Tips for Tankers

or Lessons Learned and Re-learned

by Colonel Christopher V. Cardine (Retired)

The M1 series of tanks have been in the field for 18 years. However, many soldiers and leaders continue to make the same simple mistakes when using and maintaining these vehicles. This is despite many material changes in the vehicles' design and continuous changes in our training programs. Hopefully this article will give tankers a quick reference to the most common problems and their cures.

Since the very first XM1 tanks were sent to operational testing at Ft. Bliss, the Project Manager Abrams and the prime contractor, General Dynamics (originally Chrysler), have been recording and responding to problems seen in the field. This program is called the Abrams Field Problem Management system, and is funded as part of an engineering services contract.

Every time a tech rep comes to visit you to help solve a new problem, or whenever you send an Equipment Improvement Report into TACOM, the data is recorded as a unique field incident report. All accident reports are also entered into the data base. These incidents are continuously evaluated for trends that may require equipment changes through modification work orders (MWO), safety of use messages (SOUM), maintenance advisory messages (MAM), changes to technical manuals (TMs), and/or changes in the programs of instruction (POI) at the TRADOC schools.

There is a very regimented review process in place, the Field Problem Review Board (FPRB), and a separate but related System Safety Working Group (SSWG). The FPRB evaluates problems and makes a determination of what actions are necessary. The SSWG addresses and resolves Abrams safety issues. Members of these boards include the user representatives from the TRADOC Systems Manager's (TSM) Office for tanks at Ft. Knox and Aberdeen Proving Ground, the Army Safety Center, TACOM, the contractors, and the logistics and system engineers from the Project Manager's Office. Either the Project Manager Abrams or one of his two Product Managers (PM-M1A2 or PM M1/M1A1) personally chair the board.

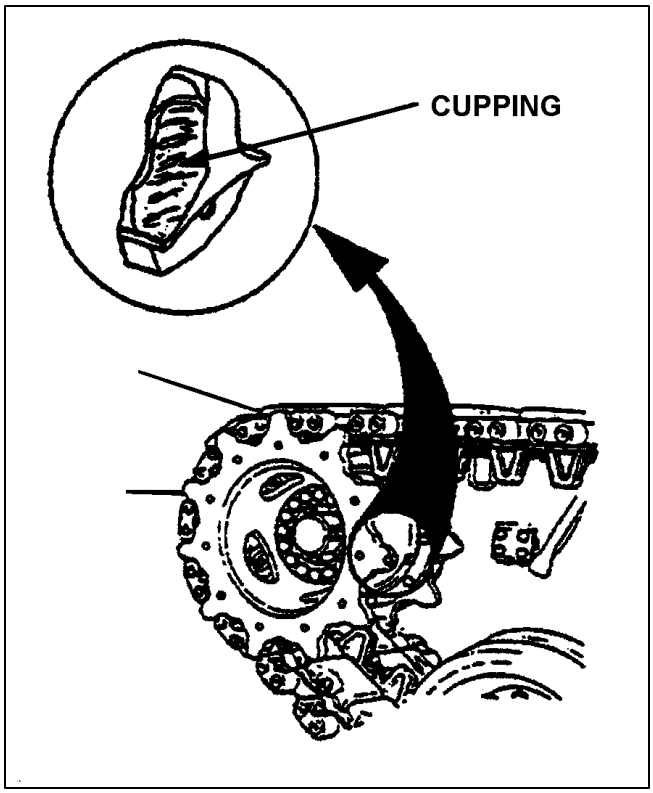

Fig. 1

After the board meets, a complete summary is published of all incidents and what is being done about them. The FPRB books were previously published and mailed to battalion commanders and their maintenance officers, but the costs became prohibitive. The results and other current tank information will soon be available on the Internet on the PM Abrams web site. You may also get copies from either your local GDLS technical representative or TACOM Logistics Assistance Officer (LAO). They are published after every FPRB, about once every two months.

As an original member of the XM1 Test Set Incident Reporting System (the FPRB precursor) while a captain, through battalion command in the field, and finally as PM Abrams the last four years, I saw too many repeat incident reports! We are not learning from our own mistakes. Even after material changes are made to the equipment and the TMs are updated, soldiers are still making simple, costly maintenance and operational errors. I will try to summarize some of the classics, explain what the symptoms are, and how you as leaders can do something about them.

HULL/AUTOMOTIVE

Sprocket Cupping

Have you ever wandered through the motor pool on an inspection and found a tank that has strangely worn end connectors and sprockets that have cups in their teeth? (See Fig. 1) Is it bad track quality? Improperly hardened sprockets? A bent roadwheel arm? No, it's a crew that thought they followed the track adjusting

procedure, but really did not. The track is actually overtightened. This, despite the fact that the track adjusting link (TAL) has an automatic relief valve to prevent this. How do they do that, you ask? Simple.

If you refer to the technical manual, it tells you before adjusting track to move the tank forward on a level surface and let it coast to a stop without applying the brakes. This is so the TAL will be the only thing pressing against the track while you add grease. When the appropriate tension is there, the grease will come out through a one-way relief valve. (Fig. 2)

If you go down to the motor pool to do maintenance and tell soldiers to adjust track tension, they will do the following: They get their grease guns and pump grease into the TAL until it comes out. Unfortunately, when they parked the tank the night before, they stepped on the brakes and then set the parking brake.

My soldiers never do this, you say. Walk through your motor pool and watch! Also, see how many tanks have cupped sprockets. It is a great maintenance indicator.

Blown Main Hydraulic Pumps/Fires

Had any instances where mechanics were complaining about poor quality pumps that blew out? Had a mysterious hydraulic oil fire caused by a pump that split a seam? Know what causes this 99 times out of 100?

When a pack is pulled and reinstalled, most mechanics do a good job of tightening the new style main hydraulic lines on the top of the pump. Where they make mistakes is when reconnecting the hydraulic pump case drain (return line) quick disconnect coupling. (See Fig.3) If it is not properly seated and positively locked, the oil flow is off. There is no oil leak because the quick disconnect is self-sealing when improperly installed or disconnected. Unfortunately, there is also no oil flow out of the pump during certain overflow conditions. This can generate sufficient pressure to cause the pump to burst, spraying hot oil in the engine compartment.

What's the cure? Training your mechanics, and a quality check by your maintenance supervisors of the quick disconnects after services. A leader who knows how to reach in and check for a properly seated QD does a lot to ensure that the soldiers do it also. Take your time to learn the feel on this one, as it is tricky.

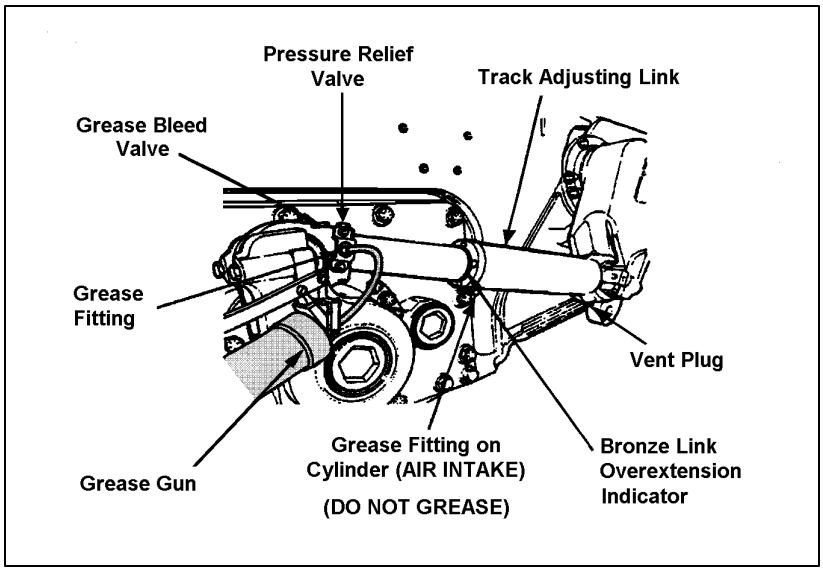

Fig. 2

Sprockets and Hub Carriers That Shear Their Bolts

Seen this one before? This happens quite frequently about 200 miles after the crew has rotated the sprockets. The cause is usually that they have reused the fastening hardware. The TM calls for replacing bolts when two or more sprocket bolts, or four or more hub bolts, are found loose during normal operations. Left unsaid: if you loosen them all to replace or rotate the item, you have exceeded this criteria and they should all be replaced. Even if you properly re-torque these bolts, they often have been stretched beyond their elastic limit and will again come loose. The result is a tank on the roadside missing training while someone looks for bolts.

The solution here is simple. Each company team PLL clerk or maintenance leader should have one or two sets of sprocket and hub bolts always on hand. When the crew replaces or rotates the sprockets or hubs, they can be given a new set on the spot to get the job done right the first time. If you are a leader and are walking around the motor pool and see a crew changing sprockets or carriers, you should take the old bolts, instructing the crew on why they should only use new.

Loose End Connectors and Missing Wedge Bolts

These are the bane of every tank crew's existence. With 156 track blocks connected together with two end connectors each, there are 312 wedge bolts to come loose. Even if you are 99% good, there are three loose ones out there! The newer T-158 and T-158LL track have a new crimped wedge that acts as a locking nut to make life better. However, if you do not assemble the track properly in the first place, the wedge bolts will still come loose.

Most crews assemble a set of track by laying out the eight block sections and hooking them together. They then tighten the end connector bolts down with all their might or actually using a torque wrench. Unfortunately, they are doing a

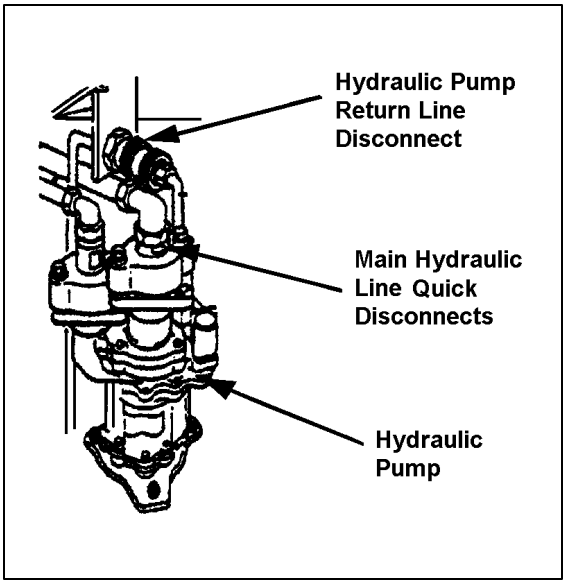

Fig. 3

lot of work for nothing as the wedge bolts will be loose as soon as the track is on the tank. To properly torque the wedge bolts, the two track blocks must be at an angle to one another. If you look at a mounted track as it comes down from the front idler wheel and goes under the #1 roadwheel, it makes the only angle where there is no tension between the wedge bolt and the angled face on the two track pins. Unfortunately, this is the only spot where you can torque the end connector wedge bolts properly.

When you assemble a new track or replace track blocks, paint each of the new end connectors and torque it only at the #1 roadwheel pivot point. This is also true for any loose end connectors you find during inspections. It does no good to "tighten" them unless the two blocks are properly angled. We have run many tracks for thousands of miles after properly torqueing the wedge bolts and have rarely had one come loose. The secret is in the location *where* you torque them and not how tightly you screw them down.

T-158 and T-158LL Track Differences on M1A2s

T-158 track will soon be replaced in the inventory with T-158LL track. Although both types of track are interchangeable and the T-158 costs less, you cannot use it on newer M1A2s. If you use T-158LL track on an M1A1, the vehicle will actually weigh less than its 68.4 ton rating because it was designed with the T-156/T-158 track weights in its budget allocation. This is OK. However, the newer M1A2s have used the T-158LL weight savings by incorporating newer, more effective survivability improvements in the vehicles. To keep the vehicle within its weight of 68.4 tons, you must only use T-158LL track on these vehicles. Both track types (T-158 and T-158LL) have a 2,000-mile life expectancy.

NBC System

The sponson-mounted NBC system and its filters located in the crew compartment are one of the best and most reliable protective systems in the world. Unfortunately, because of their reliability, they are one of the most neglected items on the tank. This neglect, and ignoring safety warnings, has led to the injury and deaths of several soldiers in the last several years. All were avoidable.

The NBC system utilizes bleed air from the turbine engine intake. This air is temperature and humidity regulated in the sponson box area and then filtered in the crew compartment before it is bulk dumped and/or delivered to the individual crewman's protective mask. Cooling air is also drawn into this area through a particle separator that shares the incoming raw air by the engine air filter intake. The main cause of problems is the neglect of the sponson area. (See Fig. 4)

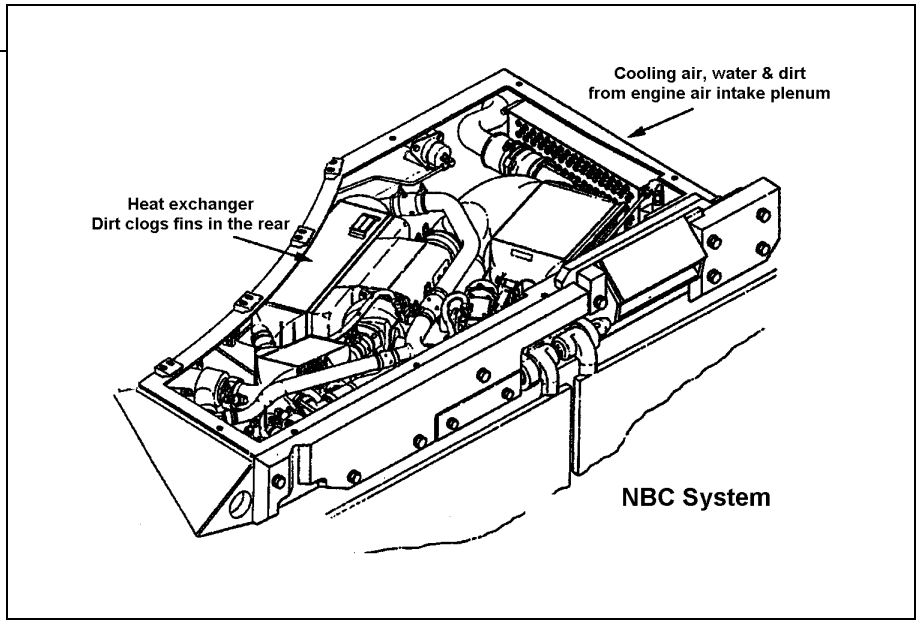

Fig. 4

During semiannual services, the sponson area must be thoroughly cleaned and inspected. All hoses and clamps must be perfect. There must be no water or dirt in this area. There are three radiator-like devices in the sponson (heat exchanger, condenser, and pre-cooler) that must not be clogged with dirt. Water and dirt enter this area when mud builds up in the engine air intake area and the tank is parked facing downhill. Although the system was designed to operate in adverse conditions, when it is not operating, water can accumulate in the sponson area. A mixture of water and fine dust can enter the heat exchangers and the air cycle machine. If they are allowed to remain submerged in this corrosive, cement-like mixture, the ACM can corrode over time and the exchangers can become blocked. This is why it is essential that a tarp be placed over this area and tanks parked with the rear end facing downhill in wet climates.

The most difficult radiator face to check for dirt blockage is the heat exchanger because its inlet face is inboard, by the turret wall. In normal operation, the dirt/dust passes through the heat exchangers, ACM, and pre-cooler and is dumped overboard. When also mixed with water, it tends to stick to the face of the heat exchanger. During operation, chunks of mud may be passed through the heat exchanger and into the ACM. This debris can cause high speed fan instability. This instability can cause an ACM stall/seizure resulting in high temperature bleed air reaching the M48 charcoal impregnated paper filters in the crew compartment. A spontaneous fire can result if the crew does not shut the NBC system down when an overtemp warning light illuminates. Letting the system "cool down" and then restarting it does not solve the problem; it only makes the probability of a fire greater! An MWO is being worked to try to limit mud ingestion in this area, but for now it must be inspected and cleaned during semi-annual services.

Several Safety of Use Messages have been released about how to check the NBC system and the importance of the warning lights to the crew. Additionally, there is a new MWO to add a warning buzzer when an over-temperature condition exists. None of these measures will work unless leaders understand both how the system functions and how well their crews and mechanics are trained.

Another unnecessary damage area can occur when you replace the bolts on the sponson covers over the NBC system. Not all bolts are the same length, and if the longer bolts are used over the pre-cooler location, they will do about $4,200 worth of damage. An MWO is also in process, but in the meantime, study which bolts go in which holes carefully.

Self Cleaning Air Filters

One of the greatest inventions of the 20th century is being added to many of your tanks — the Pulse Jet System (PJS) self-cleaning air filter. For 18 years,

we've trained soldiers to check and clean their air filters at every available opportunity. Now, along comes a self-cleaning air filter, and the worst thing you can do is open it and check it. Yes, it's true: we're actually telling you to do less maintenance! Let me explain why.

The PJS works by back-flushing different sections of the air filters sequentially with pulsed air to remove accumulated dirt. The dirt is drawn out of the filter plenum area by the scavenger fan and tossed overboard through the left rear grille door. The cycling of this function is determined by a number of calculations and the engine speed. At any given time, if you open the air filter box, there may be a dirty filter, or there may be unscavenged dirt in the bottom of the box. Unfortunately, you cannot tell by looking whether or not the PJS is working or where it is in its cycle. You must rely on the low inlet pressure warning light. If it does not come on, all is well. Additional checks are in the new TM change and a MAM that has been distributed to the field. In the case of PJS, less crew maintenance is better!

Another great killer of both old and PJS filters is soldiers with hoses on wash racks. Do not spray water directly into the air intakes! Although the tank can operate in a downpour, washing a lot of water into the intake and then turning the vehicle off in a short while will leave you with a plenum full of wet, rotting filters.

Engine and Transmission Oil Coolers

Speaking of things that dump air out of the rear grille doors, one neglected area is the oil coolers. They will frequently become clogged from the inside because the fans that drive cooling air through them utilize air that is drawn from around the tank as it moves. If the air is dusty or wet, eventually there is a deposit built up on the coolers. The easiest method to clean them is to remove the two access covers on the top of the ductwork, and with the engine running, flush large amounts of water through them. On older tanks, you must remove the rear deck to do this; newer tanks have access hatches in the back deck. High engine or transmission oil temperature lights are a sure sign of clogged coolers. Any fuel or oil leak that occurs and is repaired is also a reason to clean the oil coolers as some of this liquid will have been drawn through and deposited on the fins.

Fire Extinguishers and Halon

There are a lot of rumors about the Halon that is used in the fire suppression system and in the handheld extinguishers. First of all, Halon is safe to breathe. It irritates your throat, but it will not harm you in the concentrations that are used to extinguish fires inside the crew compartment. Halon is, however, an ozone-depleting chemical and may be replaced for environmental, not health, reasons.

A replacement for Halon for use in engine compartments has been found and is being tested. Eventually all tanks will receive a free MWO to change out their Halon engine fire extinguishers. The crew compartment is a different story.

The entire Army, less the Abrams tank, has returned to using CO^2 hand-held fire extinguishers in vehicles. The reason Abrams tanks still have Halon is because CO^2 will suffocate you if you do not evacuate the vehicle. CO^2 is heavier than air and quickly settles in the driver's compartment. The driver can be quickly knocked out and impossible to evacuate if you use CO^2 inside the crew compartment on a tank! Safe alternate agents are under investigation, but until a solution is found both the crew fixed extinguishers and hand-helds must be Halon-only. Do not try to improvise on this one. You could cause a death!

Leaders should also thoroughly understand how to safely remove and replace fixed fire extinguisher bottles. If done improperly, they can become deadly missiles. Maintenance people have been killed by not properly following the procedures. Another aspect of this is that many mechanics forget to rearm the bottle after it is remounted in the vehicle. As a pre-combat check, this is a must-do! It is also an important post-maintenance quality check.

TURRETS

External Auxiliary Power Units (EAPU)

For years, we all screamed for an auxiliary power unit (APU) on the Abrams. We finally have one, but are not using it enough. Yes, there were problems when it was initially fielded, but they are being fixed free of charge to the units.

Currently, there is an MWO team going around to replace the 12 volt starter with a more durable 24 volt one. A new voltage regulator will also be installed. This will allow a full 2 Kw of power at high temperature and high load — a condition that would cause the original design to cut back to only a 1 Kw output. And finally, the more than useless 24 volt EAPU battery is being removed and replaced with a NATO receptacle.

Now you will always start the EAPU from the vehicle batteries, or it can be slave-started from any 24 volt source. As a backup, there is still the manual rope. The procedures for both starting the EAPU and generating power to keep the vehicle batteries charged have been carefully rewritten in the -10 TMs. You can run the EAPU and not charge the batteries if you do not have all switches in the proper position during operation. This is a crew skill, just like everything else on the tank, and leaders should know and understand all of the operational modes.

Operationally, we are still not exploiting the capabilities of the EAPUs. SOPs need to be revised and TTPs developed that have crews power up their EAPU and shut down their main engine whenever they will be stationary for more than 5 minutes. The savings in fuel and engines could be astronomical!

Muzzle Reference Sensor

The muzzle reference sensor (MRS) contains a radioactive tritium light source. Some crews and master gunners have been attempting to adjust the focus with improper tools. This is not an organizational level task, and the safety and administrative complications if you break the tritium vial are not worth attempting this task.

This article was not intended to be a complete rundown of everything you need to know about Abrams maintenance as an Armor leader. It is, however, a minimal list of everything that you should not let go wrong as a responsible leader. If every vehicle commander simply knew and did the above items properly, you would all have a lot more dollars to spend on training. These vehicles are going to be with us for a long time, and it is your responsibility to pass these lessons learned on to the next generation of tankers.

COL Christopher Cardine, a 1971 graduate of the U.S. Military Academy, served over 27 years in various armored and cavalry units including the 68th and 77th Armor and 7th and 11th Cavalry. His last three assignments were as Commander, 3-68 AR, Product Manager M2/3 Bradley Fighting Vehicle, and Project Manager M1 Abrams Tank. He is currently Director of Business Development for Signal & Systems, Inc., in Troy, Mich.