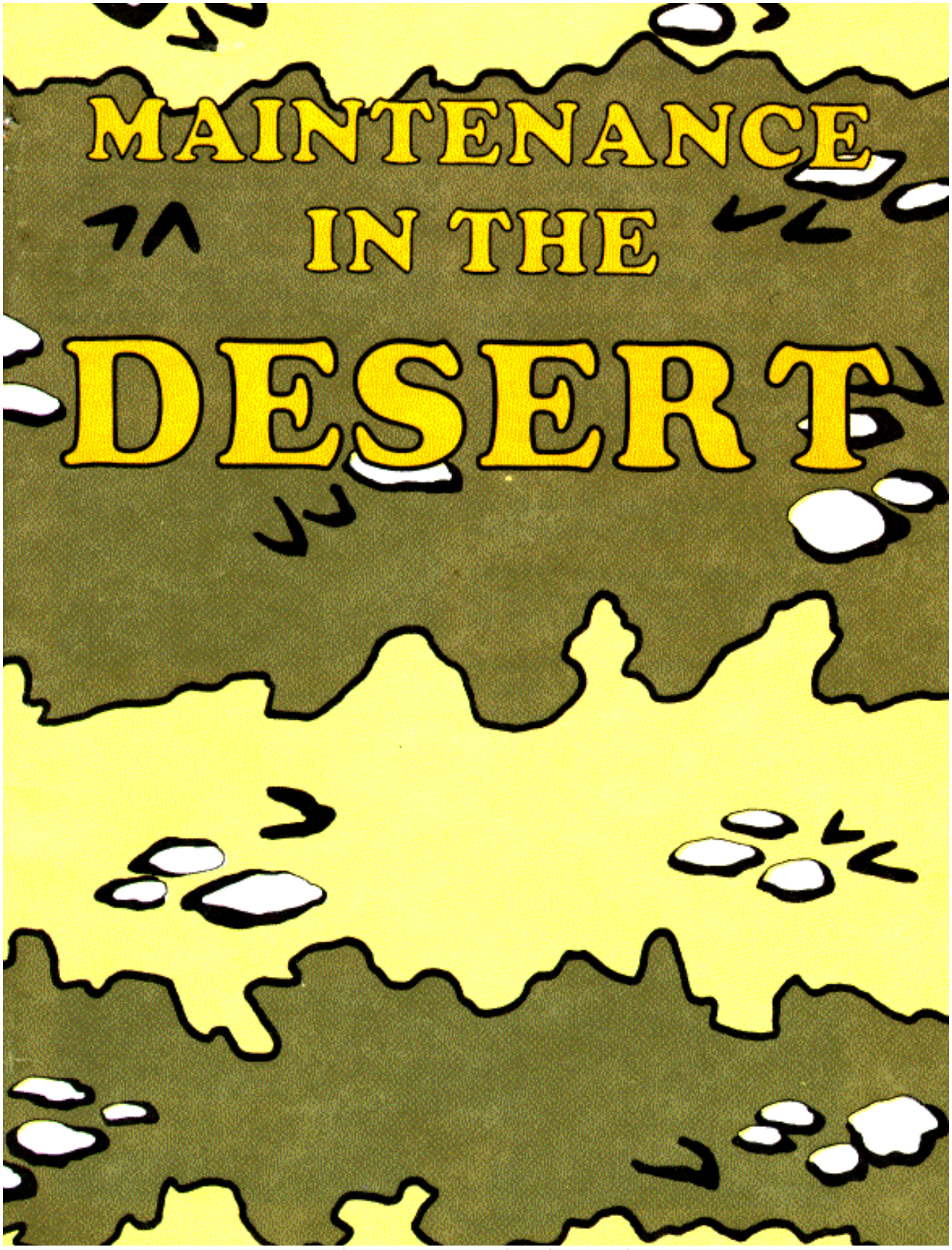


Supersedes TB 43-0239 dated 9 March 1981.
Approved for public release; distribution is unlimited.

15 OCTOBER 1990

The War with the Desert

The desert tortures your equipment.

Scorching sun heats metal to stove-top temperatures.

Thick clouds of fine dust slip around the tightest seals.

Vast stretches of sharp rock gouge chunks out of tires and track pads.

Dry air sucks the life out of hydraulic seals.

Fierce winds blow sand that's like a swarm of locusts chewing up anything in its path.

Temperatures can soar to 140 degrees in daytime summer shade and plummet to below freezing on a winter night.

Preventive maintenance becomes a full-time job. Check everything. Then check it again. Leave nothing to chance. Chance will destroy your equipment. Chance will kill you.

Do all the PMCS in your TM. Study this TB. And put these items at the top of your check list:

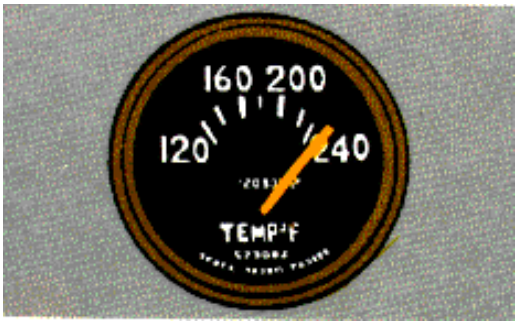
Oil and water. Measure all fluid levels often. Liquid-cooled engines need frequent inspections for leaks. Even a tiny leak can lead to disaster.

Lube. Extra lubing is needed in some spots while normal lubing is too much in others. Greasing seals on U-joints and suspension systems won't keep out fine desert dust. That dust mixes with the grease to create a grinding compound that will chew your equipment to bits. In these cases, you must lube more often to flush out the old lube. Clean grease is the only thing that will keep your vehicle going.

But on exposed bearing surfaces, like on small arms and artillery, normal lubing is too much. It attracts dust and sand like a magnet. So, hold lubrication down to the very least that will take care of friction.

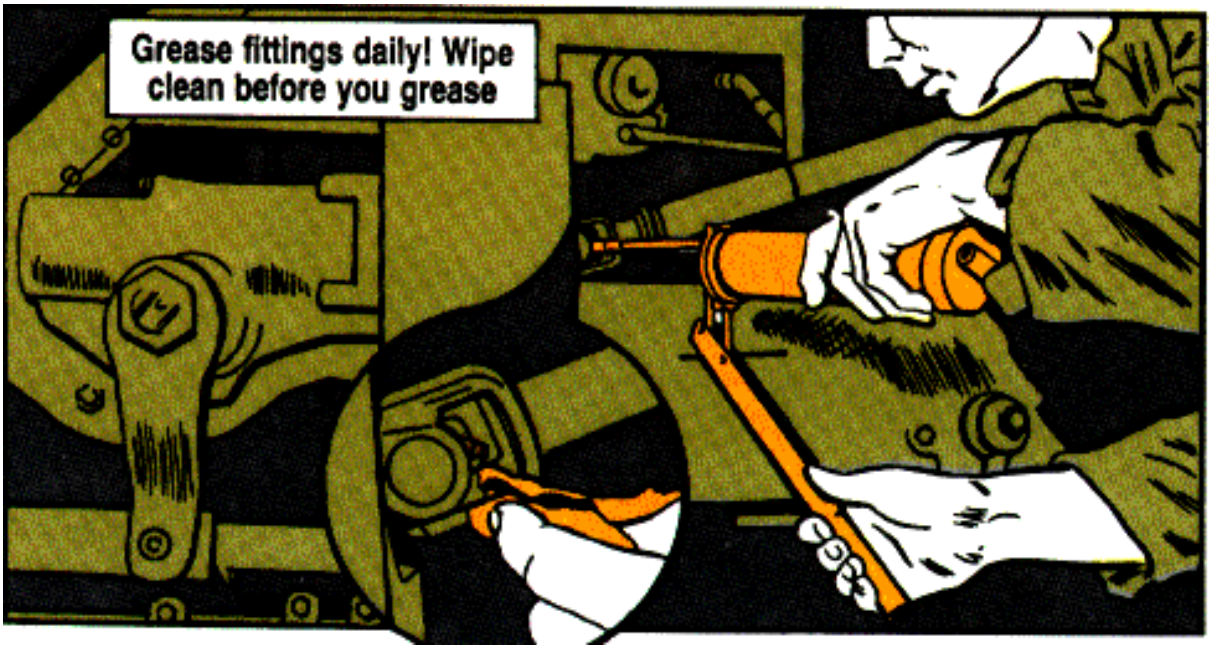
Wipe off grease fittings and the grease gun nozzle before you plug in the grease gun. Otherwise, you pump in sand with the grease. Keep lube containers covered and grease cans sealed.

Gages. Keep a constant watch for warning signs of trouble. Know what to do if you get a warning.

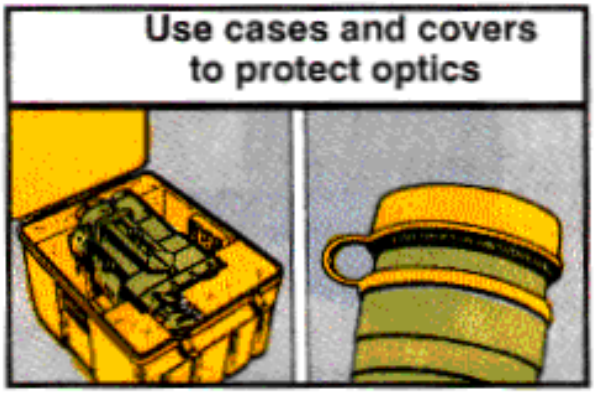


Batteries. Look for cracked cases. Check electrolyte level often. Keep sand and dirt brushed away and vents unclogged.

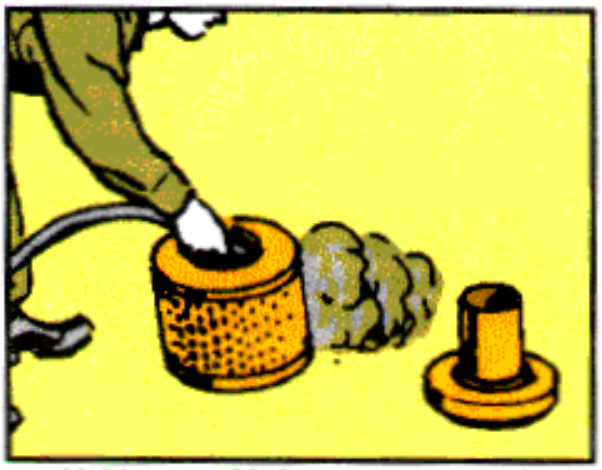
Glass surfaces. Cover those not in use.



As much as possible, keep sand and dust away from those in use. Optical parts of sight and fire control instruments such as periscopes, telescopes and night sights can get discolored by the sun and etched by sand. Flush optics with distilled water. Then clean with cleaning compound, NSN 6850-00-227-1889.



Air filters. Filters can plug up with dust in only a few hours--even quicker when



sand is blowing. Air filters need to be checked constantly and cleaned regularly.

Fuel. Drain fuel filters often.

Always wipe off the outside of the fuel nozzle before fueling. Wipe off dirt around the filler opening before removing the cap.

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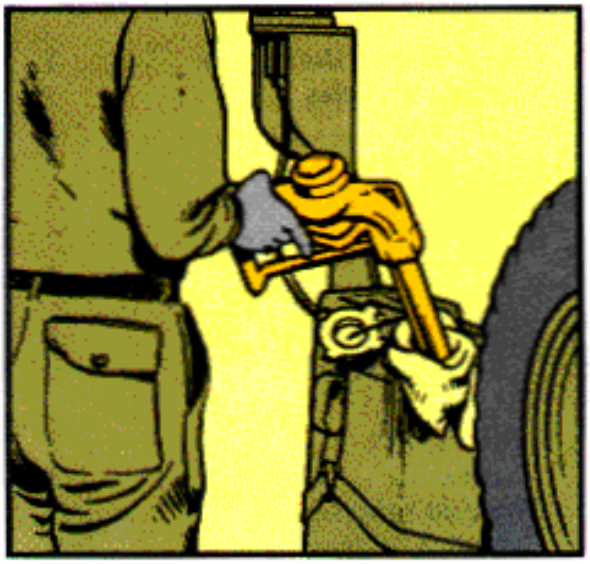
Cover the open space while the nozzle is in the opening. Put the cap back on tight

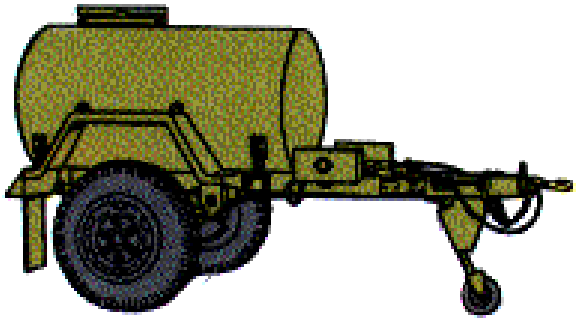


Transmissions. An overheated transmission oil cooler can bring on a sudden and complete breakdown. Screens are no guarantee that cores and fins are safe. Check them and keep them clean.

Hydraulic systems. Keep sand and dirt out of the system. When you add oil to the reservoir, it's a high-risk time. Clean dirt from around the opening before removing the cap or cover.

Ammunition. A double sunshade helps keep stored ammo cool. Improvise one by using two tarps with brush stuffed loosely in between. If you can, store ammo in a hole at least 1 meter deep. This gives more insurance against overheating.

Water handling equipment. Preventive maintenance here is vital. Make sure all seals and gaskets are in top shape to prevent evaporation and contamination. Sand and dust will penetrate anywhere there is an opening.

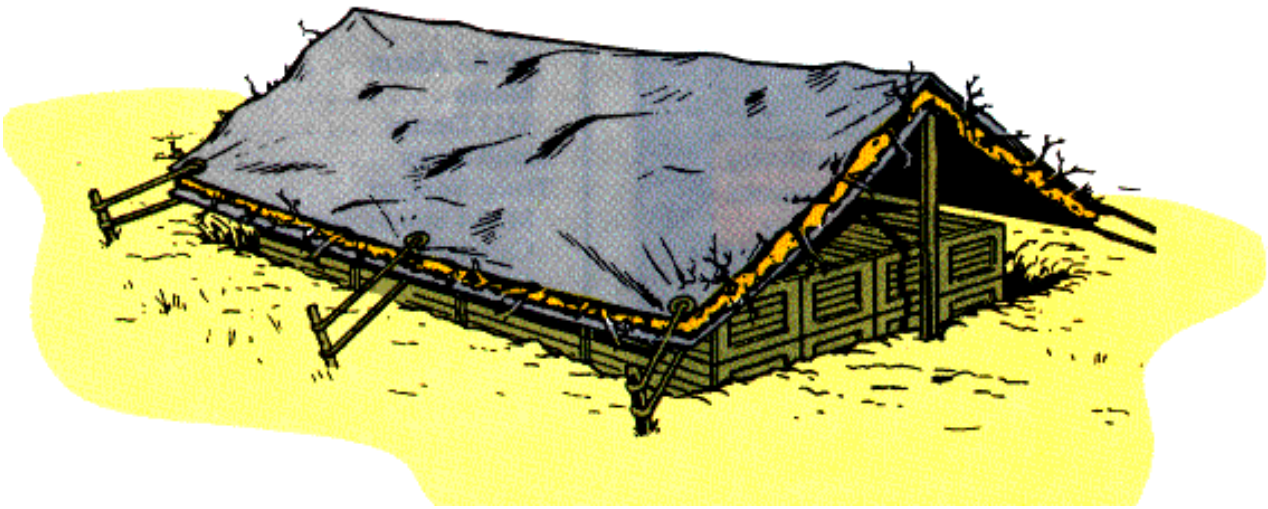


And remember these points:

Keep your equipment clean.

Report all faults to your mechanic.

When possible, keep your equipment out of direct sunlight. This is especially true for any equipment that makes its own heat, like radios, engines and generators. Cooling systems in engines and electrical equipment are pushed to the limit even in the shade. Camouflage screening offers double protection against the heat by providing shade and letting breezes pass through and carry away heat made by the equipment.



Keeping on Track

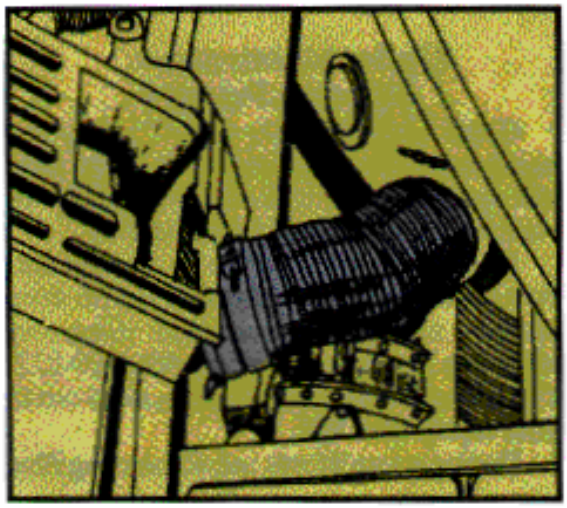
No battlefield takes a greater toll on track vehicles than the desert.

The losses show up everywhere: clogged filters, overheated engines and transmissions, burned-out bearings, thrown tracks, sandblasted optics, fried radios and other electronic gear damage.

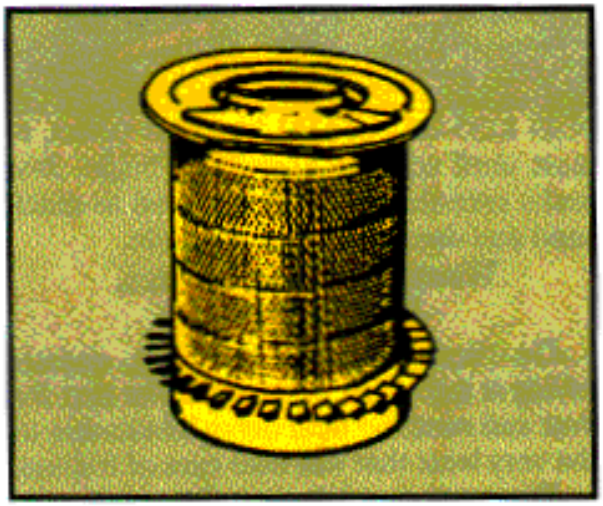
So how do you keep your combat vehicles and equipment from becoming desert losses? Here's how:

Clean Air, and Plenty of It

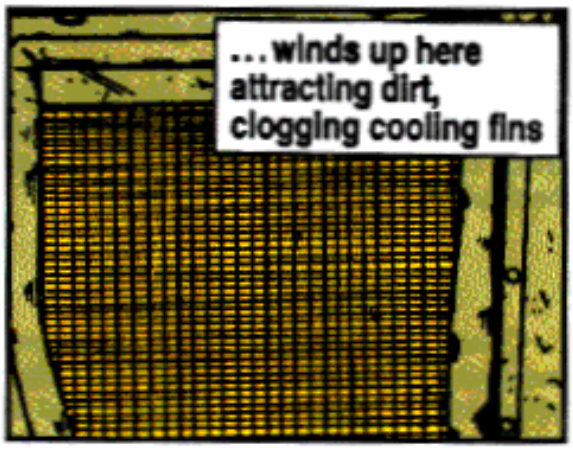
Make sure the air induction system-hoses, inlets, outlets, precleaners, filter elements--is in good condition from the beginning. Cracks, tears, holes and loose clamps let sand and dust get into engines.



Clean air filter elements as often as necessary to keep engine performance high.



Keep all air-cooled surfaces clean of oil and grease. These surfaces, part of radiators, oil coolers and the like, transfer heat away from the water and oil inside them as air flows past them. Oil and grease attract dust and sand. The heat can't escape, and that causes engine and transmission damage.



Clean Fuel, Only

The most important time to keep fuel clean is during refueling of vehicles.

Always wipe off the outside of the fuel nozzle before refueling. If you suspect there's dirt on the inside, flush it out or take the nozzle off and clean it.

Wipe away dust and sand from the filler opening before removing the cap. Then cover the open space while the nozzle's in the opening. Close the cap tight every time.

Still, some dirt gets into the fuel system. So, drain fuel filters more often to keep them from clogging.

Drain the fuel filter to get rid of the condensation. You may have to drain fuel filters more than once a day to keep engine performance high, but drain them at least once a day to keep water from diluting fuel.

You can help keep your fuel system clean by using diesel fuel stabilizer additive. The stabilizer slows fuel breakdown, kills microbial growth and inhibits corrosion.

It's used at the rate of one gallon of additive per 3,500 gallons of fuel. That works out to about 3 1/2 ounces per 100 gallons. A coffee cup half-full is about right. Add the additive to a half-full tank just before filling up.

Clean Water, Always

As much as possible, use only clean water from a reliable source for filling radiators. Local water supplies often contain mineral deposits that will eventually clog radiator cores.

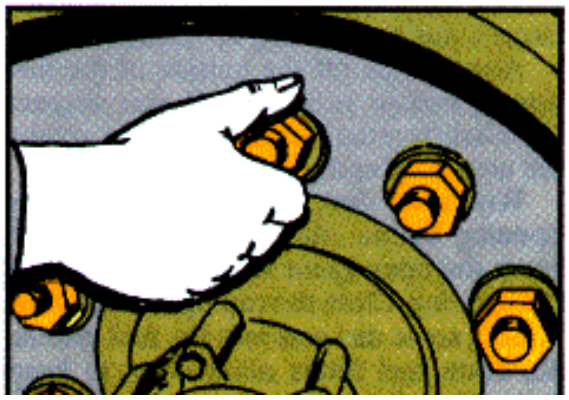
Use only distilled water, if available, for filling battery cells. Check batteries daily, because the desert heat can cause batteries to lose much of the liquid in the cells.

Water from unreliable sources can add substances to batteries that prevent them from giving normal service.

With the basics of clean air, fuel and water taken care of, you must also consider track, optics and weapons maintenance to be ready for the desert battlefield.

Track Maintenance,
First and Foremost

Check drive sprocket and roadwheel mounting bolts before, during and after operation. Sand, rocks and gravel tend to break or damage lube fittings and



relief valves. Rough terrain causes hardware to work loose, if it's not torqued right. Never neutral steer in soft sand. Sand builds up in the final drive sprockets and the track is thrown in a flash. Zig-zag turns at high speed also cause thrown track.

Pay extra attention to the tracks during at-halt inspections. Check track tension. Look for cracked end connectors and broken link pins. On tanks, look for damage to the right front roadwheel support arm, and sheared mounting bolts on the No. 1 right or left road arm housing. M 113-family carriers have more trouble with left rear idlerarm bearing burnout. Check often and keep the grease gun handy.

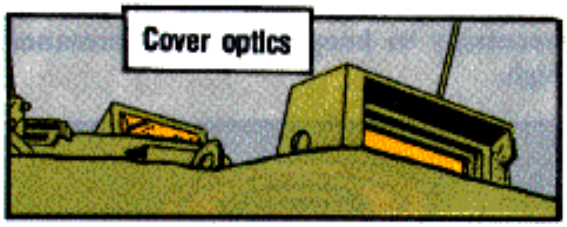
Since you'll be lubing bearings much more often in the desert, make sure you wipe away any excess lube when you're finished. Grease attracts dirt, and the two together can grind away metal real fast.

Optics Maintenance,
Clearly a Priority

Cover glass surfaces when they're not being used. Scouring and etching by sand will ruin them. This is very important for sighting and fire control equipment.

In addition, the buildup of dust on surfaces can degrade low-light vision. So keep surfaces as clean as practicable using only cleaning compound, NSN 6850-00-227-887, or other specific cleaner called out in your equipment TM.

During a sandstorm use some cling film,



NSN 8135-00-043-5331, to cover optics, at least until combat operations begin. Just make sure that optics are spared as much sand and dust damage as possible.

Weapons Maintenance,
Keep Shooting

On small arms and artillery, normal lubing is too much. It's a welcome mat for dust and sand. So hold down lubrication to the very least that will take care of friction.

Weapons may become clogged or missiles

jammed on launching rails because of sand and dust accumulation. Sand or dust clogged barrels cause in-bore explosions.

Muzzles must be kept covered by a thin cover so an explosive projectile can be fired through it without risk of explosion.

Cover missiles on launchers until just before firing.

Even weapons that are not lubed at all will accumulate sand and dirt because of condensation, another reason for daily cleaning.

And Then There's Heat..

Heat causes great strain on vehicle solid-state electronics. Carry extra regulators for M60-series tanks and M113-series FOV. They go fast.

Overcharging in combat vehicle electrical systems is a real danger because of the buildup of hydrogen in the batteries. Set voltage levels right, and carry extra batteries.

Heat does a job on radios, both from the heat of the sun bearing down on unprotected sets and from the heat inside the vehicles. Provide ventilated shade for externally mounted radios.

High temperatures kill synthetic materials, such as electrical tape, by causing them to break down chemically. Regular tape softens and unravels. If you don't want tape flapping around in an engine compartment, use high-temperature tapes or plastic ties and spiral wraps.

Heat may cause variations in missile tracker alignment and in laser range-finder operations. Read your weapon's TM for the right procedure to follow in extreme heat.

...and Wind

Flat deserts have high winds, carrying enough grit to shut down maintenance operations. Cover only those areas of vehicles on which you are working to save shelter space. Park vehicles so the engine compartment is downwind. Use portable shelters. Carry lots of plastic garbage bags to keep grit off greasy parts, spindles and out of holes.

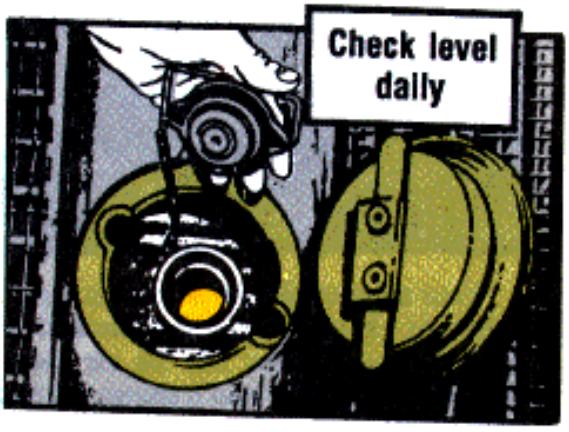
Engine removals in the desert mean wear and tear on soft aluminum, plastic and brass adapters. Carry an extra set for each type of engine and give every mechanic access to elastomeric (Teflon) tape.

Extra Tips on the M113 FOV...

More M113A2 FOV engines are ruined by overheating than by anything else.

In the desert, do these little things right:

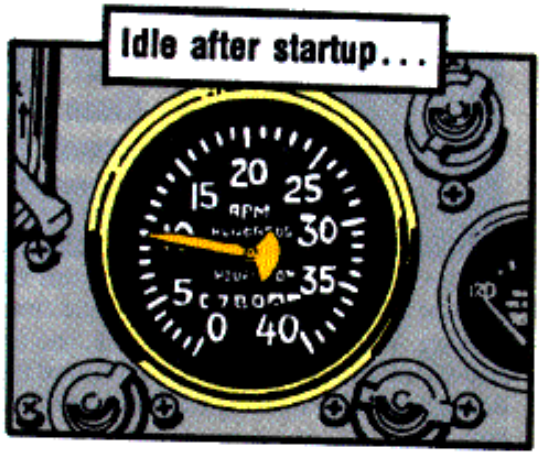
Check the coolant level daily before



operation. Be sure the coolant is within 1/2 inch of the auxiliary tank filler neck.

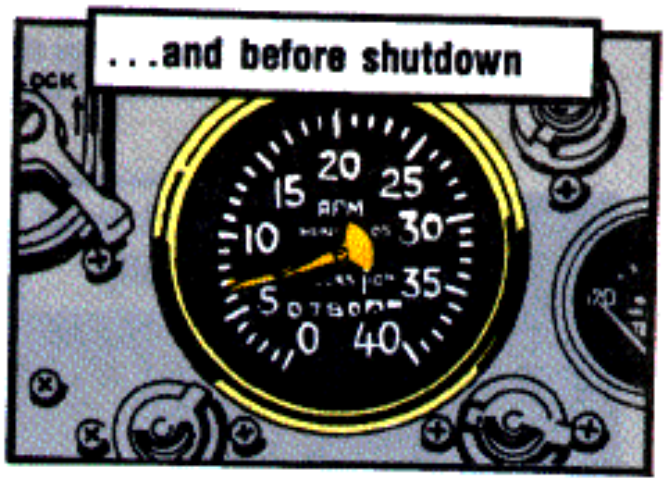
Warm the engine up before you move out. Oil drains out of bearings when the engine is at rest. You need to give the oil time to circulate.

After you start the engine, set the hand throttle and run the engine at 800-1000 RPM for at least 3-5 minutes to warm up the coolant and the engine oil.

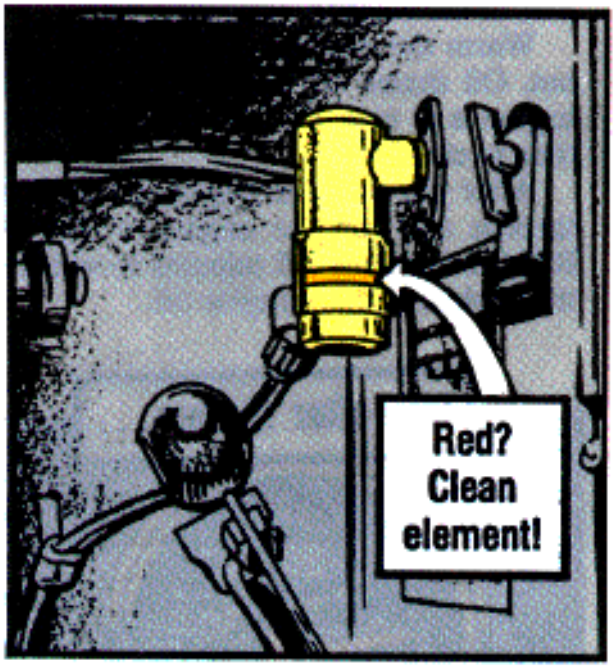


Before you shut off the engine, run it in neutral at about 1,000 RPM for 2 minutes. At the end of the 2 minutes, set the engine

back to idle (650-700 RPM) and check the instrument panel for normal readings.

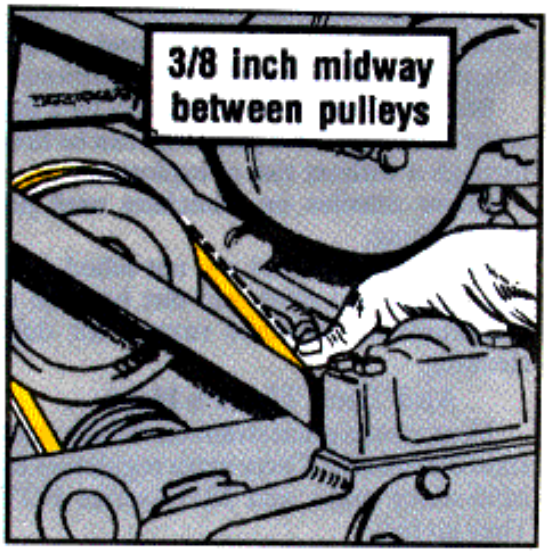


Your engine will lose power and heat up if the air cleaner element is choked with dirt. If your carrier has an air cleaner restriction indicator and it shows red in the window, clean the element. If your vehicle has no indicator, open the container latches and check the filter often.



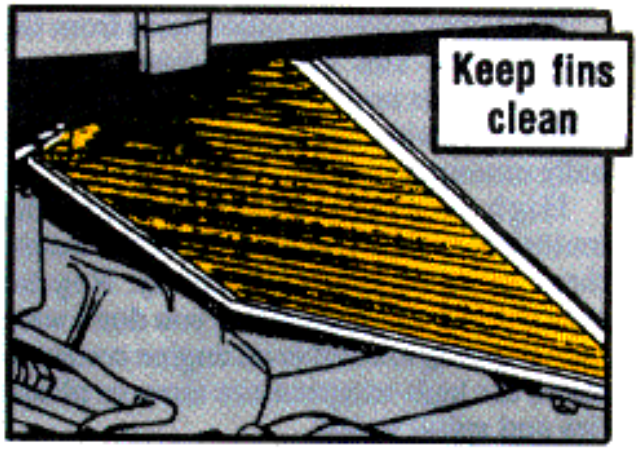
the V-belts for the fan drive and the coolant pump are involved in engine overheating. When the belts get loose, the fan and the coolant pump are not operated fast enough to keep the engine from overheating.

Check the fan drive belt at the idler. Make sure the adjuster rod is between the operating range marks. Check the coolant pump belt by pushing in on it halfway

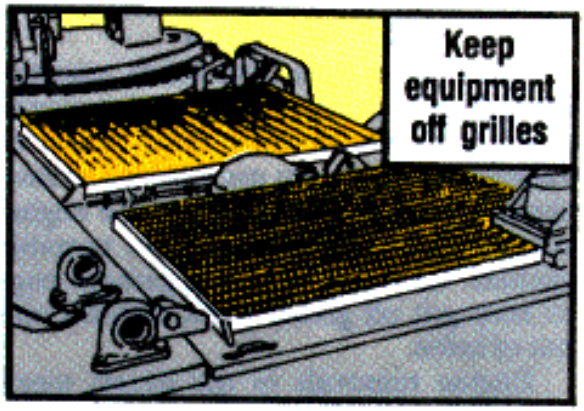


between the pulleys. If you can push clown more than 3/8 inch, get it adjusted.

Your radiator fins must be clear of dirt, sand and oil. Anything that restricts the air



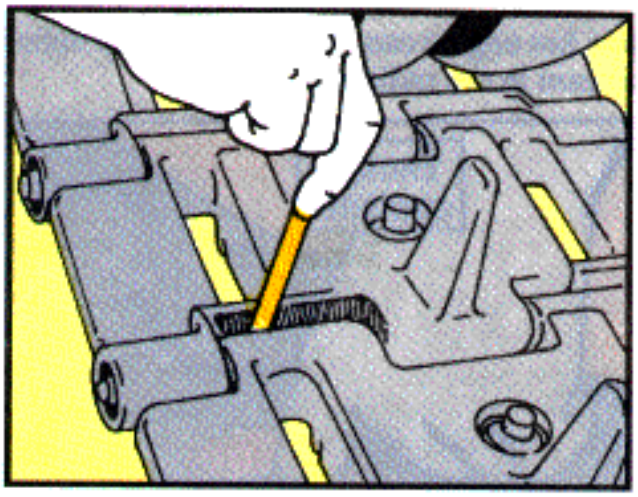
from moving through the radiator keeps the coolant hot and overheats the engine.



Keep your equipment off both the air intake and the air exhaust grilles.

One more thing to remember on the track: look for unusual or uneven gaps be

tween adjacent shoes. Try to insert a 1/4-inch rod (or something about that size, like a government ink pen) in the gap. If the rod or pen goes in, you need to get out



the bushing wear gage and check those shoes. If you get a "NO GO" reading on either the outside or inside bushing, replace the shoe.

...And on the M60, too

The engine and transmission oil coolers in your tanks deserve every break you can give them to prevent engine and transmission overheating.

Here's how to keep them cool:

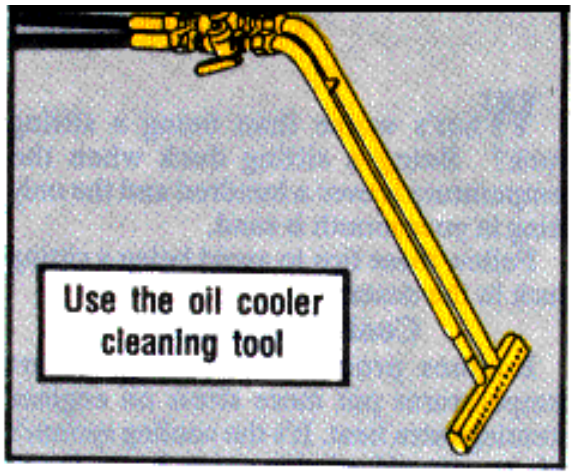
Keep the screen over the outer surface of the coolers clean so air can flow.

Use the oil cooler cleaning tool as often as needed to keep grease and dirt from caking around the cooling fins.

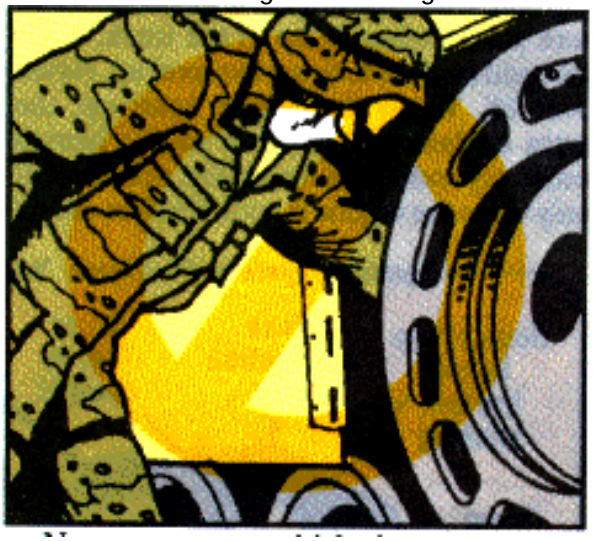
Safety

Desert safety includes using safe practices around vehicles. Keep in mind:

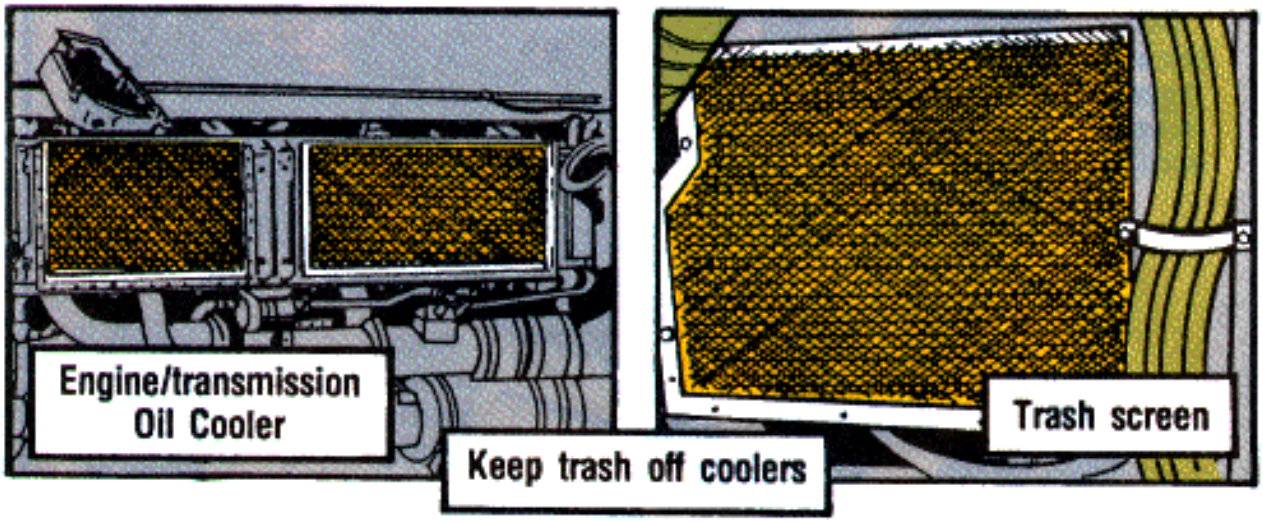
Never stand or sit on the outside of a tank when the turret's turning.



Never work under a vehicle if the engine is running. Never put your body over or around the track of a vehicle when the engine is running.



Never move a vehicle in a congested area without ground guides day or night.



The Next Battle...

The Wheels Must Roll!

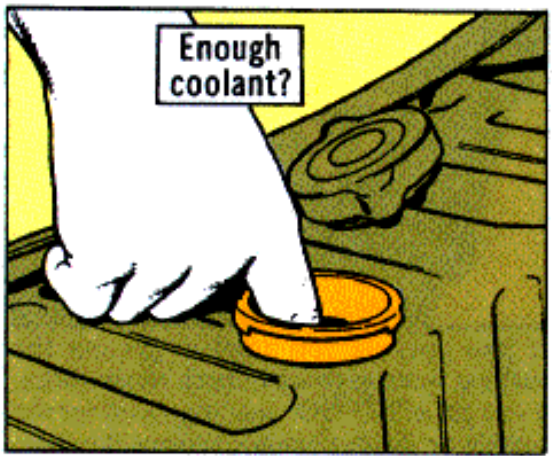
What's worse than being a sitting duck? Being a sitting duck when the temperature is over a hundred and the only thing in your mouth is sand.

Follow these tips to avoid being a sitting duck in the desert:

Cooling Systems

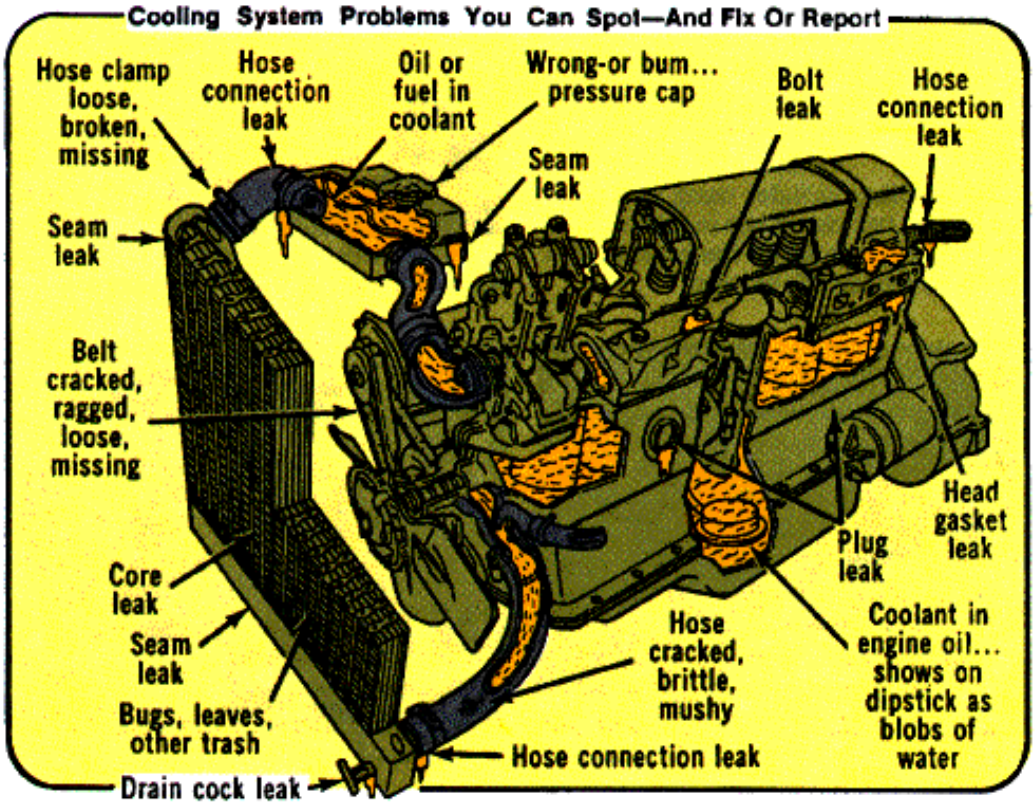
Engines produce heat. High desert temperatures put more stress on engines creating extra heat. It's the cooling system's job to get rid of this extra heat. Small problems in the cooling system, like low coolant level or cracked hoses, soon turn into big problems for your engine and you.

Check the coolant level often. Before you roll, when the engine is still cool, make sure your coolant is up to the mark. If it's low, add coolant to bring the level up. Never over fill. When the engine heats up, the extra coolant will overflow as the heated water expands. When possible, add coolant only when the engine is cool. Coolant added to a hot engine can crack the block or burst a seam in the radiator.



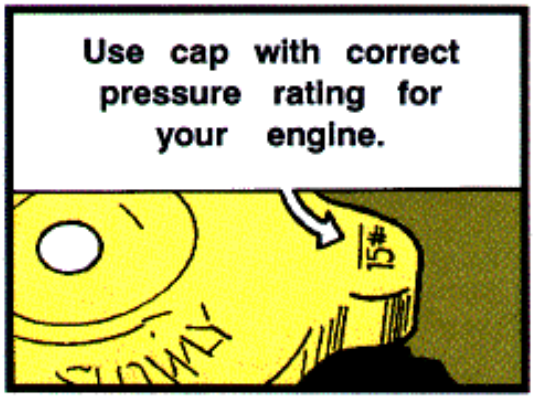
Use a mix of antifreeze and water even in the desert. The mix raises the boiling point of the coolant so it won't boil away like plain water does.

Use only potable water. Ground water



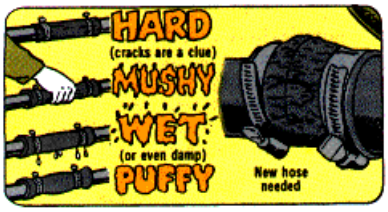
contains chemicals that will calcify in the radiator and clog it.

While you are adding water take a close look at the radiator cap. Make sure it is in top notch condition and is the right cap for your engine. Check the pressure rating on the cap with that listed in your TM.



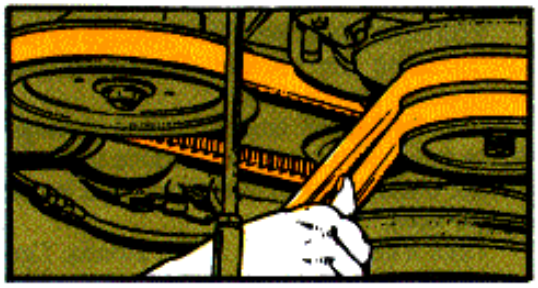
Check for wetness around your engine's radiator or hoses. Wetness means a leak.

Check and feel hoses. Replace mushy, cracked or leaky hoses right away.



During operation, keep an eye on the temperature gage. If it goes above the normal operating range, shut down and find out why. Watch the tachometer, too. If the RPMs are too low, the fan is turning too slowly to drive out the heat.

Extreme heat cause belts to stretch. Have your mechanic tighten any loose belts



Check belt tension

and replace those that are cracked or damaged.

Pay close attention to the instrument panel data plate on transmission and transfer positions for certain speeds. Keep engine RPMs in the right range.

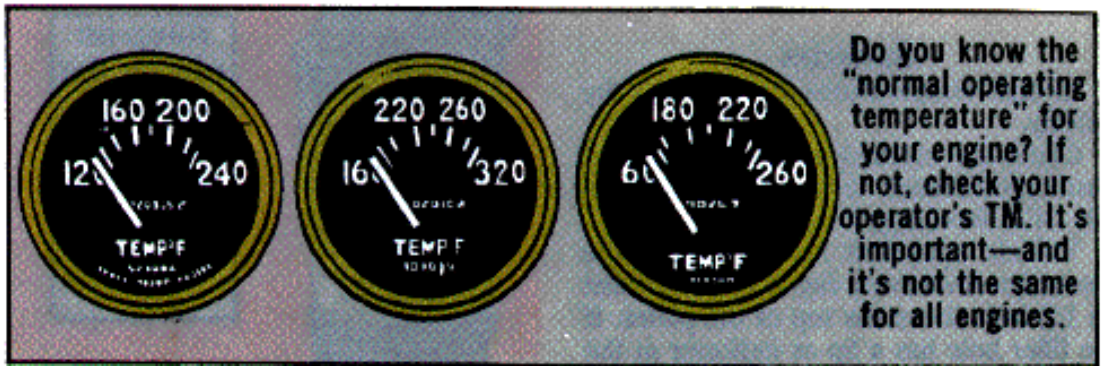
Blow out sand and dust daily from the radiator fins so the radiator has no trouble getting fresh air.

Avoid driving for long periods in low gear. That causes your truck to overheat.

Tires

Heat softens and weakens tires. Soft tires and sharp rocks mean lots of flats. Take two spares for each vehicle and a good supply of tire patches.

The operator's manual for some trucks lists a lower tire pressure for driving in sand. A lower pressure gives the tires more bite.



If you lower the pressure in your tires, be sure to add air before you drive on pavement.

You can help prevent tire damage by not overloading the vehicle. Overloads put extra strain on the tires.

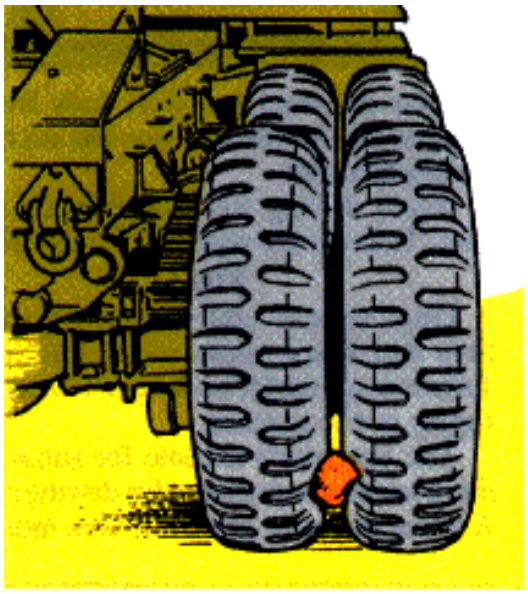
Heavily loaded trailers pulled through loose sand can bog down. Reduce the load on the trailer, as well as the pressure in the trailer tires.

Take it easy in rocky, rough terrain. The sidewalls on radial tires are thin and rocks can cut them to ribbons.

Look at your tires at every stop. Check them for cuts and wear. Tubeless tires lose air during travel through rocky terrain because of "bead breaking." That's when the tire breaks loose from the rim. Check the pressure in your tires frequently.

During stops, look for rocks caught between dual tires. A rock caught between the sidewalls will rub holes in them.

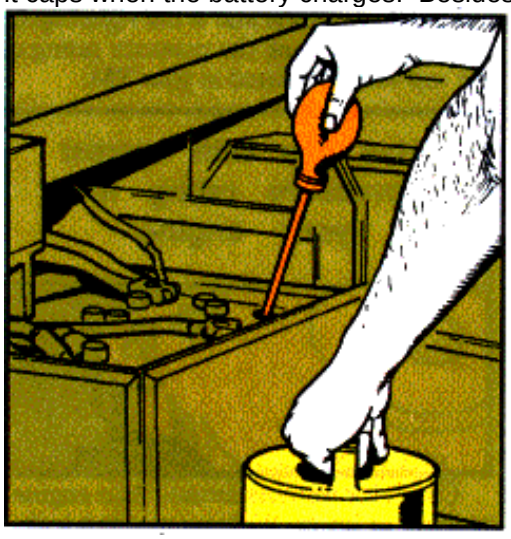
Get rocks out



Batteries In high temperatures, batteries go dry quickly.

Check the electrolyte using the optical battery/antifreeze tester, NSN 6630-00-105-1418. Recharge if necessary.

Vehicle operators need to check the electrolyte level every day. It should at least be 1/2 inch above the top of the plates. If the filler hole has a lip or indicator at the bottom, fill to that. More is not better. If batteries are filled to the rim, the electrolyte will boil out through the vent caps when the battery charges. Besides being



messy, it causes corrosion.

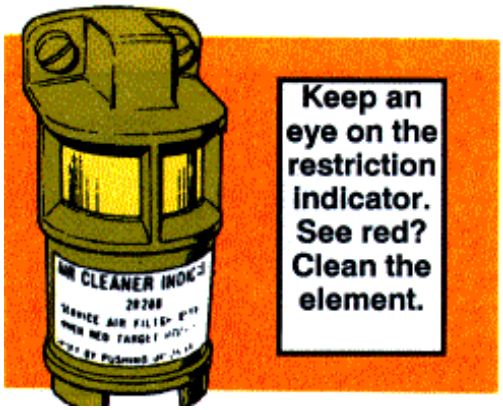
Be sure to keep the caps on the fill holes on your battery. That will keep electrolyte in and sand out.

Batteries have vented caps so that internal gases can escape. Make sure the vents are open and stay that way. Clean them daily. Plugged vents cause gases to build up that can cause the battery to explode.

Filters

Drain fuel filters first thing daily. Condensation forms in the fuel tank from the desert's cool night air. Water causes your truck to run rough and damages diesel engine fuel injectors. Drain into a clear container until you see clean fuel.

Sand clogs air filters. Keep a close eye on your truck's air restriction indicator. If it



shows red, stop. Take out the filter and tap it to knock out most dirt. Don't bang it against a rock or tire. You'll bend the sealing edge or crush the filters. An air hose will blow away stubborn dirt. Use no more than 30 PSI. Make sure the filter is in good shape with no holes and a snug fit in the housing.

If your vehicle still can't get enough air, your mech will need to wash or replace the filter.

On the CUCV, you'll need to check the filter element at least weekly. If it's clogged, get a new element.

General Stuff

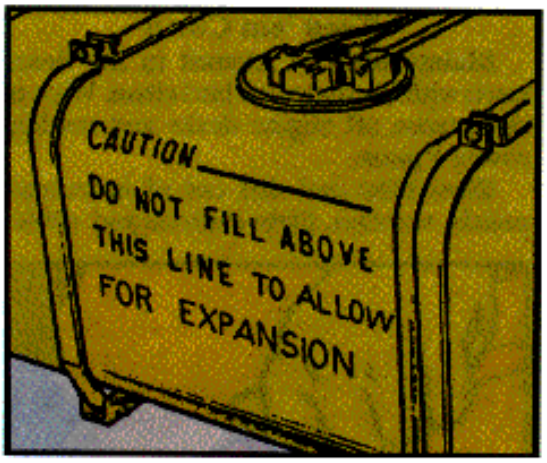
Vehicle must be almost self-sufficient as far as supplies and equipment are concerned. Each vehicle should have:

- A small tool kit
- Flashlight and highway reflector
- Fire extinguisher
- Compass, binoculars, maps, goggles
- Communications equipment
- Shovel, sand ladders and tow rope or cable
- 5 gallons of water for each occupant
- Sunscreen lotion and lip balm
- Siphoning hose
- Slave cables
- Mounted air compressor with reservoir and air hose
- Jack support plate
- Oil, hoses, fan belts, tape, filters, wire and sandbags.

If you've got to be reminded to check your engine oil often, you'll never make it in the desert. Carry extra oil with you. Besides reducing friction between moving parts, engine oil helps the cooling system carry away heat.

Never try to help your cooling system by opening doors, covers or panels or changing the position of shrouds or louvers unless your TM tells you to. You'll change the forced air flow through the engine compartment. Some places will get no cooling at all. You'll burn up your engine.

Overfilling your fuel tank is just a waste of fuel. With desert heat beating on the tank, the fuel will expand and overflow. Top off your tank by filling only to the limit line on the tank.



Travel over rocks will crack frames, loosen and shear rivets, loosen nuts and bolts and generally tear up everything that moves. Head off the damage by inspecting closely and thoroughly after every operation. Be sure to check for loose engine and gear case mounts.

Heat shock can knock out vehicle engines that have been running hard unless you idle-cool before shut down. This is a matter of life and death for diesel engines.

You're less likely to get stuck in sand if you carry lighter loads and make wide turns. In sharp turns, your front wheels tend to push against the sand instead of rolling over it.

If your truck does stall in soft sand, make sure your front wheels are straight before you try to move out. Dig out the wheels and lay brush crossways in front of the wheels for traction.

If you lose traction going through sand, don't sit there spinning your wheels. You'll only dig yourself in deeper. Lower your tire pressure to about one-half of normal. This will improve traction and may get you out. Jacking up stuck wheels may help, too. Sand will flow under the wheels filling the hole and putting your wheels on higher ground. A jacking pad about a foot square should be something you carry.

The Air Battle...

Flying the Entire Route

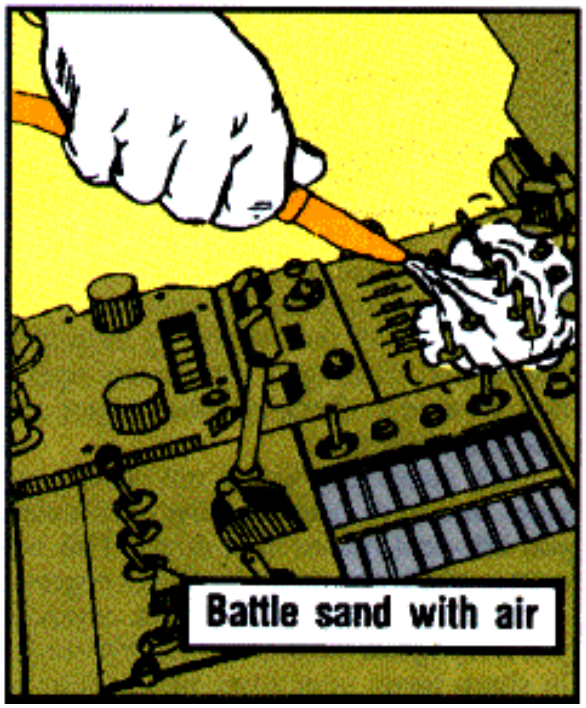
When equipment fails on your aircraft because of poor maintenance, there's no pulling to the side of the road.

Here's how to keep flying in the desert.

Keep 'em Clean

Maintenance of aircraft in the desert starts with keeping your bird clean. Wipe oil and grease off engine decks and cowling covered parts.

Blow sand and dirt out of instrument panels, switches, flight controls and cables.

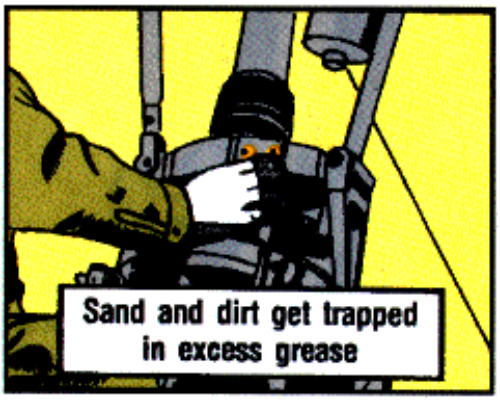


Make sure all filters and air cleaners are inspected and cleaned daily.

Clean radio and receiver ventilating ports and channels to stop overheating.

Clean all fuel, oil and instrument filters daily. Add oil and hydraulic fluid directly from their original just-opened containers. That helps stop sand from getting into the bird's lubrication and hydraulic systems. When a can is opened, never save what's left.

Lubricate the main and tail rotors after every flight or at least daily. Inspect and purge all lubricated bearings daily. Wipe off excess grease every time you lube. Sand gets trapped in excess grease and forms a paste that grinds and wears lubricated parts.



Remove the Oil cooler compartment access panel daily and clean caked dirt and sand off the fan's inner lip.

Keep 'em Covered

Blowing sand will destroy aircraft windshields, optics, avionics and engines. Minimize the damage by keeping your bird covered when parked.

Use covers to keep out sand

Clean your windshields before you cover them. Even fine dust can scratch the windshield when the wind moves the cover. If possible, don't let the covers touch the windshield at all. Put down styrofoam, newspapers, cardboard or other nonabrasive material before the cover. When you attach the cover, make sure it's snug. Otherwise the wind will blow sand under the edges.

Sand's worst destruction is unleashed on

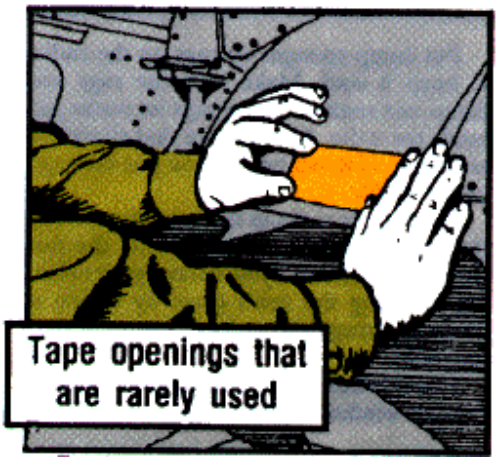
your optics. Dust will destroy a lens. Keep optic lenses, when not in use, covered with cling film.

If sand does its worst to your optics, its Number 2 punch brings down your commo. When not in use, keep all avionics equipment covered. Just a little sand will grind delicate commo parts to a halt.

Your engine can also fall victim to the destruction of sand. Keep the engine inlet cover on and on tight. If it blows off, or up, and the engine fills with sand, kiss that engine goodbye.

Keep 'em Sealed

To keep the sand out, tape all openings or seams around windows, chin bubbles and access panels. Be sure you don't stop the airflow that's needed for cooling, though.



Replace damaged sealant around windows, doors and chin bubbles. Inspect weather stripping for damage.

Extreme heat and temperature swings cause O-rings, seals and gaskets to continually expand and contract. They'll warp out of shape and then you're stuck with seals that don't seal. Watch for leaks.

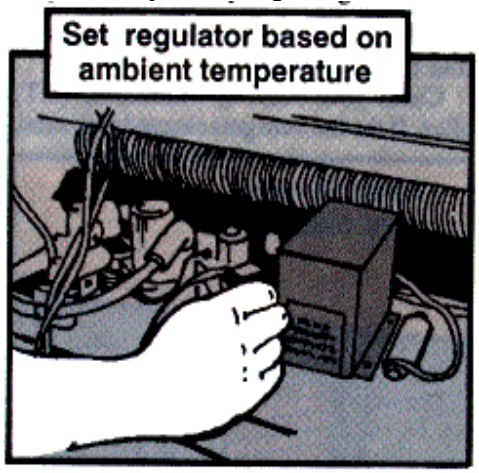
Change the seals when you find one.

Keep 'em Rotating High winds in the desert hurl sand like small missiles tearing into leading edges of your bird's rotor blades. You can slow this destruction by keeping the blades clean.

Look at the blades after every flight and clean them as necessary.

Keep 'em Adjusted

Your bird's voltage regulator must be adjusted to the ambient ground temperature. An improperly adjusted regulator can cause overcharging. You'll kill your battery and maybe your bird. See your bird's TM for procedures to adjust the regulator.



Keep Them in Shape

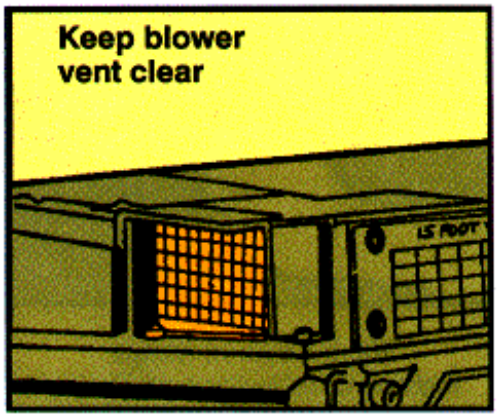
Right now, check your survival vest and its contents. Is everything there? Intact? Clean? If you find a problem with your vest or if you're missing components, tell your unit's Aviation Life Support Equipment technician.

The Air Waves Battle...

Good Desert Commo: Hear! Hear!

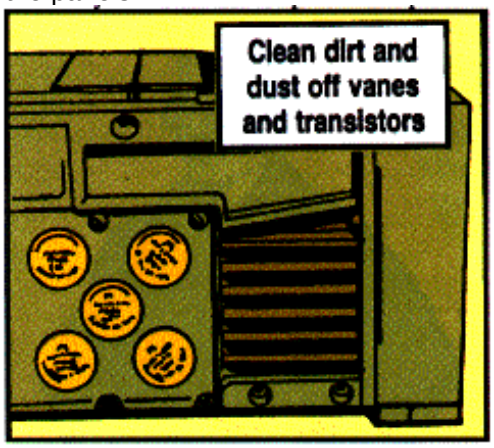
The key to desert radio survival is to keep them cool. Here are some tips to keep your radio on the air:

Clean your receiver-transmitter (RT) often. If the fan vent gets clogged with sand, dust or dirt, the RT



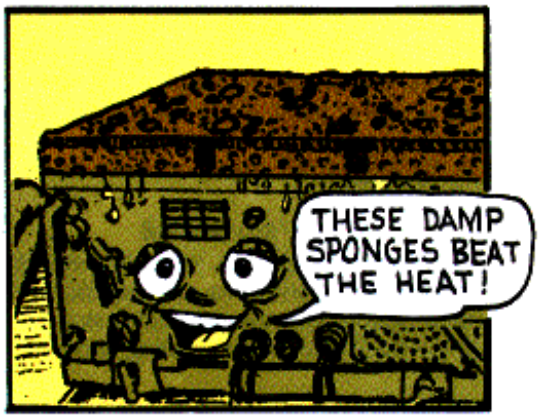
motor gets hot and burns out.

Take the side and rear panels off the RT. Use a brush or compressed air to clean the heat exchanger vanes and power transistor assembly. Be sure to replace the panels.



They funnel air from the fan to the vanes where its needed.

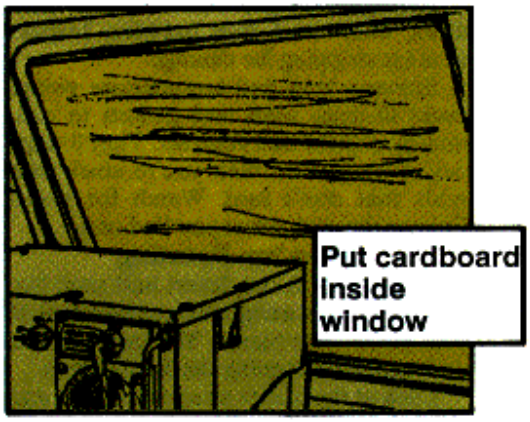
Give your commo equipment room to breathe. If you pile gear on or around it, heat quickly builds up. Keep coats, field gear, maps, manuals and other items away from the RT blower fan. Blocking the airflow will cause the heat to build up inside your set.



Put damp sponges or rags on the radio to keep it cool. Make sure the rags are damp, not soaked. Soggy rags let water get inside the radio. Also, be sure that all screws are snugged down before you put the rags on the radio.

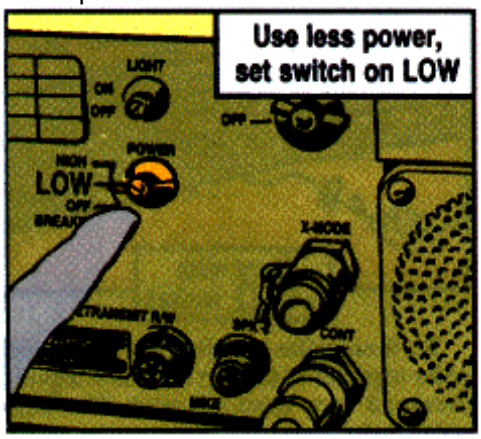
Shade your radio as best you can. When the sun beats down on the radio, the fan runs itself to death trying to cool your radio. Try blocking the sun's glare by taping a piece of corrugated cardboard to the top of e radio.

Use another piece of cardboard to block e side window if your radio's in a CUCV.



Use low power for transmissions of less than 15 miles. Low power generates less

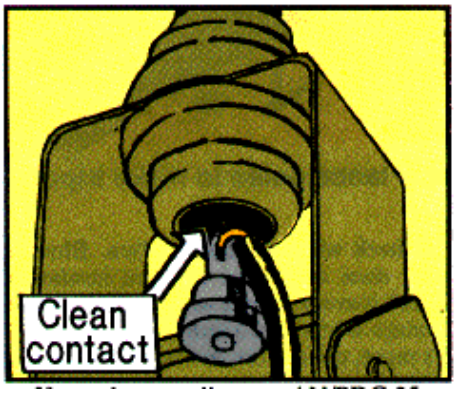
heat. If you're transmitting more than 15 miles, use high power but keep the duration of the transmission short.



Keep the radio set aligned. A misaligned radio heats up fast.

Protect electronic equipment from dust and sand. Poor electrical connections can be a result of dust getting inside. Microswitches can be knocked out completely by dust. Clean daily with low pressure air or a soft brush. Keep dust covers on hand microphones.

Check the whip antenna's mast base to be sure the contact is clean.



If you have radio sets AN/PRC-25 or AN/PRC-77, push the pressure relief valve on the battery box out to make sure it doesn't stick. Brush the valve's screen clean.

These items need to be checked daily:

Knobs, switches and connectors. Get broken or missing ones replaced.

Receptacle locknuts. Loose locknuts cause twisted wiring. Twisted wiring leads to broken wiring.

Contacts. Dirt and sand work into the connectors and keep the contacts from touching. Check them and clean them.

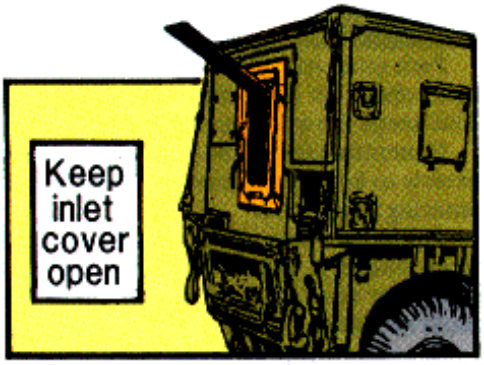
Panel and cover screws. If one is loose or missing, tighten or replace it. A missing screw lets dirt and sand get inside your set.

Latches and mounts. Loose latches and mounts can cause commo equipment to bounce out on a rough desert ride.

Shelters

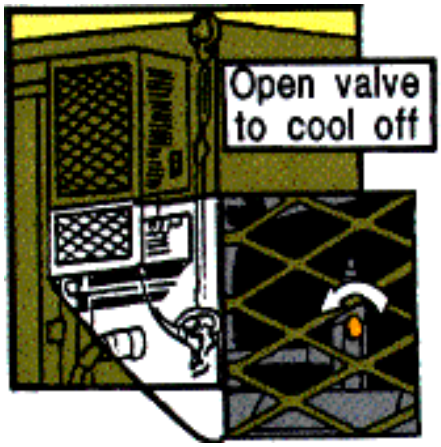
Shelters need a steady flow of air to keep inside temperatures down. Radio teletypewriter equipment inside the shelter puts out enough heat to burn up a radio or power supply. They need moving air to stay in good shape.

Keep the temperature down by leaving the shelter door's inlet cover open enough to let cooling air into the shelter.



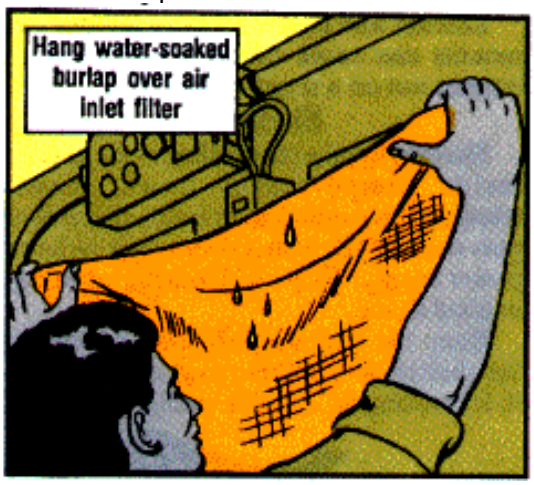
There are exhaust vents behind the radio power supply. Make sure these vents are open and that they are not blocked by clothing or other items. These vents let hot air escape.

Some equipment needs air conditioning to keep it operating. If your shelter has an air conditioner, use it. You will need to close the vents and inlets. The receiver valve on the air conditioner will need to be



open so that coolant is let out of the holding tank. To open the valve, turn it counterclockwise.

If your shelter is not air conditioned, lower the inside temperature by hanging a water-soaked burlap cloth over the door's inlet cover. Soak the cloth often and be sure to keep the door closed.



Park your vehicle so the shelter door is in the shade for most of the day, if possible. This keeps the inside area cooler.

Generators should be put in front of the vehicle to keep the exhaust and noise from entering the shelter.

The door filter often gets overlooked when PMCS is pulled. Make it a habit to check the door filter when you check the radio air filters.

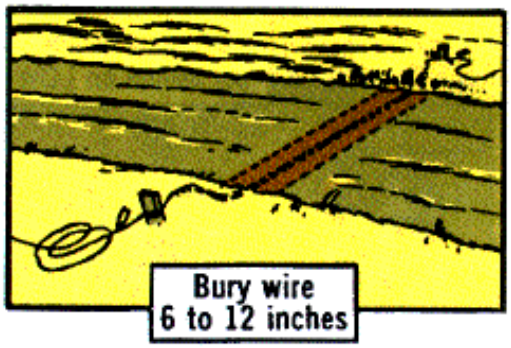
Field Wire

When you use wire in the desert, leave plenty of slack in the line to allow for sand shift.

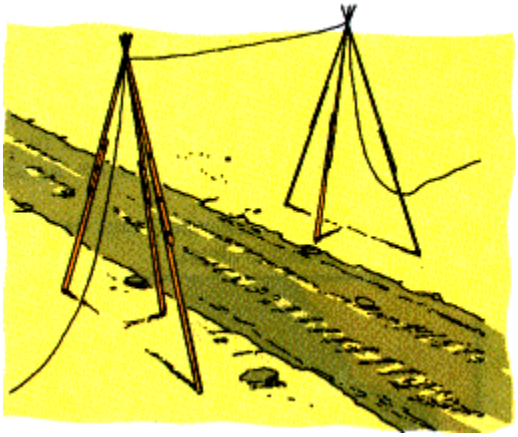
Shifting sand causes wire to disappear, too. To make finding it easier the next time, tag and tie it.

Bury the lines. For better wire service, make sure the wire is buried about 12 inches deep so it won't be damaged by tracked vehicles.

Buried lines should be tied and tagged whenever a new reel of wire is spliced to the line. Also, map the location and direction of the buried wire to help ease your maintenance task.

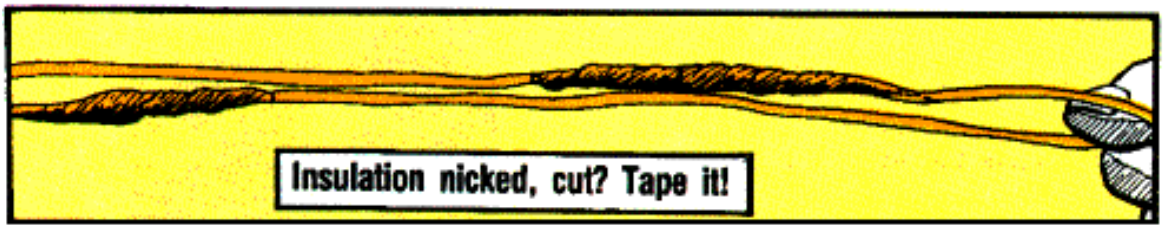


Tie lance poles together. Put three lance poles together at the top to form a tripod if overhead wire must be used. The lance poles help keep the wire up in severe windstorms.



Use lance poles to make tripods

Check wire insulation often. Blowing sand does a number on wire insulation. Check it every chance you get. If insulation damage is less than 3 inches long, tape it. If it's more, cut out the damaged section and splice it.



Grounding--Down to Earth Tips

Getting a good ground for your generator set or commo shelter is a definite challenge in the desert.

Here are some tips to make your challenge easier to face:

Equipment Bonding

The generator set and all the equipment it supplies with power must be connected together with an equipment grounding conductor (EGC). This protects you from being shocked when you touch the equipment, and it protects the equipment from being damaged.

If your equipment does not have an EGC, put an external ground wire of 6 AWG or larger to the chassis frame of the generator set and then connect it to each piece of load equipment.

Earth Grounding

While not a substitute for an EGC, ground rods or plates can be used in your tactical power generating equipment for lightning or surge protection. They can also protect the equipment from being damaged if the system is hooked up wrong.

In poor soil conditions, you can get a better ground by driving more than one ground rod. If only three rods are used, drive them in a triangle pattern. If more rods are used, put them in a straight line and connect all the rods together then run a single connection between the grounds and your equipment.

If additional ground rods are not available, use a metal ground plate. There's no NSN for this plate so you'll need to make one. The plate is 1/4 inch thick metal that's three foot square. A ground strap is put in the middle of the plate with a bolt or screw then buried at least four feet deep.

When the grounding plate is used with trailer-mounted equipment, you can improve the contact of the plate with the soil by placing the trailer tire directly over the buried plate.

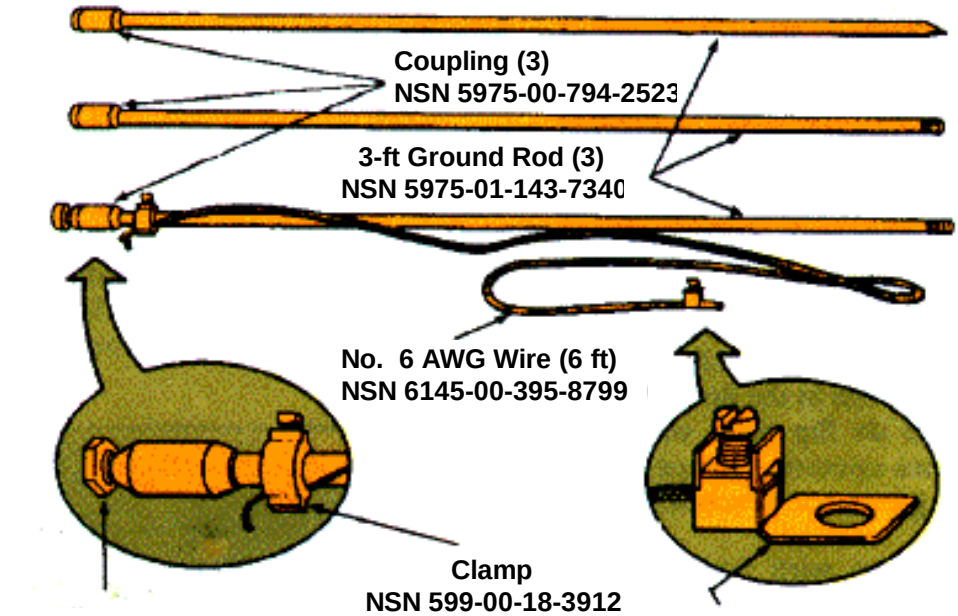
Chemical Treatment

Adding a chemical treatment to the soil gives a better ground. If water is available, mix five pounds of table salt with five gallons of water and pour into the hole around the ground rod or plate. Keep the soil around the rod or plate moist at all times.

Check out TC 11-6 and FM 20-31 for more grounding tips.

Here are the parts of the ground rod assembly,

NSN 5975-00-878-3791



The Fight for Generators...

You Must Have the Juice!

Generators in the desert need your help to make sure they get clean air and fuel.

Drain fuel filters daily.

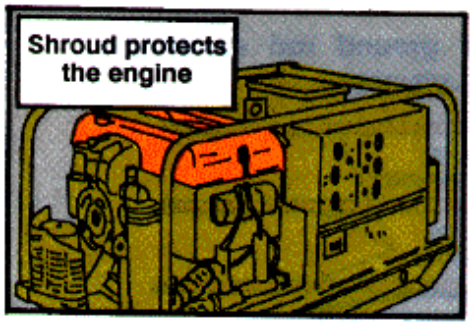
A dirty or clogged filter stops the flow of air and chokes the engine. It will shut down when you need it most.

Never run a generator without a filter. Sand or dirt in your engine will grind moving parts to bits.

Keep an eye on the air restriction indicator. If you see red, clean or replace the filter element. If your generator does not have an indicator, clean the element every day. If it's too clogged to clean or is torn or damaged, replace it.

Check and feel engine oil daily. Heat causes oil to break down. Sand damages the engine. If you feel grit on the dipstick, get the oil and filter changed.

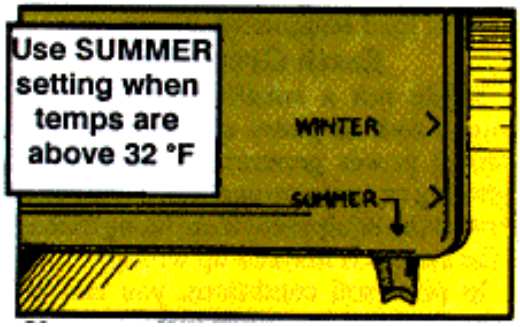
Close doors and make sure the engine shrouds are in place when you operate a generator. With the doors closed and the shrouds in place, air is funneled to the parts of the generator that need cooling. They also help shield the unit's oil from the sand that clogs filters and damages rings.



Never block open the radiator shutter on the 15-KW or larger diesel generators. That keeps the generator from reaching operating temperatures, even in the desert. Make sure the shutters do flip open when the generator reaches operating temperature. Otherwise, the generator overheats in no time.

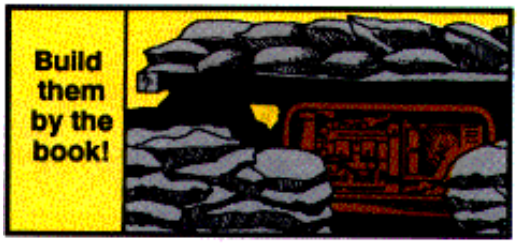
Small generators with "splash type" lubrication must be level during operation. If they run on an incline, oil won't be picked up. Moving parts won't get lubed, causing bearings to get hot and seize.

Make sure your 6-HP Mil Std engine's air intake shutter is set for SUMMER.



If set on WINTER, hot air is routed directly from the exhaust manifold to the air intake filter. This extra heat can break down the filter. Filter pieces will be drawn into the carburetor, causing a number of problems, including fire.

Leave plenty of breathing room around working generators. A revetment of sand bags and such cuts noise and protects your unit from dust, but it can be an enemy. Generators need lots of air to keep cool, so design revetments so air can flow around the unit. Without air, generators get too hot, and you lose your power. See your TM for instructions on how to build a revetment.



The NBC Battle...

Gas! Gas! Gas!

Desert conditions present special problems for surviving chemical attacks:

- Extreme heat makes wearing MOPP gear tough.
- Soil soaks up liquid agent. The sun's heat can revive the agent after you think the danger has passed.
- High winds and lack of vegetation help nerve agent spread quickly.
- Coolness of desert nights makes it more likely chemical attacks will occur at night when the agent will linger in low places, like foxholes.

Here are a few things you can do to combat these problems:

Do strenuous activities at night when cooler air makes wearing MOPP suits more bearable.

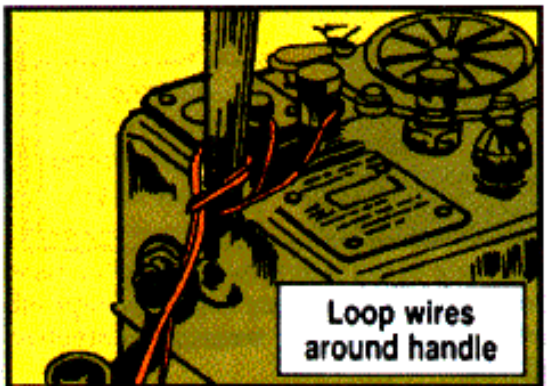
Place the M8A1 alarm so it has the widest possible coverage.

The best defense, though, is good preventive maintenance. Follow these PM tips on your NBC equipment:

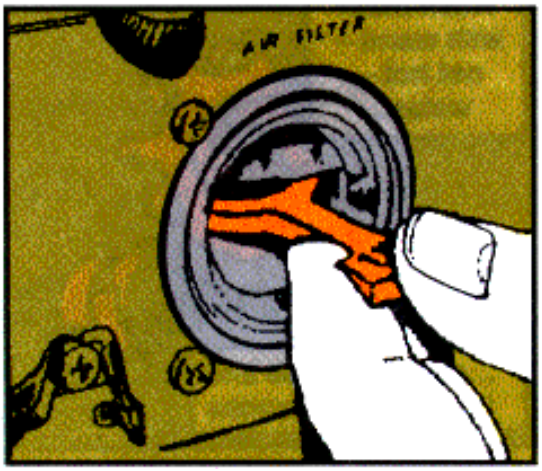
M8A1 Alarm

When you connect the M43A1 detector to the M42A1 alarm, tie off 9 inches of the telephone wire at the loop on the side. That prevents someone from tripping on a wire and breaking the wire or binding post. If the loop is missing, wrap the wire around the detector handle.

Don't depend on your commo people for telephone cable. Your NBC NCO can order as much as you need. It's part of the M8A1's AAL. You don't want to run out of cable.



Never leave a test paddle in an M8A1 longer than 2 minutes or try more than 2 paddles during BEFORE PMCS. Otherwise, you contaminate the detector cell. It takes hours to purge the cell.



Test 2 minutes max

Keep the inside of the M43A1 case clean. Dirt and detection don't mix. Change the air filter every 24 hours. The M8A1 won't detect with a dirty filter.

If the remote binding posts stick or are weak, report them. Sticking posts make it difficult to connect the alarm. Weak ones make for a weak connection and an unreliable alarm.

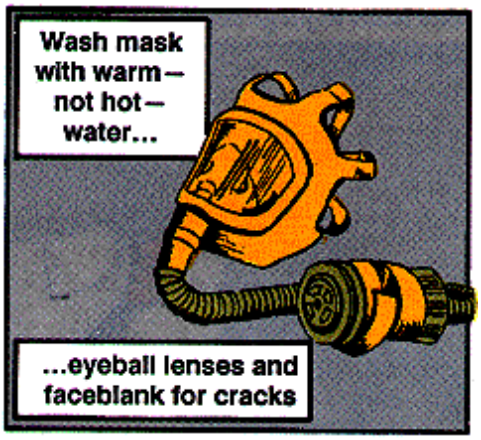
Masks

Temperatures above 120°F crack the lenses, the faceblank rubber and the hose on the M24 and M25A1 masks. Protect

your mask from the heat by keeping it in its carrier when not in use.

Never lay your M24 or M25A1 mask down on hot metal, like a vehicle that has been sitting in the sun. Don't leave the mask shut up in a vehicle or aircraft where the temperature can quickly zoom upward.

Use warm water to wash your mask.



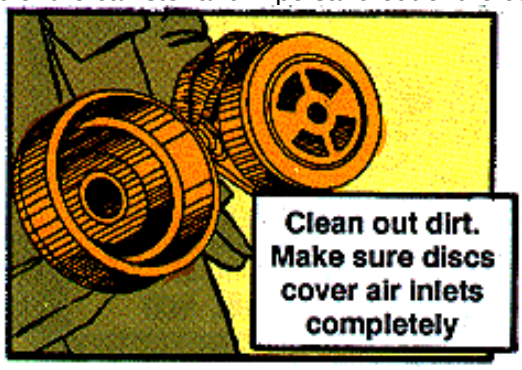
If your mask does get hot, put it in a cool place for 15 minutes before you try to flex it or stow it.

Sand is also a major problem. If it gets on the areas where valve assemblies and canisters fit together, nerve agent can seep in the mask. If sand clogs the filters and valves, you can't breathe. So clean valves and canisters as often as possible.

Wipe sand out of M17 valve assemblies with a clean cloth. Use the toothbrush in the M17 cleaning kit to brush away sand from the mesh covering the inlet valves.

Rotate valve discs with your finger to be sure the discs are not stuck and are seated properly.

On the M24 and M25A1s, pull the coupling off the top of the canister and wipe sand out of the coupling and canister with a clean cloth. Make sure the valve discs lie flat and completely cover the air inlets.



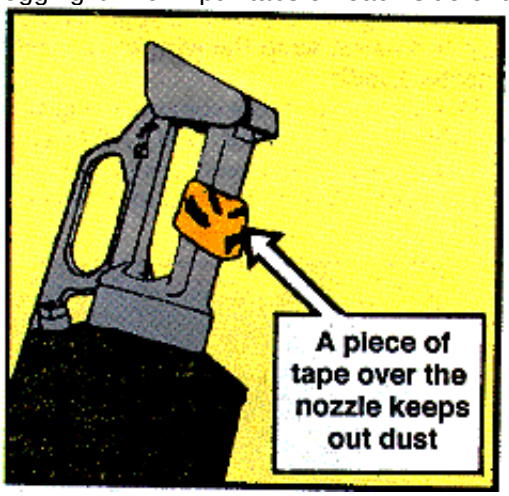
Don't forget the mask's carrier. Sand gets in it even if it has not been opened all day. Sand in the carrier will scratch the lenses. Shake sand out of the carrier before you repack the mask.

M11 Decon

Rust and O-rings are the main things to watch on the M11. Rust doesn't automatically knock out an M11. As long as rust doesn't break off and block off the siphon tube strainer, keep using the M11. Just wipe out rust flakes and shake them from the container.

Check the O-rings often. A bad O-ring won't let the M11 pressurize. If an O-ring is split, cracked or loose, get it replaced.

Tape over the M11's nozzle to prevent sand from clogging it. Form pull tabs on each side of the nozzle by bending the tape back. That makes it easy to pull the tape off even when you are wearing protective gloves.



The Battle in Close...

The Weapons on Hand Better Work!

In the desert, wind blows sand into the smallest openings in your weapons, like the muzzle and ejection port. Sand mixes with lube and creates gunk. That gunk acts like scouring powder. It grinds up moving parts and slows them down until your weapon coughs to a stop.

You can't stop sand problems entirely, but your weapon can do the job in the desert if you focus on these PM rules:

Clean your weapon as often as possible. That means at least daily. Even wiping it off with a clean, dry cloth during firing breaks will help. Clean in enclosed areas whenever possible to get away from sand.

Give special attention to internal moving parts, like the bolt carrier. Wipe and brush them as clean as possible. Use your own lung power to blow out sand from areas like the trigger assembly.

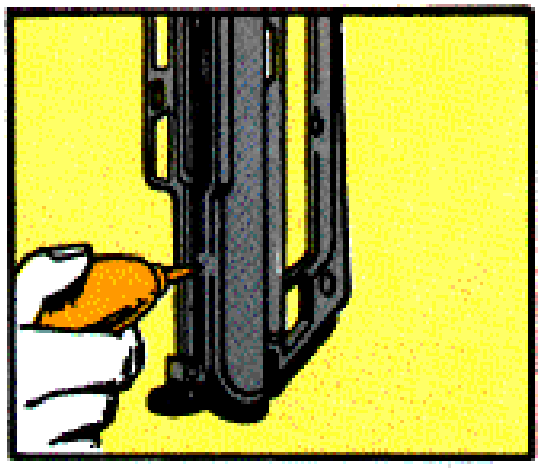
Take it easy with the lubes like CLP. They will attract sand. Limit lubing to internal parts. Wipe the outside of your weapon dry.

Remember magazines. If they jam with sand, your weapon won't fire. Unload and wipe off ammo daily. Run a rag through the magazine. Do not put any lube in magazines or on ammo.

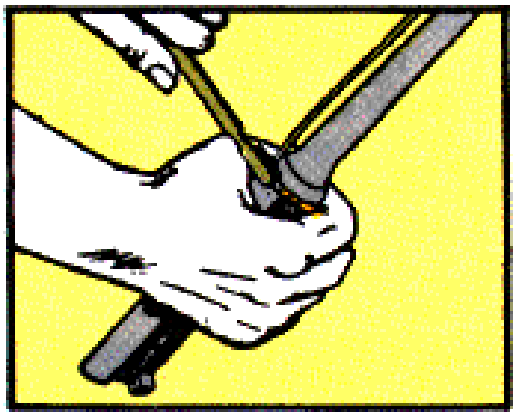
Keep weapons covered. Use rifle covers, muzzle caps, and spare magazine bags as much as possible. Cover mounted machine guns. On rifles, keep the ejection port cover closed and a magazine installed.

Here are some special instructions for your M16-series rifle:

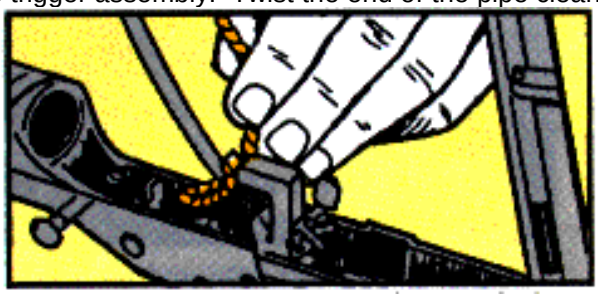
Forward Assist. Give the forward assist port inside the upper receiver one squirt of CLP or the other approved lubes. Work the forward assist back and forth until all the sand is forced out.



Slip Ring. After removing the handguards, gently pull the slip ring down. Use a pipe cleaner and tooth brush to work out sand from under the slip ring. Blow the sand away. Keep cleaning out sand until you can't feel any grit when you move the slip ring up and down.

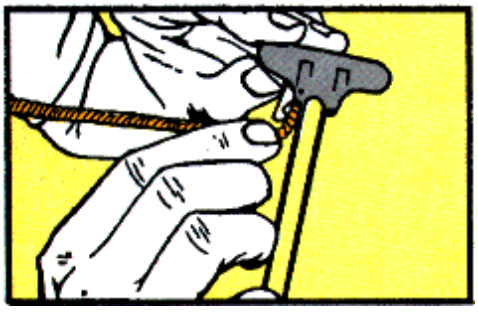


Trigger Assembly. Clean gently with a pipe cleaner and CLP so you don't bend the springs around the trigger assembly. Twist the end of the pipe cleaner



into a circle so that you get more sweeping action. If you can't get at sand with the pipe cleaner, try blowing it out with your own lung power.

Charging Handle. Remove the charging handle from the upper receiver and clean it with a rag and CLP. Work a pipe cleaner dipped in CLP in the area where the handle moves in and out of the receiver until the grit is gone.

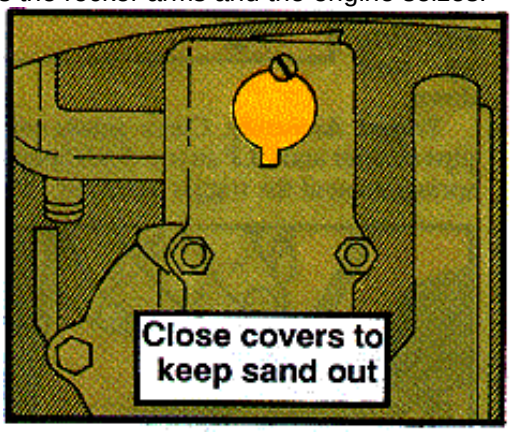


Attention to Small Details

M3A4 Smoke Generator

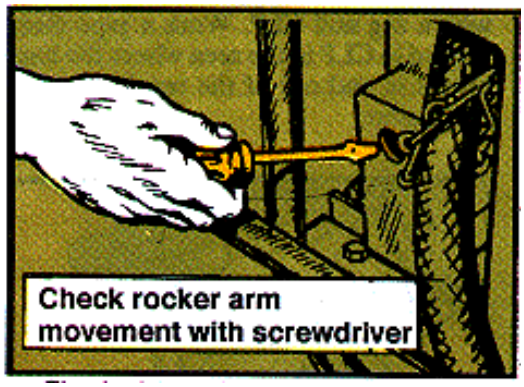
Hot times can mean hard times for your M3A4 when it comes to smoking in the desert. Here are a few ways to beat the heat:

Tighten daily the screws of the fog oil pump covers and keep the covers over the rocker arm holes when your M3A4's not operating. If loose covers swing back and forth or the holes are left uncovered, sand freezes the rocker arms and the engine seizes.



Tighten the head tight and then stop. If you overtighten the head, its seal distorts, the head overheats, and the M3A4 shuts down.

In the desert, repairmen should keep extra seals on hand. Heat knocks out the seals fast.

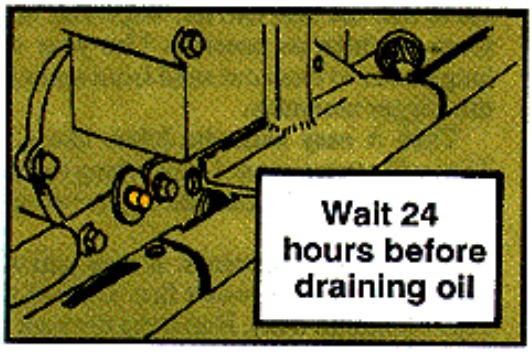


Check the rocker arms for movement with a screwdriver before startup. If they don't move freely, report it.

Pay special attention to the fuel line and fuel hose during BEFORE PMCS. The desert's heat and harsh sun will increase cracking of the lines and hoses that leads to leaks and fires. If you spot cracks or damp spots, get the line or hose replaced.

Wrap your tools in the tool roll before you put them in the toolbox. If you leave them loose, they become finger-burning hot without the insulation of the tool roll.

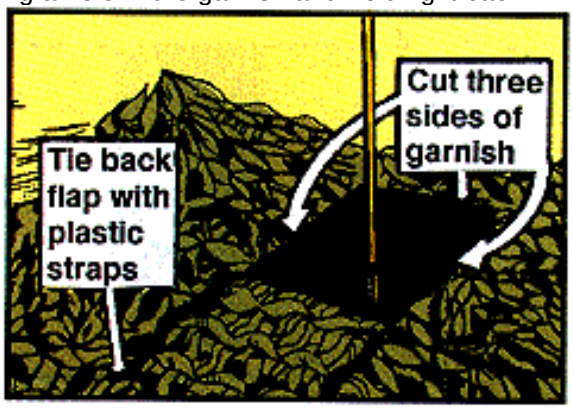
Wait as long as possible-24 hours is best-after shutdown to drain the fog oil pump. Hot fog oil can ignite if it splatters on a hot engine. The cooler the engine the safer draining will be.



Camouflage

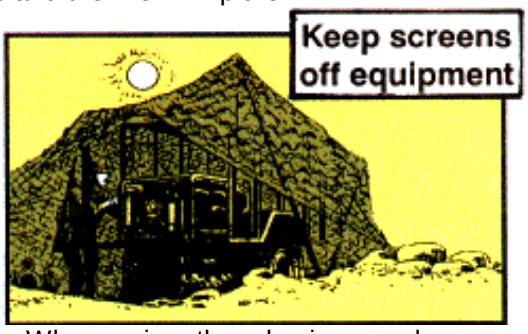
The desert punishes camouflage screen with an unrelenting attack of blowing sand and fatiguing heat. When using camouflage in the desert, remember these points:

Radar-scattering screens can catch fire if the garnish touches the antenna when you transmit. Make sure all antennas are 8 inches away from the garnish by cutting a hole in the garnish and folding it back.



Keep camouflage screens away from hot surfaces such as heaters and exhaust systems.

Never spread screens directly over equipment. Sharp corners, armament, bumpers, antennas, exhaust stacks and the like will rip them.



When using the aluminum poles, smooth by filing off any nicks or burrs. They'll go together easier and won't snag screens.

Also, make mating the poles a lot easier by removing all mud, sand, dirt and other crud from the ends.

The poles aren't made for heavy lifting jobs so don't use them as pry bars.

Before striking a screen, clear the ground underneath of all rocks. They'll tear the screen for sure.

It's important to have tears mended as soon as they occur. Otherwise, they will become huge holes and your screens will be useless.

If you need to order new screens use NSN 1080-01-075-4014 for the desert radar scattering kit and NSN 1080-01-073-3220 for the radar transparent kit. Each screen kit comes with:

ITEM	NSN
200 black plastic straps	1080-01-022-8633
30 quick connect/disconnect pins	1080-00-559-1551
30 quick connect/disconnect brackets	5340-00-564-9062
lanyard	1080-00-571-5015
16-ft cord	4020-01-041-0788
6 5-ft lengths of twine (30-yd shuttle)	1080-01-060-1698
1-sq meter garnished net (radar scattering only)	1080-01-183-4481
1-sq meter garnished net (radar transparent only)	1080-01-183-4482
20-sq feet camouflage cloth (radar scattering only)	1080-01-073-1269
20-sq feet camouflage cloth (radar transparent only)	1080-01-075-4016

Gloves

Everything in the desert is hot-including tools and equipment. Wear gloves to protect your hands. Here are NSNs for three different kinds of gloves:

Light Duty Work Gloves

Size	NSN 8415-00-268-
1	7871
2	7872
3	7869
4	7870
5	7868

Heavy Duty Work Gloves

Size	NSN 8415-00-227-
S	1220
M	1221
L	1222

Anticontact Gloves

Size	NSN 8415-00-
1	634-4794
2	634-4793
3	269-5700
4	269-5701
5	269-5702

Chemical Protective Gloves

Size	NSN 8415-01-033-
S	3517
M	3518
L	3519
XL	3520

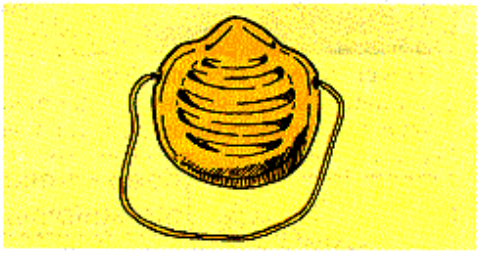
Glove Liners

Size	NSN 8415-00-268-
S	8354
M	8353

Personal Items

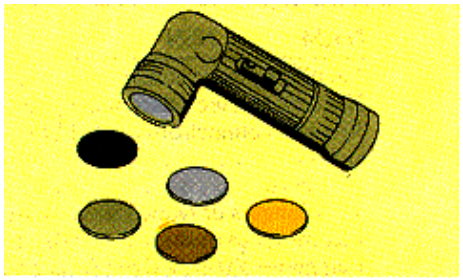
Here are some other items that may come in handy when you're a long way from a PX:

Item	NSN
Chapstick, pkg of 100	6508-01-265-0079
Desert camouflage face paint	6850-00-161-6202
Ear plugs and case, pkg of 20	6515-01-100-1674
Ear plugs, disposable, foam	6515-00-137-6345
Ear plugs, disposable, silicone	
(24 pair/box)	6515-00-135-2612
(100 pair per box)	6515-00-135-5416
Goggles, Safety	4240-00-052-3776
Goggles, sun, wind, & dust	8465-01-004-2893
Hydrogen peroxide, 1-pt bottle	6505-00-153-8480
Insect repellent, 2-oz bottle	6840-00-753-4963
Insect sting kill, pkg of 10	6510-01-045-3506
Mask, dust	4240-01-234-6117*



Neat's foot oil, 1 quart	8030-00-244-1031
Saddle soap, 1 pound	7930-00-170-5467
Snake bite kit	6545-00-526-1887*
Sunburn preventative, 2-oz can	8510-00- 162-5658*
Sunglasses	8465-01-114-1488
Sunscreen, 4-oz bottle	6505-01-121-2336
Talcum powder, 9-oz can	8510-00-817-0295
Toothbrush, 6-in handle	8530-00-290-2920

***Order on a DD Form 1348-6.**



Flashlights	NSN 6230-00-
MX-991	264-8261
MS-212	583-3699
Flashlight Filters	NSN 6230-00-
Red	111-0190
Opaque (Blackout)	128-2464
Diffusion	356-4825
Green	504-8341
Amber	504-8342

Comments and suggestions on how to improve this Technical Bulletin should be sent to Commander, US Army Materiel Readiness Support Activity, ATTN: AMXMD-PS, Lexington, KY 40511-5101

Technical Bulletin
TB 43-0239

Headquarters
DEPARTMENT OF THE ARMY
Washington, DC 15 October 1990

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

Thomas F. Sikora
Brigadier General, United States Army
The Adjutant General

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BE EXACT PIN-POINT WHERE IT IS

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IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 048290-000