UNITED STATES MARINE CORPS
Motor Transport Test Site
Marine Corps Research, Development, and Acquisition Command
Quantico, Virginia 22134-5080

11240
SSCM-MTS
31 May 1988

MEMORANDUM

From: Major K. R. Williams, Jr.
To: Charles Hegedus, Naval Air Development Center,
Warminster, Pa. 18974-5000 (Code 6062)

Subj: EVALUATION OF MILITEC, INC. LUBRICANT

1. Militec, Inc. has delivered some lubricants to the Motor Transport Test Site that supposably provides a film barrier between all moving parts. The oil, when added to regular engine oil, will allow the engine to operate under full load even if all oils are lost. The product is added at the amount of 4 ounces for every quart of engine oil. It is allowed to mix for a few minutes and then left for 12,000 miles, when a new treatment must be added.

2. As you see, this could have potentential for front line equipment if the oil pan etc, is damaged as it would allow the vehicle to still operate and leave the hostile area. Militec states that we can operate a jeep for at least 20 minutes under a full load without any oil.

3. Request you evaluate the oils for penetration, wear, separation, evaporation, load wear, hot and cold tests, corrosive properties, gumming, toxic properties, and any other tests to support our project.

4. The results of your tests and our actual test in an engine operated without oil will assist us in evaluating this product.

K. R. WILLIAMS,JR

C0076A		
4. TITLE (and Subtitle) M151A2 MEU (SOC) ENGINE TEST		5. TYPE OF REPORT XXX FINAL JULY 88
		6. PERFORMING ORG. REPORT NUM 3 C0076M
7. AUTHOR(S) MAJ WILLIAMS. K. R.		8. CONTRACT OR GRANT NUMBER(S)
9. PERFORMING ORGANIZATION NAME AND ADDRESS COMBAT SUPPORT SYSTEM MCRDAC SSCMTS 22134-5080		10. PROGRAM ELEMENT PROJECT XXX AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE
	13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (If different from Controlling Office)	15. SECURITY CLASS (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION DOWNGRADED SCHEDULE

16. DISTRIBUTION STATEMENT

DISTRIBUTION B: LIMITED TO U.S. GOVERNMENT AGENCIES ONLY. OTHER REQUESTS FOR THIS DOCUMENT MUST BE REFERRED TO CG, MCRDAC, WASHINGTON, D. C. 20380-001

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18.SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

MILITEC
OIL
M151A2
ENGINE

20. ABSTRACT (Continue on reverse side if necessary and identify by block

THIS REPORT IS THE RESULT OF THE TEST CONDUCTED BY MCRDAC OF THE CAPABILITES OF THE M151A2 TO OPERATE WITH COMPLETE ENGINE OIL LOSS, WITH USE OF MILITEC

14A

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 83 IS OBSOLETE S/N 0102*014*6601 SECURITY CLASSIFICATION OF THIS PAGE

CLASSIFICATION: Unclassified

PROJECT NUMBER: C0076M

REFERENCE: (a) MC0 5000.11A.
(b) C0076M

ANNEXES: A. Test Data
B. Test Criteria
C. Deficiencies and Suggested Improvements
D. Ram Data and Computation

1. Purpose. The purpose of this test is to evaluate the Militec oil additive that has been added to a M-151A2 engine and to determine if the additive allows the treated engine to operate after all oil has been drained.

2.System Description.

a. Militec is a synthetic liquid metal conditioner that penetrates the metal pores after being added to the engine oil and operated for at least 200 miles. Once added, the product does not have to be drained.

b. The engine selected for the test is a General Army Design, 4 cylinder,

65 Horsepower @ 4000 rpm, Torque rating of 128 lb-ft @ 1800 rpm, Overhead valve, 7.5:1 Compression ratio, 5 quart oil capacity with filter, and a firing order of 1-3-4-2.

3. Background.

a. The modification of the M-151A2 for the MEU(SOC) required a vehicle that could enter and exit a hostile environment quickly. If shrapnel or a round penetrated the oil pan, how long could the vehicle continue to operate before engine failure occurred. In order to add time to the life of engine without oil, a product such as Militec was tested.

b. Militec metal conditioner has advertised that when its product is added to an engine at the ratio of 4 ounces of Militec to one quart of oil and circulated for 200 miles that it will allow the engine to operate for at least 20 minutes after the oil has been drained.

c. The Commanding General, Marine Corps Research, Development and Acquisition Command authorized a test to be conducted.

4. Test Objective. To determine if an engine treated with Militec can operate for a longer period of time and over a greater distance when compared to an untreated engine.

5. Test Limitations.

a. Test Course: Because of video restraints, a hard surface road was utilized.

b. Similar Products: No attempt was made to acquire and test every available product that may have similar qualities. Militec was selected because it was readily available and was undergoing other tests within DOD.

c. M-151A2 Engine: A compression test and oil change with new oil filter was performed on both engines prior to the test and prior to adding the Militec. The compression test indicated that both engines were well within limits. Recorded mileage was 10,342 miles on the untreated engine and 3,585 miles on the Militec engine. Both vehicles were communication variants, therefore, no engine hours could be determined. It was decided that the engine with less mileage should be treated with Militec as the tolerances were probably closer, therefore, heat would cause the engine to seize quicker.

6. Conduct of the Test.

a. The initial step was to add 20 ounces of Militec to test vehicle "B" and drive the vehicle for 200 miles over normal highway and speed.

b. Both vehicles were driven to the test course starting area, a distance of 13 miles. This allowed vehicle operating temperature to be met as the

outside temperature was 76°. Both vehicles had 150 pounds of sandbags in the rear.

c. Vehicle "A", the untreated vehicle, had its drain plug removed and all oil was drained in 4 minutes.

d. Vehicle "A" was then driven 13.5 miles as follows: 11.8 miles at 35MPH and 45 MPH for 1.7 miles. Road surface was blacktop, two lane divided highway that included curves and hills. A driver and the video operator were in the vehicle the entire time. At the end of this portion the vehicle had its drain plug removed and oil filter removed in order to remove any remaining oil. 1/2 quart of oil was removed prior to replacing the drain plug and oil filter. The vehicle was then restarted and driven at 35 MPH until the engine seized.

e. Vehicle "B" was started for five minutes, stopped, then had its drain plug removed for four minutes to drain all oil.

f. Vehicle "B" was then driven as in paragraph (6d.) . At the end of this period the oil drain plug and oil filter with approximately 1/2 quart of oil being removed prior to replacing the drain plug and filter. The vehicle was then restarted and driven at 35MPH until the engine seized.

g. At the end of the test, both vehicles were towed back to the test site. 5 quarts of 10W30 oil was added to each engine for a restart attempt.

h. Both engines were torn down to determine internal damage.

7. Test Results.

a. Vehicle "A" was driven a total of 19.5 miles over a total time of 39 minutes/50 seconds. After 27 minutes/30 seconds and 13.5 miles, the vehicle was stopped and the second oil drain took place. The vehicle was then able to be driven 6.0 miles over a time of 12:20 minutes before the engine seized.

b. Vehicle "E" was driven a total of 25.9 miles over a total time of 51 minutes/34 seconds. After 26 minutes/22 seconds and 13.5 miles, the vehicle was stopped and the second oil drain, took place. The vehicle was then able to be driven 12.4 miles over a time of 25:12 minutes before the engine seized

c. After the second oil drain, vehicle "A" was smoking from the oil filler cap and knocking after 3.3 miles. At 4.9 miles the vehicle had no power climbing the hills and stalled on one occasion but was able to be restarted. After 6.0 miles, the vehicle no longer had power on the hills or the flats. At this point the engine seized and the vehicle was pulled to the side of the road.

d. After the second oil drain, vehicle "B" developed a very slight knock and squeal at the end of 6.7 miles. No loss of power was experienced. At 8.3 miles puffs of smoke came from the oil filler cap, still full power. At 9.8 miles very bad engine raps and knocks were sounding. They were most

noticeable on down hill inclines when less power was applied to the engine. What sounded like a broken rod let go at 12.4 miles on a down hill slope. The vehicle still had power.

e. Four hours after completion of testing 10W30 oil was added to each engine. Vehicle "A" still would not turn over, vehicle "B" would turn over, however, the loud knock was still heard inside of the engine.

f. The following engine parts were found to be damaged during the engine tear down of vehicle "A".

1. The engine had seized and spun the #3 connecting rod bearing and also bent the rod on the large end.
2. The bent connecting rod caused the piston to move down and strike the counterweight on the crank-shaft, denting the piston.

3. The #4 connecting rod bearing was damaged, but did not seize to the crankshaft.

g. The following engine parts were found to be damaged during the engine tear down of vehicle "B".

1. #2 connecting rod broken
2. #1 bearing destroyed
3. The #1 and #2 rod journals on the crankshaft showed signs of high heat on the bearing surfaces and crank throw area.
4. Piston on the 12 connecting rod was damaged in the skirt area.
5. At the lower lip of the #2 cylinder wall a 1" x 2" section of the wall was broken off and found in the oil pan.
6. Hole in the oil pan.
7. Entire interior surface of the engine was coated with a powdery reddish/orange residue.

ANNEX A TEST DATA

1. The following information pertains to the M-151A2 without the additive. (Vehicle "A")

a. USMC# 508431
b. Start mileage: 10342.7
c. End mileage: 10362.2
d. Total miles: 19.5
e. Total time: 39 minutes/50 seconds
f. Time after second oil drain: 12 minutes/20 seconds
g. Mileage after second oil drain: 6.0

2. The following information pertains to the M-151A2 with the additive. (Vehicle "B")

a. USMC# 506101
b. Start mileage 3585.9

c. End mileage 3611.8
d. Total miles 25.9
e. Total time 51 minutes/34 seconds
f. Time after second oil drain: 25 minutes/12 seconds
g. Mileage after second oil drain: 12.4

2. Appendix 1 contains the results of the Naval Air Development Center test results of Militec. This is a preliminary report as further testing will be conducted. Since the Militec used was synthetic, the first testing was done with synthetic hydraulic fluid. Follow-on testing will be conducted with the synthetic Militec and 10W30 oil at both a 5% and 10% mixture. Results will be forwarded when complete.

ANNEX B TEST CRITERIA

1. Data Requirements

Objective1. Determine if the engine treated with the additive can run longer and farther after all oil has been drained compared to the engine that has not been treated.

1.1 Does the additive allow a standard M-151A2 engine to operate longer, time wise, than an untreated engine? : Yes 25 min. 12 sec. vs. 12 min. 20 sec.

1.2 Does the additive allow a standard M151A2 engine to operate longer, mileage wise, than an untreated engine? Yes: 12.4 miles vs. 6.0 miles.

ADDITIONAL DATA

19 SEP 1988

Mr. Brad Giordani
President
Militec Incorporated
900 17th Street, N.W. Suite 1100
Washington, D.C. 20006-USA

Dear Mr. Giordani:

This is in response to your request for an independent engineering evaluation of a Militec comparative test conducted on two United States Marine Corps M-15lA2 engines.

I inspected the engines at the U.S. Marine Corps Station at Quantico, Virginia on September 13,1988. Upon my arrival, They had been disassembled and generally laid out for easy inspection. For the purpose of standardization, the same identification and terms will be used as those indicated in the U.S. Marine Corps document DD-1473, dated FINAL JULY 88. The following evaluation of the engine parts and proposed engine failure

determinations are presented:

Vehicle A:

* The crank shaft journals of the #1, #3, and #4 piston-rod assembly positions indicted much galling and metal deposits from the bearings. Heat discoloration and scoring of all the journals and the remaining portions of the rod bearings indicated much heat buildup as well an obvious seizure of the engine.

* The rod bearing of #3 had "spun" off the rod-cap assembly seating causing that assembly to be destroyed during the next rotational cycle of the crank shaft. The failure occurred at the bolt connection of one side of the #3 cap-rod assembly. The #1 and #4 bearings had begun to "spin" from their seating and would have destroyed their respective rod-cap assemblies within the next few rotational cycles of the crank shaft.

* The crank shaft front main bearing was scored and heat discolored. The other two main bearings were not disassembled for inspection.

* The cam shaft had signs of peening and the #3 piston skirt was broken as a result of the destroyed #3 rod assembly impacting the side of the block and cam shaft. The counterweight area of the crank shaft had signs of impact from the loose rod assembly.

* The piston wrist pins appeared to be smooth in operation within the pistons of all four assemblies.

Cylinder walls and pistons showed some heat build up and some scuffing in the # 3 cylinder wall caused by the broken piston skirt.

* The rings on all pistons appeared to be normal and rotated freely in their seats.

* Normal carbon build up was evident on the top of the pistons. No evidence of extreme heat was indicated at the rings or in the walls of the cylinders.

Vehicle B:

* The crank shaft journals of #1, #3, #4 piston-rod assemblies showed no signs of metal deposits. Discoloration was evident, but was a uniform black color - not the various hues of blue as indicated on the journals in Vehicle A's engine. No galling nor evidence of scuffing to the surfaces of the #1, #3, #4 rod bearings were observed.

* A failure of the #2 piston occurred at the webbing of the base of the rod arm. The cap still retained both attaching bolts to the remaining portions of the rod forming a length of 8-9 inches and remained attached to the piston. Peening was evident at the stub of the rod arm and along the remaining rod-cap portion. Similar marks of metal-to-metal contact were evident to the counterweight portion of the crank shaft. #2 cylinder skirt was broken. Surface edge of the fracture at the cylinder skirt was a

uniform dull sheen indicating a fatigue failure.

* A hole in the bottom of the oil pan was below the #2 cylinder from a possible contact from the rod being expanded to an extreme length.

* Piston wrist pins were free and smooth in movement.

* Surface areas of the cam shaft appeared to be normal with no evident metal-to-metal contact.

* There was a normal build up of carbon deposits on the top of each piston.

* The rings on each piston moved freely within their seats.

Interior condition of the engine appeared to be dry with little evidence of oil. From the center main bearing to the front of the engine, a reddish/orange coating on all engine parts was in evidence. The rear portion of the engine appeared dry and visually similar to the engine from vehicle A.

NOTE:

* No micrometer readings were taken before the test to provide a "Base Reading".

* No micrometer readings were taken from any component after either engine's disassembly for wear comparison.

* No magna-flux or die-penetrant testing was taken on either rod to ascertain the cause of failure or further impending failure.

CONCLUSIONS:

Engine from Vehicle A failed from a seizure of internal moving parts. Rod #3 bearing failed causing the crank shaft to accelerate into the cap attached to the rod arm. This forced that cap's attaching bolt to yield, bending the cap and remaining rod portions into a semi-circular form. Bearing failure was caused from lubrication starvation.

As indicated in the referenced official U.S. Marine Corps report, the engine from Vehicle B continued to operate with a failed #2 rod. Failure cause of the #2 rod cannot be ascertained without a magna-flux test or other non-destructive test of the failed component. Supposition as to the failure is that the rod material failed as evidenced by its yielding at the section of webbing of the rod arm as opposed to the bearing failure-loss of the #3 rod, as indicated above, in the engine from vehicle A. In this case, the failure of the rod from the engine in vehicle B would had to have been a result of:

seizure from oil starvation or, by material failure under stress and heat or manufacture stress defect.
Since the remaining moving parts of the engine continued in operation prior to intentional engine shut-down and upon engine start-up attempt, a oil starvation (or metal contact seizure) of all contacting surfaces should be discounted.

Comadore A. J. Perry
CDR USN