Series: AWM95
Australian Army commanders' diaries
[Vietnam]

Royal Australian Electrical and
Mechanical Engineers units

Item number: 14/3/21

Item: 106 Field Workshop

Narrative

Annex

[1-31 Jul 1971]

PART 1

COVERING LETTER

Reference No R707-14

To: OIC, Military History Section, AHQ.
DEME AHQ ALBERT PARK BARRACKS MELBOURNE
ADEME HQ AFV

1. I enclose Commanders Diary (AF C 2118) (Adapted) as indicated at Part 2.

2. Please return receipt below.

Received 13/9/71

(Signature) Capt

106 FD. WKS.P. RAEME. 83704
AFPO 4

Appointment
(OC Unit or senior staff officer)

STORES, 2690.

PART 2

AF C 2119 (Adapted)
Revised Jun, 1965

SECRET

ORIGINAL
~~DUPLICATE~~

Strike out where not applicable

COMMANDERS DIARY

OF

Unit or Formation 106 FD WKSP RAEME

From 1 JUL 71 **To** 31 JUL 71

INDEX

		Enclosure Numbers
	Narrative (AF C 2118)	
	ANNEXES	
* A	~~Duty officer's log~~	..... to .....
* B	Messages connected with log	..... to .....
C	Operation orders and instructions issued	..... to .....
D	Operation orders and instructions received	..... to .....
* E	Sitreps issued	..... to .....
F	Orders of battle and location reports issued	..... to .....
G	Intelligence reports and summaries issued; appreciations made	..... to .....
H	Administrative orders and instructions issued	..... to .....
I	Administrative orders and instructions received	..... to .....
J	Administrative reports and bulletins; ammunition returns; field strength returns	..... to .....
* K	Standing orders issued	..... to .....
L	Commander's policy and demi-official letters	..... to .....
M	Action reports (if required)	..... to .....
N	~~Other papers, eg, maps and diagrams, air photos, reports from sub-units~~	..... to .....
O	Periodical summaries of operations	..... to .....
Z	~~Top Secret Supplementary Diary~~	..... to .....

† NIL
† RETAINED
† Despatched to

on.....

* Only to be included during operations.
† Cross out whichever is not applicable.

PART 3

COMMANDERS DIARIES
INSTRUCTIONS

AIM

1. The aim of a Commanders Diary is to provide data on which to base future improvements in Army training, equipment, organization and administration, and to furnish historians with a record of the activities of units and formations in operational and non-operational periods in peace and in war.

GENERAL

2. *Entries are to be made daily* on AF C 2118 (Adapted) each entry being initialled by the officer detailed to keep it.

3. Commanders Diaries will conform with the rules for drafting orders given in "Staff Duties (Australia)" Chapter 2, Section 12.

RESPONSIBILITY

During Non-operational Periods

4. A Commanders Diary is to be compiled by commanders of all formations.

During Operational Periods (1)

5. A Commanders Diary is to be compiled in duplicate by:
   - **a.** Commanders of all formations.
   - **b.** Each branch of the staff at formation headquarters commanded by a brigadier or above.
   - **c.** Heads of services not below the rank of lieutenant colonel.
   - **d.** Personal staffs and officers holding special appointments.
   - **e.** Unit commanders.
   - **f.** Commanders of a detachment of a unit when so ordered.

COMPILATION

6. Both original and duplicate copies are to consist of:
   - **a.** Cover (AF C 2119) (Adapted).
   - **b.** Index as printed on cover.
   - **c.** Narrative (AF C 2118) (Adapted).
   - **d.** Annexes as shown in the Index.

7. All details of the unit or formation (if a detachment is concerned, the name of the parent unit), period covered and enclosure numbers of the annexes are to be shown on the cover. If there has been a change of command since the last report, the date of assumption by the new commanding officer is to be included.

8. The annexes are to be assembled in the groups shown on the cover. If there are no enclosures for an annex NIL will be entered on the cover. If additional annexes are convenient for a particular headquarters, tarting at **B.**

for operations form Annex "Z", "TOP SECRET the document. It is to be prepared and disposed of as

TENTS

es as well as map references), establishment, equipment

d orders given.
he day's fighting, including company movements.
mmander with regard to equipment, tactics, organization

otential importance.
to officers, men and equipment.
ipment captured.
employed in the time not accounted for. The type of

s and to save work as much information as possible is to cuments issued and received, routine returns, etc. All d and the time of receipt or despatch is to be given.

the annexes, but need not give a precis of any of them.

(continued on back cover)

1 B P Coy—274/65—55m

OW84/5

E BOX 47

DISPOSAL

13. **Original Commander's Diary.** This is to be forwarded monthly, unless otherwise ordered, by the seventh day of the succeeding month direct to AHQ.

14. **Duplicate Commander's Diary.** This must be clearly marked as a duplicate. It is to be sent separately from the original to AHQ one month after the original has been despatched but not before the former has been acknowledged.

15. When overseas, both copies of diaries are to be sent through the Army Records organization in the overseas theatre but at different times.

16. **TOP SECRET Supplementary Diaries.**

a. The documents referred to in Paragraph 9 together with a list of them made out on AF C 2118 (Adapted) must be placed in separate cover (AF C 2119) (Adapted). All details must be filled in and the cover clearly marked in red: "ANNEX Z — OFFICER ONLY". It may be convenient to group the papers by appendices.

b. Supplementary diaries must be forwarded under the normal rules for TOP SECRET correspondence, to AHQ. The inner envelope must be plainly marked:

TOP SECRET

ANNEX Z to

Commanders Diary of.....(Formation or Unit)

From.....to..... (Dates)

c. The duplicate supplementary diaries must be despatched as shown in Paragraph 14 as soon as receipt of the original has been acknowledged.

1 B P Coy—274/65—55m

AWM 95
[14/3/Jul 71]

This form is to be enclosed with the annexes in AF–C2119 (Adapted).

AUSTRALIAN MILITARY FORCES

AF – C2118 (Adapted)
Revised Apr. 1969

COMMANDER'S DIARY NARRATIVE

UNIT/FORMATION 106 FD WKSP RAEME

MONTH and YEAR JUL 71 REFERENCE MAP 6130 COMMANDING OFFICER Maj J.S. SINCLAIR

Serial	Place and grid reference	Date	Time	Event or Information	Reference to annex letter and/or enclosure No.
(a)	(b)	(c)	(d)	(e)	(f)
1.	BARIA YS 380608	1 JUL 71		Recovery of Case Forklift from Civil Affairs Project	
2.	BARIA YS 380608	1 JUL 71		Recovery of Truck 2½ Ton MK5 with Broken Axle	
3.	FSB MAUREEN YS 455765	10 JUL 71		Transport Size 0 Dozer to FSB MAUREEN	
4.	BARIA YS 395610	12 Jul 71		Recover 4 RAR Landrover	
5.	VUNG TAU	13 JUL 71		Backload M113 to 2ACD	
6.	FSB MARION YS445585	13 JUL 71		Recover 5 Ton Veh (Bogged) for C Bty 5/42 US ARTY	
7.	YS554714	17 JUL 71		M113A1 Fitters Track Dispatched in SP of Land Clearing Team Whilst Their Veh was in Wksp. Returned 19 Jul 71.	
8.	COURTNEY YS 450905	17 JUL 71		VET of one Elec Fitter to Repair 3 Cav M113A1	

This form is to be enclosed with the annexes in AF–C2119 (Adapted).

AUSTRALIAN MILITARY FORCES

AF – C2118 (Adapted)
Revised Apr. 1969

COMMANDER'S DIARY NARRATIVE

UNIT/FORMATION 106 FD HOSP

MONTH and YEAR JUL 71 REFERENCE MAP 6430 COMMANDING OFFICER Maj J.S. SINCLAIR

Serial	Place and grid reference	Date	Time	Event or Information	Reference to annex letter and/or enclosure No.
(a)	(b)	(c)	(d)	(e)	(f)
9.	FSB MARY	18 JUL 71		Transport Size 0 Dozer to FSB	
10.	HORSESHOE YS495620	19 JUL 71		Recover Truck 5 Ton with Broken Prop Shaft	
11.	AP PHU HAI YS 320620	21 JUL 71		Recover Landrover	
12.	VUNG TAU	21 JUL 71		Backload Forklift to 2AOD	
13.	BIEN HOA	25 JUL 71		Recover Landrover with Broken Axle	
14.	YS 3865	26 Jul 71		Deployed 16 Man Fighting Patrol in 1 ATF TAOR	
15.	VAN KIEP YS 399608	27 JUL 71		Lifting Tasks for AATTV MATT Team	
16.	YS 3865	27 JUL 71		16 Man Patrol Airlifted Out of TAOR Due to 1ATF Operation Iron Fox	
17.	BARIA YS 380608	28 JUL 71		Recover Pettibone Forklift	
18.	FSB ZIGGIE	28 JUL 71		Platoon of 1 Offr and 26 OR Deployed to Defend and Patrol FSB Ziggie Whilst 1 ATF Op IRON FOX in Progress, Under Op Con 3RAR.	

TELEPHONE EBONY 115

AUSTRALIAN MILITARY FORCES

Quote in Reply
R707-1-1

ADDRESS 106 Fd Wksp RAEME
AFPO 4 GPO
SYDNEY NSW 2890

17 Aug 71

RAEME UNIT MONTHLY REPORT - JUL 1971

Reference: A. ARTI Gen D101.

WORKSHOP CAPACITY

General

1. Production and Trend Statistics for Jul 71 are attached at Annexes A and B respectively.

2. Major influences during the month were:

a. Operation IRON FOX which commenced on 28 Jul71

b. Establishment of the Forward Repair Group

c. Transfer of stores to 102 Field Workshop.

3. Although June was an unprecedented month for PRC 25 and RT 524 repair further increases were shown for July. Three times the normal number of PRC 25 sets and twice the normal number of RT 524 were repaired. The Moving Annual Total graphs are standing on their tails.

4. Apart from radio repair there was a noticeable falling away in the load arising late in the month, obviously due to Operation IRON FOX. This is similar to the situation during Operation OVERLORD in June. Arms units echelons are too busy during operations to send their defective equipment to workshop for repair or even to collect after repair unless the equipment is required for operations. This fitted in very well with Operation TIMOTHY requirements for the workshop and demands for fighting patrols and a rifle platoon to secure FSB ZIGGIE during the redeployment of 3 RAR on Op IRON FOX.

.../A Vehicles

A Vehicles

5. The main work consisted of two centurion engine changes and three M113A1 power pack changes.

6. Details of the engine changes were:

Engine Number	Change Advise	Engine Mileage	Reason
R45519	86/71	504	B Bank Low Compression
R47957	87/71	676	A Bank Low Compression No 3 and 4 Cylinders

7. It will be noted that for the second month there have been no coolant failures. While there are less tanks operating, those which are, have been worked hard during the last two months through thick vegetation. This rather supports the contention that most of our earlier problems were caused by dirty and damaged radiators.

8. In response to a request from HQ AFV we have had a look at the pattern of failure of M113A1 engines. This study is attached at Annex C. It is complete to 30 Jun 71. Once again Change Advice Notices and 114's were found to be very much less than satisfactory.

9. Terminal engine changes during the month were:

	Engine Number	Change Advise	Engine Mileage	Reason
a.	6D9965	A91/71	4401	Crankshaft seals leaking, lacks power, minimum result on stall test
b.	6D63052	A92/71	14	Engine seized, lack of oil, drain plug fell out. (Misadventure)
c.	6D19327	46/71	5120	Loss of power, excessive oil consumption. (This change was effected by A Sqn 3 Cav Regt LAD)

10. The number of APC's being processed for repair through 106 Fd Wksp has been on the increase for the past few months. This increase is almost entirely due to the fuel cell modifications done by the Welders.

.../11.

11. The position with M113A1 Transmission Assemblies (2520-00-066-4239) has not improved. Two were received by the Stores Section during July and two were used. We are still holding only one. The Stores Section has had dues in for six on their D3431 on 2AOD since 15 Jun 71.

12. Hose Assembly, Transmission to Cooler M113A1 (2520-00-727-8411) is not being supplied now. Hose is supplied in lengths and has to be cut to size in the workshop and the couplings from the old assembly fitted. This can add up to 2 hours to a power pack change and for operations is a retrograde step.

13. One Meteor engine has been put into preservation by this workshop in accordance with EMEI Veh M354-12 and Veh X009-2 and returned to Australia. Our 2350-41-1 to HQ AFV and DEME refers. We ensured that that assembly was not interfered with by 2 AOD when in the RSG system.

B Vehicles

14. The statistics show a heavy month for B Vehicles but much of the work was of a minor nature. In addition 32 vehicles were carried over from June. 16 of these vehicles were in progress at the start of July. The loading was slightly heavier than moderate for the first two weeks of the month and light from that time onward.

Electrical

15. A fairly normal month of medium to light loading.

16. The transformer on the GCE truck broke down but sufficient GCE assemblies are held to meet any future requirement. Repair or replacement of the transformer will be left until the vehicle has returned to Australia.

General Engineering

17. Four turret changes were carried out. The plastic balls and spaces strips have been received and two turrets have been fitted with them. They are quicker to fit than the old ceramic balls which require alternate placing of the ball and the spacer. Having slipped the spacer strip into position the plastic balls are poured into the groove and located by running a thumb over the balls. The whole procedure takes no more than three minutes against the old system of up to 15 minutes.

.../18.

18. The APC's are being brought back to a 50/30 combination from the 30/30 combination. During the transition stage we are maintaining two change over turrets, one for each configuration. The additional turret was obtained from an old and badly damaged carrier held by C Sqn 1 Armd Regt which is to be destroyed in country. Considerable refurbishing was necessary.

19. Other GE work was at a moderate level but light towards the end of the month.

M2A2 Programme

20. The last Howitzer completed rebuild on 17 Jul. The report on this programme is still being prepared.

Metal Smithing

21. The Metal Smiths were loaded to capacity during the month.

22. Eight Fitters Tracks and 1 APC were fitted with the fuel cell modification. One other Fitters Track and one other APC remain to be done. We have the modification kits for them. They will be done in Aug. . The two APC's belong to engineers and are used with the mine clearing and land clearing teams. They had been overlooked previously. Most of the other work was fabrication. A number of body panels for trucks and landrovers were made and fitted.

A large steel casting from a Dozer was repaired where it had cracked across a 2 ft square hollow section.

We are in the process of trying to rebuild a mast and extension unit which had been dropped from a helicopter. This aluminium fabricated equipment is held by 104 Sig Sqn and is used to erect a 45 ft aerial in small clearings. It is of US Army supply and cannot be replaced.

Instruments

23. Although we are now on top of the instrument work, the section remains very busy.

24. The frequency of typewriter repair is falling, thought to be due to condemnation of a number of machines and heavier repair of the remainder.

.../25.

25. A stereo plotter from Topo Survey was successfully repaired after the plotter table had been bent.

Telecommunications

26. Mention has already been made of the extent of the Tels load. Last month 173 PRC 25 and 53 RT 524 were repaired. This work and other equipment was done by six mechanics. Cpl O'Neill of 102 Fd Wksp was loaned for the week Op IRON FOX commenced. Cpl NOONAN of 3 RAR spends two or three days in the workshop working on his battalion's sets. By these means and long working hours the load is just being held.

27. Since tels mechs with units were prevented from opening sealed sets, the frequency of breakdown has not changed but the faults on the sets are simplier. During Jun and Jul a large number of the sets had multiple and peculiar faults, particularly the RT 524 sets some of which took up to eight hours to fully repair.

28. Modules being supplied from Australia are still not satisfactory. Only three of the last nineteen crystal switches for RT 524 were usable. We have now demanded crystals and will replace defective crystals in these modules where we have the capacity. Because of the high rate of loss, supply is having difficulty in keeping up with us.

29. We believe that much of the trouble with the RT 524 is caused because the VRC 46 mount used in the APC's is too rigid. The mount should be able to be modified to accept rubber in shear resilient shock mountings.

30. During Operation OVERLORD in June a number of problems arose on the ACV's used at TF HQ Main because of overheating of RT 524's. We have fitted a blower to one vehicle to direct an air flow over the radios. This appears to have solved the problem. We have now been directed to so modify all ACV's belonging to 1 ATF units. Our DIR 15/71 refers.

31. There has been an effort to get all the modules held in the Task Force together. They have all been withdrawn from unit tels mechs and we have cleaned out our own hidden corners. The quantities returned through the Stores Section since May are detailed at Annex D. A very large number of these modules were originally obtained on the 'old boy' net from US army sources.

.../Computer

Computer

32. The computer failed during July after some weeks of deteriorating **malfunction. Eventually the controller** and transporter units were sent to Australia. These have now returned with L/Cpl COOK but after one week's use the computer is again inoperative, this time because the computer itself malfunctions and will not answer commands. We are again unable to repair.

33. The problems are:

a. Knowledge - Cook does not have sufficient knowledge. All he had was a five days familiarization on the machine. This gave him a basic understanding of what the machine does but next to nothing on how it does it. I cannot see how a technician with no grounding in logic systems could be adequately trained in under eight to twelve weeks. If the man was trained on logic systems the training period could possibly be reduced to three to four weeks.

b. Documentation - The references Cook has brought with him are completely inadequate.

c. Test Equipment - We have not been supplied with the necessary test equipment. Essential equipment held by 547 Sig Tp is defective and has been returned to Australia. However we are not really in a position to use it without the necessary references or knowledge of the machine.

d. Spare Parts - We have a random selection of replacement modules. 547 Sig Tp have some additional items. Overall however the situation is not good. We have not got sufficient spares to maintain the machine.

e. Diagnostic Service - In theory the diagnostic service provided by WRE reduces the skill required of the local technician to diagnose and repair faults. However reliance on this is wrong because unless the machine will function and print out against the diagnostic tapes, the WRE service cannot be used. Both recent failures of the machine were

.../complete

complete after a period of erratic performance. By the time advice was received from the Diagnostic Service the machine was incapable of accepting the test programmes they suggested. The technician on the spot must be able to get the machine to a running condition.

34. Although the Battle Intelligence computer is on trial it has in fact become an important and integral element of the Intelligence system for 1 ATF. As a result, RAEME, who have accepted local responsibility for maintenance, are coming out of the situation in a very poor light indeed.

All Equipment Repair Requisitions

35. The statistics at Annex A and B indicate an increasing number of repair requisitions being received. The reason for this is that in order to more closely check the load which will arise in Nui Dat, we now insist on a Repair Requisition for all work carried out. Previously quick urgent jobs were done without a Requisition being submitted.

OPERATIONS OF INTEREST

Recovery

36. July was a relatively quiet month for recovery. 39 tasks were completed for 176 task hours and 665 task miles.

Forward Repair Teams

37. A Fitters Track was attached to 1 Fd Sqn land clearing team between 17 and 19 Jul to allow us to get one of their APC's into workshop for the fuel cell modification.

38. On 17 Jul an FRT was deployed north of COURTNEY to carry out electrical repairs to A Sqn 3 Cav Regt M113A1's.

Patrolling

39. On 26 Jul a sixteen man fighting patrol was deployed into the foot hills of the WARBURTONS for what was planned to be four days.

40. On 28 Jul Operation IRON FOX commenced. In accordance with the Op Order 106 Fd Wksp was to provide a rifle platoon headquarters and a rifle section to secure FSB ZIGGIE (YS 615812) to allow the redeployment of 3RAR for the operation. It later became necessary for 106 Fd Wksp to provide a full rifle platoon. The patrol in the WARBURTONS was therefore

.../needed

needed for redeployment. They were extracted by helicopter after a force march of 2500 metres to a suitable LZ. Gunships flew cover. They arrived back at the workshop at 1730 hrs on 27 Jul.

41. The rifle platoon for ZIGGIE deployed by Chinook at 0800 hrs 28 Jul. They returned to Nui Dat at 0930 hrs 5 Aug. Apart from some difficulties with a tiger, swarming bees, a small attempted sapper attack and a light CS gas problem they carried out the normal functions of infantry in a FSB with little to report except one recent track.

Op TIMOTHY

42. Over the period 24-26 Jul the Forward Repair Group was set up but as part of 106 Fd Wksp. All vehicles, weapons and stores however were transferred to 102 Fd Wksp at the same time. The FRG occupies the old 1 Pl area. The electrical shop has been lined and converted to an air conditioned telecommunications and instrument shop. A major problem was created when engineers fed 415 volts into a 240 volt circuit supplying our air conditioned repair trucks. Some test equipment was damaged.

43. The unit is now organized as follows:

a. FRG

(1) Strength: 1 and 38

(2) Tasks:

(a) Second line repair and recovery support for 1 ATF

(b) Defence of old 1 Pl Section

(c) Picketting of strong point 88B by night.

b. Rear Party

(1) Strength: 1 and 11

(2) Tasks:

(a) Administration of unit

(b) Return unit to Australia

(c) In conjunction with the Stores Section for the Headquarters Defence Group.

.../c.

c. Stores Section:

(1) Strength: 1 and 12

(2) Tasks:

(a) Provide back up support to FRG Stores Section Det

(b) Prepare Stores Section for RTA

(c) In conjunction with, and under command of Rear Party form the Headquarters Defence Group.

d. Main Body

(1) Composition: Commanded by Capt EME and comprising Admin Supplement 18 and FRG Supplement 1 and 29.

(2) Tasks:

(a) Supplement FRG by attachment of tradesmen

(b) Maintain the unit site including performance of all day duties and, at night, provision of Duty Telephone Piquet and Duty Driver.

(c) Prepare unit site for shared occupation with another unit, or, in the case that the unit site is abandoned, dismantle facilities as directed by HQ 1 ATF.

(d) Assist Rear Party in preparation and packaging of unit stores for movement

(e) Defend old 2 Pl and Stores Section Sectors.

44. Advance Party stores and vehicles were dispatched on J39. In the broad they comprise:

a. Two landrovers

b. Two ½ Ton trailers

c. Massey Ferguson Tractors

d. One 5 ton GS truck cargo

e. Unit files

f. A quantity of unit stores such as typewriter and duplicator required to set up a rudimentary headquarters.

.../45.

45. Two additional technical vehicles being one 2½ Ton GCE repair truck and one ¾ Ton welding truck with ½ Ton trailer will be returned on J40. No more vehicles are being returned to Australia. All other technical vehicles have been transferred to 102 Fd Wksp. All other GS vehicles are to be returned to 2AOD for use in theatre in accordance with theatre directives.

46. A number of other technical stores and equipments are also to be retained in theatre. The unit will have only a small quantity of its entitlements on RTA. The QM is sending details to Capt COLE, RTC, of the units entitlements being sent from SVN.

47. Ninety nine indents were raised during the month but almost entirely for bulk expense items. However 40% of the CES items ordered for the FRG are still outstanding. These are being hastened, and will be transferred to 102 Fd Wksp on receipt.

48. For Cat A, three IOR's and one BOS were conducted to the value of $7099.00. For Cat B1, one IOR and two BOS's were conducted to the value of $1113.00.

49. We are trying to arrange for the QM to take the unit ledgers with him on RTA. We will require him to be met on arrival in SYDNEY by a representative for 106 Fd Wksp Aust Component, possibly the TQMS.

50. We are also applying for permission to take home the workshop job files and the full Stores Section records, covering all transactions since the formation of 1 Indep Armd Sqn Wksp. Analysis of these records would produce a great deal of useful information particularly if set against 1ATF equipment holdings presumably available to some extent from RAAOC Census records and equipment tables. We do not have the capacity to carry out the appropriate reviews in theatre. One activity in which they may be useful is in setting up a pilot computer programme for field workshops with operational formations.

51. A final decision has yet to be made on the location of the Forward Repair Group.

(J.S. SINCLAIR)
Major
Officer Commanding.

ANNEX A TO
106 FD WKSP R707-1-1
DATED 17 AUG 71

PRODUCTION STATISTICS - JUL 71

	A VEH	B VEH	ELEC	CE	INST	TELS	TOTAL
JOBS BF	1	32	10	18	17	61	139
JOBS RECEIVED	17	35	55	50	126	252	535
JOBS COMPLETED	16	62	62	53	130	279	602
JOBS CARRIED FWD	2	45	3	15	13	34	72

EQUIPMENT	COMPLETED	IN PROGRESS
TANK MT & DOZER	4	1
M113A1	19	1
M125A1	1	NIL
TRUCK ¼ TON	3	NIL
TRUCK ¾ TON	26	2
TRUCK 2½ TON	4	2
TRUCK 5 TON	11	3
TRUCK 5 TON DUMP	9	NIL
TRACTOR SIZE 5	1	NIL
TRACTOR SIZE 7	3	NIL
RADIO SET 25	173	10
RADIO SET 524	53	6
RADIO SET C42	6	NIL
RADIO SET B47	1	NIL
SUV	1	NIL
MINE DETECTOR	5	1
PROJECTOR	10	3
TYPEWRITER	13	3
OTHER OFFICE MACHINES	10	3
WRIST WATCH	126	NIL
COMPASS	25	NIL
BINOS PRIS	30	NIL
SIGHT UNIT	37	1
MISC OPT EQPTS	10	2
MISC NON OPT EQPTS	12	1
CENT ENGINE CHANGES	2	NIL

ANNEX B TO
106 FD WKSP R707-1-1
DATED 13 JUL 71

TREND STATISTICS - JUL 71

Serial	ELEMENT	MONTH FIGURE			CUMULATIVE FIGURE		MOVING ANNUAL TOTAL				
		This Month Last Year	Last Month	This Month	Last Year	This Year	This Month Last Year	Last Month	This Month	High Since Aug70	Low Since Aug70
1	A VEH REQS	19	15	16	142	131	252	227	224	257 Sep	220 Apr
2	CENT ALL REPAIR	9	5	4	70	45	149	77	72	132 Aug	72 Jul
2a	CENT ENGINE CHANGE	2	1	2	30	29	42	38	38	45 Apr	38 Jul
3	APC ALL REPAIR	10	22	20	89	112	195	168	178	180 Aug	147 Feb
4	APC ENGINE CHANGES	3	4	3	26	31	48	50	50	50 Jul	45 Feb
5	B VEH REQS	79	47	62	440	369	712	708	691	766 Nov	691 Jul
6	5 TON CARGO	5	6	11	31	45	66	78	84	84 Jul	64 Aug
7	5 TON DUMP	13	7	9	85	37	123	58	54	115 Aug	54 Jul
8	2½ TON "	6	3	4	46	31	74	62	60	83 Oct	60 Jul
9	LANDROVER	30	16	29	188	195	324	361	360	383 Apr	292 Sep
10	FORKLIFTS	5	4	4	39	24	51	41	40	57 Oct	40 Jul
11	ELEC REQS	67	62	62	458	368	745	683	678	766 Sep	669 May
12	SMALL ARMS	68	0	0	553	170	977	380	312	979 Aug	312 Jul
13	GE REQS	75	71	53	546	415	1038	853	831	1090 Sep	831 May
14	INST REQS	197	134	130	1254	935	1815	1827	1760	2142 Dec	1815 Jul
15	TYPEWRITERS	21	22	13	153	111	244	245	237	279 Dec	237 Jul
16	OTHER OFFICE MACHINES	10	4	10	39	57	58	98	98	98 Jul	63 Aug
17	PROJECTORS	13	12	10	58	94	90	159	156	159 Jun	94 Aug
18	WATCHES	183	91	126	522	606	790	1294	1237	1338 Feb	988 Aug

Serial	ELEMENT	MONTH FIGURE			CUMULATIVE FIGURE		MOVING ANNUAL TOTAL				
		This Month Last Year	Last Month	This Month	Last Year	This Year	This Month Last Year	Last Month	This Month	High Since Aug70	Low Since Aug70
19	BINOCULARS	16	22	30	56	79	146	133	149	170 Oct	115 May
20	COMPASSES	43	117	25	625	380	727	718	700	946 Dec	661 May
21	MISC NON OPT INST	15	4	12	94	95	140	166	163	185 Feb	141 Aug
22	MISC OPT INST	27	33	10	210	161	326	249	232	308 Aug	232 Jul
23	TELS REQS	194	226	279	1443	1298	2455	2132	2217	2412 Aug	2132 Jun
24	PRC 25	43	138	173	319	495	562	585	715	715 Jul	500 Apr
25	RT 524	15	35	53	85	196	113	200	228	228 Jul	119 Aug
26	B 47	4	0	1	24	7	51	28	25	47 Aug	25 Jun
27	C42	6	6	6	68	67	169	119	119	160 Aug	119 Jul
28	ALL EQPT REQ	704	549	1155	4875	4128	8063	6965	7416	8332 Oct	6965 Jun

Note: Serial 4 includes terminal engine changes only. Figures include changes by Sqn LAD as well as 106 Fd Wksp.

ANNEX C TO
R 707-1-1
DATED 17 AUG 71

M113A1 ENGINE CHANGES

INTRODUCTION

1. On 18 Jun 71 HQ AFV wrote in their 2320-41-10 to HQ 1 ATF requesting that the operating, repair and servicing procedures used on the M113A1 vehicle family be examined to determine the cause of low engine mileages and higher than normal failure rate of M113A1 engines during Apr 71. They noted that six engines had failed during April and that their average mileage was 2974 miles. This was said to be approximately 60% of the average mileage achieved in 1970. In addition they noted that the average number of engines changed per month in 1970 was 3.5 per month.

2. In accordance with the HQ AFV request we have carried out a study of the failure pattern of M113A1 engines in this theatre since April 1969. The findings of that study are contained in this Annex.

Situation

3. The start date for the study was 1 Apr 1969 because it is only from that time onwards that intelligible records are available.

4. The information used has been obtained from Change Advice Notices raised by both 106 Fd Wksp and the Cav Sqn LAD. 117 engine changes have been included, sixty having been done by 106 Fd Wksp and 57 by the Cav Sqn LAD. Excluded are:

a. Power pack changes which were not terminal for the engine e.g. due to transmission failure.

b. Any engine changes effected before 1 Apr 69 or after 30 Jun 71.

c. A number of engine changes effected in the study period but for which the workshop copy of the Change Advice Notice was unreadable or did not contain adequate information.

Details of Engines Changed

5. Details of the engines changed during the study period are given at Appendix 1.

.../6.

6. The Appendix shows for each engine:

a. The mileage it ran before failure

b. The year and month it failed

c. The assigned reason for failure.

7. From the nature of the information supplied on many of the Change Advice Notices it is difficult to determine under which category the failure should be placed. In addition a number of the categories are closely related, such as cylinder liner failure and loss of compression. The types of failure which have been grouped under each category are:

a. Coolant Failure

(1) Overheating - Lack of Water

(2) Overheating - Burst water hose

(3) Overheating - Cylinder seals blown

(4) Water in oil - Head seals suspected

(5) Water leak from cylinder block.

b. Power Loss, Low Compression

(1) Uneven compression ratios

(2) Failed stall test

(3) Lack of power.

c. Excessive Oil Consumption

(1) Excessive Oil consumption

(2) Excessive leak from air box drain.

d. Cylinder Liners

(1) Cracked liners

(2) Pulled and loose liners

(3) Very low compression

(4) Water in sump.

.../e.

e. Other Mechanical Faults

(1) Knocking

(2) Excessive crank case pressure - suspect pistons, rings

(3) Broken Transmission Housing

(4) Broken crankshaft

(5) Suspected valve problems

(6) Suspected crankshaft problems

(7) Blower Seal U

(8) Oil cooler U

(9) Bearing noise.

f. Unspecified

(1) This category is used where the fault is insufficiently specified to allow it to be allotted to a category.

g. Misadventure

(1) Operational damage due to RPG and mines.

Nature of Analysis

8. The information supplied in Appendix 1 has been subject to a number of correlations which are recorded at Appendices 2 to 4. They are all concerned with finding patterns of failure by cause against either calendar time or mileage.

Deductions

9. There has been no significant change in the reasons for failure over the studied period with perhaps the exception of failures due to excessive oil consumption. (Appendix 2)

10. There is apparently no seasonal pattern of failure. (Appendix 2)

11. The average engine mileage has remained fairly constant overall (Appendix 2 Table 7) at about 4300 miles. One significant aspect is the reduction in the average mileage of engines with cylinder liner failure (Appendix 2 Table 4) from 4000 to 3000 miles over the studied period.

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There have also been significant variations in the average mileage at which failure occurs due to loss of power but there is no pattern (Appendix 2 Table 2). The variation is caused by the range of engine mileage at failure.

12. It is significant that one third of all engines failed below 2000 miles. (Appendix 3 Table 1), the major reason being cylinder liner failure. Failures in that bracket due to coolant failure, loss of power and other mechanical faults are also significant.

13. The mean engine mileage should apparently be about 6000 miles (Appendix 4 Table 1). In other words the average engine mileage should be about 6000 miles and not 4000 miles. The reason it is not is tied up with the very high rate of failure of engines in the first, second and third 1000 miles brackets. If it were not for these the pattern of failure against mileage would assume a fairly normal distribution. A more detailed examination of the causes of failure under 1000 miles and between 1000 and 2000 miles is given in Appendices 5 and 6.

Cause of Early Average Engine Failure

14. The engine used with the M113A1 vehicle family is the six cylinder two stroke GMC diesel model 6V-53. It is fitted with wet liners.

15. If the failure patterns occurring in SVN are abnormal for this engine used in the A Vehicle role, then the area for concern is the failures at low mileage.

16. RAEME do not strip failed engines in SVN. The cause of failure can only be assumed by the nature of the malfunction and associated signs. Although for analysis purposes, failures have been categorized there must be areas of doubt in such categorization.

17. A number of the categories are interrelated especially coolant failure, loss of compression and cylinder line failure. They may be due to the way in which the vehicle is used, the standard of the components fitted, the extent of overhaul or the standard of workmanship during overhaul. There are however certain indicators but they are only indicators.

18. One of the factors most important to the successful use of a wet sleeved diesel engine is prevention of differential cooling when the engine is shut off. This is done by following a close down procedure

.../which

which involves allowing the engine to cool, while running, to a specified temperature before switching off.

19. A Sqn 3 Cav Regt have orders published on the closed down procedure to be used and allowance is made for this procedure in their SOP's. Troop Leaders claim to enforce this procedure with the only possible exception being when a track arrives late at a night ambush position.

20. A poor standard of workmanship is definitely indicated with some of the failures and possibly indicated with others. The extent is hard to judge. The engines involved are those originally fitted to the tracks when they were shipped from Australia and replacement engines, both new and overhauled, supplied through the US Army system. There is a generally held opinion in Nui Dat that those engines which were rebuilt in Japan are of poor quality. The records now available do not allow this opinion to be substantiated. Possibly Australia could determine which engines in the study were supplied from there. We would have no idea of the source of supply of any of the engines in the study.

21. It is interesting to note and possibly significant, that although there has been no great change in the number of cylinder liner failures, the average mileage at which such failure has occurred has reduced in a relatively steady pattern since 1969 from over 4000 miles to about 3000 miles. This would seem to indicate an inherent fault with the engines since there would be little grounds for assuming that APC driver training has changed or that any group of drivers are any better, or worse, than any other group of drivers.

22. There is a possibility that there is inadequate quality control on the replacement cylinder liners. Their metallurgical structure is critical. They can be either too crystalline or too 'soft' or both. They may be incorrectly surfaced. They may be damaged during fitment or incorrectly fitted.

23. Additional to these things is the vehicle coolant and temperature gauging systems. If these are unsatisfactory, liner damage resulting in cracked or loose liners and scouring of the bore with early loss of compression and high oil usage could result.

24. If a criticism were to be raised it would be levelled against the RAEME inspectors who have failed to provide adequate information on the cause of failure in addition to the malfunction. EMEI Veh X746 lays down

.../the

the sequence of tests to be followed when the engine malfunctions. Rarely have these tests been carried out or, alternatively, rarely have the results been recorded on the Change Advice Notice. Many of these tests can be carried out relatively quickly without extensive stripping of the engine. If they had a much more definite analysis they could have been carried out. Even allowing for operational requirements the standard of the Change Advice Notices are less than satisfactory.

Conclusion

25. There has been no significant change in the pattern of engine failure or the rate of engine failure throughout the study period. The statistics used by HQ AFV are inappropriate.

26. There appears to be an abnormally high number of engines failing under 3000 miles which is reducing the average mileage to 4300 miles from a mean mileage of approximately 6000 miles.

27. The reason for this reduction cannot be determined from the facts now available.

Recommendations

28. The following recommendations are made:

a. A Sqn 3 Cav police drivers on the engine close down procedure.

b. Close attention be paid to the vehicle coolant system and temperature gauging procedures, blocked and damaged radiators should be cleaned, repaired or replaced. Temperature gauges should be tested and replaced if faulty.

c. Both 106 Fd Wksp and A Sqn 3 Cav Regt LAD carry out the appropriate testing as detailed in EMEI Veh X746 whereever possible to diagnose more closely the cause of failure and record the results of such testing on the Change Advice Notices.

d. The Change Advice Notice should record the source of supply of the engine, if it was rebuilt and, if so, by whom.

APPENDIX 1 TO
ANNEX C TO
106 FD WKSP R707-1-1
DATED 17 AUG 71

HISTORY OF ENGINE CHANGES
GMC DIESEL 6V-53

Serial	Engine Number	Change Advice Number	Engine Miles	Month of Change												Reason for Changes					
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Coolant Failure	Power Loss/Low Comp	Excessive Oil Consump	Cracked Cylinder Liners	Other Mech Cause	Unspecified
								1969													
1	6D9345	A14/69	7660				X														X
2	6D47803	A17/69	214				X													X	
3	6D12317	A19/69	3421				X										X				
4	6D11612	A20/69	4439				X													X	
5	6D12309	1/69	8600				X											X			
6	6D10715	A22/69	5409				X										X				
7	6D34497	2/69	1562				X										X				
8	6D34495	A24/69	5190				X													X	
9	6D33909	A28/69	4590				X												X		
10	6D9960	A31/69	6362					X									X				
11	6D9964	A32/69	9490					X									X				
12	6D47746	3/69	120					X												X	
13	6D12306	4/69	5802					X											X		
14	6D33684	A36/69	6909					X									X				
15	6D11304	A37/69	9617					X									X				
16	6D34012	A44/69	5059						X											X	
17	6D33917	A45/69	4077						X								X				
18	6D34521	A47/69	5164						X								X				
19	6D45674	5/69	418						X										X		
20	6D44407	6/69	6245						X										X		
21	6D33967	7/69	4211							X									X		
22	6D33541	A56/69	6788							X								X			
23	6D34564	8/69	6135								X							X			
24	6D34009	A60/69	4175								X						X				

Serial	Engine Number	Change Advice Notice	Engine Miles	Month of Change												Reason for Change						
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Coolant Failure	Power Loss/ Low Comp	Excessive Oil Consump	Cracked Cylinder Liners	Other Mech Cause	Unspecified	
25	6D36779	6/69	130								X								X			
26	6D33904	10/69	6231								X								X			
27	6D44749	A65/69	2692								X					X						
28	6D49371	11/69	5391									X						X				
29	6D11568	A67/69	1363									X					X					
30	6D10747	A68/69	5176									X					X					
31	6D74022	12/69	6996									X						X				
32	6D34563	A72/69	6228										X							X		
33	6D10714	A76/69	6896										X						X			
34	6D33993	13/69	8093										X						X			
35	6D11556	A79/68	782										X						X			
36	6D34005	14/69	5031										X						X			
37	6D44654	A90/69	7302											X			X					
38	6D33973	15/69	6517											X					X			
39	6D11533	16/69	3161											X					X			
40	6D33906	17/69	8224											X						X		
41	6D34513	18/69	7090											X			X					
42	6D33096	A96/69	14												X		X					
43	6D32476	20/69	588												X			X				
44	6D34014	21/69	8798												X		X					
									1970													
45	6D50571	A2/70	3495	X														X				
46	6D12377	22/69	1523	X																X		
47	6D61727	23/69	1250	X														X				
48	6D61777	A9/70	12	X															X			
49	6D62993	A12/70	156	X												X						
50	6D37815	A14/70	602		X											X						
51	6D11608	3/70	7293		X																X	
52	6D50510	4/70	1940		X																X	
53	6D33537	5/70	7972			X											X					

Serial	Engine Number	Change Advice Notice	Engine Miles	Month of Change												Reason for Change							
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Coolant Failure	Power Loss/Low Comp	Excessive Oil Consump	Cracked Cylinder Liners	Other Mech Causes	Unspecified	Misadventure	
54	6D47888	A31/70	2521			X																X	
55	6D57475	A32/70	2030			X															X		
56	6D62657	6/70	1370			X											X						
57	6D22818	7/70	866			X										X							
58	?	A42/70	2323				X												X				
59	6D33569	8/70	5345				X												X				
60	6D11345	9/70	1946					X									X						
61	6D33628	10/70	7455					X											X				
62	6D50439	11/70	2840					X														X	
63	6D56488	12/70	2200					X										X					
64	6D33954	13/70	12411						X											X			
65	6D33984	14/70	3585						X										X				
66	6D50440	15/70	2631						X										X				
67	6D52742	16/70	3833						X										X				
68	6D11821	17/70	977								X								X				
69	6D9298	18/70	4366								X						X						
70	6D27541	A95/70	205								X									X			
71	6D34558	A100/70	9809									X								X			
72	6D48760	20/70	898									X							X				
73	6D40222	21/70	6643									X						X					
74	6D28149	A116/70	240										X						X				
75	6D21281	A118/70	731										X			X							
76	6D33573	22/70	9476										X					X					
77	6D11346	23/70	10899										X				X						
78	6D34454	A120/70	12511										X					X					
79	6D42324	24/70	1262										X			X							
80	6D41071	A125/70	54										X								X		
81	6D11560	A130/70	4852											X			X						
82	6D52996	A136/70	45											X							X		
83	6D11555	25/70	6027												X		X						

Serial	Engine Number	Change Advice Notice	Engine Miles	Month of Change												Reason for Change						
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Coolant Failure	Power Loss/Low Comp	Excessive Oil Consump	Cracked Cylinder Liners	Other Mech Causes	Unspecified	Misadventure
84	6D30638	27/70	6147										X					X				
85	6D12323	28/70	6920										X				X					
86	6D34053	A145/70	5524										X					X				
87	6D29641	29/70	548											X				X				
88	6D50577	A152/70	5494											X								X
89	6D52933	31/70	3633											X							X	
							- 1971 -															
90	6D49976	A1/71	1450	X													X					
91	6D12420	A6/71	6390	X																	X	
92	6D34516	A7/71	789	X																		X
93	6D62983	A9/71	3369	X																		X
94	6D63097	33/70	15172	X												X						
95	6D38407	A13/71	2449		X											X						
96	6D58312	A16/71	1320		X																	X
97	6D48388	34/70	1134		X														X			
98	6D44161	35/70	143			X																X
99	6D55404	36/70	442				X													X		
100	6D25361	A43/71	4196				X												X			
101	6D50558	A44/71	1014				X										X					
102	6D29240	37/70	10393				X														X	
103	6D38623	38/70	220				X												X			
104	6D9984	39/70	3811				X												X			
105	6D62129	A54/71	8159				X															X
106	6D50600	A55/71	2826				X													X		
107	6D54333	40/71	5999					X								X						
108	6D62761	A65/71	8413					X											X			
109	6D28020	A66/71	1108					X									X					
110	6D12320	A68/71	5442					X									X					
111	6D52741	A73/71	4164					X									X					
112	6D9513	A79/71	5058					X									X					
113	6D17175	42/71	5558					X								X						

Serial	Engine Number	Change Advice Notice	Engine Miles	Month of Change												Reason for Change						
				Jan	Feb	Mar	Apr	May.	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Coolant Failure	Power Loss/Low Compression	Excessive Oil Consump	Cracked Cylinder Liners	Other Mech Causes	Unspecified	Misadventure
114	6D12374	A80/71	2563						X								X					
115	6D59318	A81/71	8121						X													X
116	6D46670	A84/71	457						X							X						
117	6D25951	44/71	6490						X											X		

Notes:

1. Where Change Advice Notice is prefixed 'A' the engine change was carried out by 106 Fd Wksp.

2. Where Change Advice Notice has no letter prefix the engine change was carried out by Cav Sqn LAD.

APPENDIX 2 TO
ANNEX C TO
R707-1-1
DATED 17 AUG 71

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

1. This Appendix is an attempt to correlate the information to establish seasonal patterns and average engine mileage trends.

2. It consists of seven tables.

   a. Changes ascribed to coolant failure

   b. Changes ascribed to loss of power, low compression ratios and failure of stall test

   c. Changes ascribed to excessive oil consumption

   d. Changes ascribed to cracked, pulled or loose cylinder liners

   e. Changes ascribed to other mechanical failure

   f. Changes due to misadventure and for unspecified reasons

   g. Changes due to all causes

3. The tables show:

   a. Month Figure: The number of engines changed in any particular month.

   b. Cumulative Figure: The number of engines changed to the end of each month since the 1 Jan of the year under consideration.

   c. Moving Annual Total (MAT) Engine Changes: The number of engines changed in the twelve months preceeding the end of the month under consideration. For example Table 7:

      (1) 57 engines were changed between 1 Apr 69 and 31 Mar 70

      (2) 50 engines were changed between 1 May 69 and 30 Apr 70

      (3) 48 engines were changed between 1 Jan 69 and 31 May 70.

   d. The total mileage run by the engines changed in each particular month. For example from Table 7:

      (1) The 9 engines changed in Apr 69 had run a total mileage of 41085 miles

      (2) The 6 engines changed in May 69 had run a total mileage of 38330 miles.

e. Moving Annual Total (MAT) Engine Mileage: The total mileage run by the engines changed in the twelve months preceeding the end of the month under consideration.

(1) 249410 miles were run by the 57 engines changed between 1 Apr 69 and 31 Mar 70

(2) 215993 miles were run by the 50 engines changed between 1 May 69 and 30 Apr 70

(3) 192104 miles were run by the 48 engines changed between 1 Jun 69 and 31 May 70.

f. Average MAT Engine Mileage: The average mileage run by the engines changed in the twelve months preceeding the end of the month under consideration. For example:

(1) The average mileage run by the 57 engines changed between 1 Apr 69 and 31 Mar 70 was 4380 miles $\left(\frac{249410}{57}\right)$

(2) The average mileage run by the 50 engines changed between 1 May 69 and 30 Apr 70 was 4320 miles $\left(\frac{215993}{50}\right)$.

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

TABLE 1 - COOLANT FAILURE

OVERALL AVE MILEAGE = $\frac{43260}{13}$ = 3330 miles

ELEMENT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FOR YEAR
No. of Engine changes in the year and month of	1969				0	0	0	0	1	0	0	1	1	3
	1970	1	1	0	0	0	0	0	0	2	0	0	0	5
	1971	1	1	0	0	2	1							5
	TOTAL													13
Cumulative No. of Engine changes in the year	1969				0	0	0	0	1	1	1	2	3	
	1970	1	2	3	3	3	3	3	3	5	5	5	5	
	1971	1	2	2	2	4	5							
Moving Annual Total Engine Changes	1970			6	6	6	6	6	5	7	7	6	5	
	1971	5	5	4	4	6	7							
Total Mileage of Engines Changed in the Month of	1969				0	0	0	0	2692	0	0	7302	14	10008
	1970	156	602	866	0	0	0	0	0	1993	0	0	0	3617
	1971	15172	2449	0	0	11557	457							29635
	TOTAL													43260
Moving Annual Total Mileage of Engines Changed	1970			11632	11632	11632	11632	11632	8940	10933	10933	3631	3617	
	1971	18633	20480	19614	19614	31171	31628							
Average Engine Mileage in the 12 months ending (MAT AV)	1970			1940	1940	1940	1940	1940	1790	1560	1560	610	740	
	1971	3730	4100	4900	4900	5200	4520							

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

TABLE 2 - POWER LOSS

OVERALL AVE MILEAGE = $\frac{143794}{29}$ = 4960 miles

ELEMENT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FOR YEAR
No. of Engine changes in the year and month of	1969				3	4	2	0	1	2	0	1	1	14
	1970	0	0	2	0	1	0	1	0	1	1	2	0	8
	1971	1	0	0	1	4	1							7
	TOTAL													29
Cumulative No. of Engine changes in the year	1969				3	7	9	9	10	12	12	13	14	
	1970	0	0	2	2	3	3	4	4	5	6	8	8	
	1971	1	1	1	2	6	7							
Moving Annual Total Engine Changes	1970			16	13	10	8	9	8	7	8	9	8	
	1971	9	9	7	8	11	12							
Total Mileage of Engines Changed in the Month of	1969				10392	32408	9241	0	4175	6539	0	7090	8798	78643
	1970	0	0	9342	0	1946	0	4366	0	10899	4852	12947	0	44352
	1971	1450	0	0	1014	15772	2563							20799
	TOTAL													143794
Moving Annual Total Mileage of Engines Changed	1970			87985	77593	47131	37890	42256	38081	42441	47293	53150	44352	
	1971	45802	45802	36460	37474	51300	53863							
Average Engine Mileage in the 12 months ending (MAT AV)	1970			5500	5970	4713	4740	4700	4760	6060	5920	5920	5540	
	1971	5100	5100	5200	4700	4660	4500							

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

TABLE 3 - EXCESSIVE OIL CONSUMPTION

OVERALL AV MILEAGE = $\frac{70073}{12}$ = 5830 miles

ELEMENT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FOR YEAR
No. of Engine changes in the year and month of	1969				1	0	0	1	1	2	0	0	1	6
	1970	2	0	0	0	1	0	0	1	2	0	0	0	6
	1971	0	0	0	0	0	0							0
	TOTAL													12
Cumulative No. of Engine changes in the year	1969				1	1	1	2	3	5	5	5	6	
	1970	2	2	2	2	3	3	3	4	6	6	6	6	
	1971	0	0	0	0	0								
Moving Annual Total Engine Changes	1970			8	7	8	8	7	7	7	7	7	6	
	1971	4	4	4	4	3	3							
Total Mileage of Engines Changed in the Month of	1969				8600	0	0	6788	6135	12387	0	0	588	34498
	1970	4745	0	0	0	2200	0	0	6643	21987	0	0	0	35575
	1971	0	0	0	0	0	0							0
	TOTAL													70073
Moving Annual Total Mileage of Engines Changed	1970			39243	30643	32843	32843	26055	26563	36163	36163	36163	35575	
	1971	30830	30830	30830	30830	28630	28630							
Average Engine Mileage in the 12 months ending (MAT AV)	1970			4920	4380	4100	4100	3720	3790	5160	5160	5160	5930	
	1971	7710	7710	7710	7710	9550	9550							

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

TABLE 4 - CRACKED CYLINDER LINERS

OVERALL AV MILEAGE = $\frac{115389}{31}$ = 3720 miles

ELEMENT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FOR YEAR
No. of Engine Changes in the year and month of	1969				1	1	2	1	2	0	4	2	0	13
	1970	1	0	0	2	1	3	1	1	1	0	2	1	13
	1971	0	1	0	3	1	0							5
	TOTAL													31
Cumulative No. of Engine changes in the year	1969				1	2	4	5	7	7	11	13	13	
	1970	1	1	1	3	4	7	8	9	10	10	12	13	
	1971	0	1	1	4	5	0							
Moving Annual Total Engine Changes	1970			14	15	15	16	16	15	16	12	12	13	
	1971	12	13	13	14	14	11							
Total Mileage of Engines Changed in the Month of	1969				4590	5802	6653	4211	6361	0	20802	9678	0	58097
	1970	12	0	0	7668	7455	10049	977	898	240	0	11671	548	39518
	1971	0	1134	0	8227	8413	0							17774
	TOTAL													115389
Moving Annual Total Mileage of Engines Changed	1970			58019	61187	62840	66236	63002	57539	57779	36977	38970	39518	
	1971	35906	40640	40640	41199	42157	32108							
Average Engine Mileage in the 12 months ending (MAT AV)	1970			4160	4080	4190	4140	3940	3820	3610	3080	3250	3020	
	1971	2990	3120	3120	2940	3010	2910							

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

TABLE 5 - OTHER MECHANICAL FAILURE

OVERALL AV MILEAGE = $\frac{69669}{17}$ = 4100 miles

ELEMENT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FOR YEAR
No. of Engine changes in the year and month of	1969				3	1	1	0	0	0	1	1	0	7
	1970	1	0	0	0	0	1	1	1	1	1	0	0	6
	1971	1	0	0	2	0	1							4
	TOTAL													17
Cumulative No. of Engine changes in the year	1969				3	4	5	5	5	5	6	7	7	
	1970	1	1	1	1	1	2	3	4	5	6	6	6	
	1971	1	1	1	3	3	4							
Moving Annual Total Engine Changes	1970			8	5	4	4	5	6	7	7	6	6	
	1971	6	6	6	8	8	8							
Total Mileage of Engines Changed in the Month of	1969				9843	120	5059	0	0	0	6228	8224	0	29474
	1970	1523	0	0	0	0	12411	205	9809	54	45	0	0	24047
	1971	6390	0	0	3268	0	6490							16148
	TOTAL													69669
Moving Annual Total Mileage of Engines Changed	1970			30997	21154	21034	28386	28591	38400	38454	32271	24047	24047	
	1971	28914	28914	28914	32182	32182	26261							
Average Engine Mileage in the 12 months ending (MAT AV)	1970			3870	4230	5210	7099	5720	6400	5490	4610	4010	4010	
	1971	4820	4820	4820	4020	4020	3280							

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

TABLE 6 - UNKNOWN CAUSE & MISADVENTURE

OVERALL AV MILEAGE = $\frac{65705}{15}$ = 4380 miles

ELEMENT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FOR YEAR
No. of Engine changes in the year and month of	1969				1	0	0	0	0	0	0	0	0	1
	1970	0	2	2	0	1	0	0	0	0	0	0	2	7
	1971	2	1	1	2	0	1							7
	TOTAL													15
Cumulative No. of Engine changes in the year	1969				1	1	1	1	1	1	1	1	1	
	1970	0	2	4	4	5	5	5	5	5	5	5	7	
	1971	2	3	4	6	6	7							
Moving Annual Total Engine Changes	1970			5	4	5	5	5	5	5	5	5	7	
	1971	9	8	7	9	8	9							
Total Mileage of Engines Changed in the Month of	1969				7660	0	0	0	0	0	0	0	0	7660
	1970	0	9233	4551	0	2840	0	0	0	0	0	0	9127	25751
	1971	4158	1320	143	18552	0	8121							32294
	TOTAL													65705
Moving Annual Total Mileage of Engines Changed	1970			21444	13784	16624	16624	16624	16624	16624	16624	16624	25751	
	1971	29909	21996	17588	36140	33300	41421							
Average Engine Mileage in the 12 months ending (MAT AV)	1970			4290	3450	3320	3320	3320	3320	3320	3320	3320	3680	
	1971	3320	2750	2510	4020	4160	4600							

ENGINE CHANGE AND AVERAGE MILEAGE TRENDS

TABLE 7 - ALL CAUSES

OVERALL AV MILEAGE = $\frac{507890}{117}$ = 4340 miles

ELEMENT	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FOR YEAR
No. of Engine changes in the year and month of	1969				9	6	5	2	5	4	5	5	3	44
	1970	5	3	5	2	4	4	3	3	7	2	4	3	45
	1971	5	3	1	8	7	4							28
	TOTAL													117
Cumulative No. of Engine changes in the year of	1969				9	15	20	22	27	31	36	41	44	
	1970	5	8	13	15	19	23	26	29	36	38	42	45	
	1971	5	8	9	17	24	28							
Engine Annual Total Engine Changes	1970			57	50	48	47	48	46	49	46	45	45	
	1971	45	45	41	47	50	50							
Total Mileage of Engines Changed in the Month of	1969				41085	38330	20953	10999	19363	18926	27030	32294	9400	218380
	1970	6436	9835	14759	7668	14441	22460	5548	17350	35173	4897	24618	9675	172860
	1971	27170	4903	143	31061	35742	17631							116650
	TOTAL													507890
Moving Annual Total Mileage of Engines Changed	1970			249410	215993	192104	193611	188160	186147	202394	180261	172585	172860	
	1971	193594	188662	174046	197439	218740	213911							
Average Engine Mileage in the 12 months ending (MAT AV)	1970			4380	4320	4000	4120	3920	4140	4410	3920	3840	3840	
	1971	4300	4200	4200	4200	4377	4278							

APPENDIX 3 TO
ANNEX C TO
106 FD WKSP R707-1-1
DATED 17 AUG 71

FAILURE RATE BY CAUSE AGAINST MILEAGE

1. This Appendix concerns failure by cause against the mileage bracket in which the failure occurs. The attached Table 1 correlates failure against thirty one mileage brackets being 0 to 500, 0 to 1000, 0 to 1500 and so on to 0 to 15500 miles which covers all failures.

2. Two correlations are presented:

   a. The first is an analysis of the percentage cause of failure in each particular mileage bracket.

   b. The second, shown in the right hand column, is the percentage of all failure which occur in any particular mileage bracket.

3. An Example from the Table: Twenty four engines, representing 21% of all engine failures, failed under 1000 miles. Of these 24 engines, 38% (9 engines) failed due to cylinder liner problems.

TABLE 1

MILEAGE BRACKET 0 Miles to	Number and % of failure in this mileage bracket due to													% of Engines which fail in this bracket
	Coolant Failure		Power Loss/ Low Comp/ Fail Stall Test		Excess Oil Consump		Cracked Cylinder Liner		Other Mech Cause		Misadv & Unknown		All Causes	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	
500	3	20	0	0	0	0	5	33	6	40	1	7	15	100	13
1000	6	25	0	0	1	4	9	38	6	25	2	8	24	100	21
1500	7	21	5	15	2	6	10	30	6	18	3	9	33	100	28
2000	7	19	7	19	2	5	10	27	7	19	4	11	37	100	32
2500	8	19	7	17	3	7	11	27	7	17	5	12	41	100	35
3000	9	19	8	17	3	6	12	25	8	17	7	15	47	100	40
3500	9	18	9	18	4	8	13	25	8	16	8	16	51	100	44
4000	9	16	9	16	4	7	16	29	8	15	9	16	55	100	47
4500	9	15	13	21	4	6	18	29	9	15	9	15	62	100	53
5000	9	14	14	22	4	6	19	30	9	14	9	14	64	100	55
5500	9	12	19	25	5	7	21	28	11	15	10	13	75	100	64
6000	11	14	19	24	5	6	23	29	11	14	10	13	79	100	68
6500	11	13	21	24	6	7	26	30	14	16	10	11	88	100	75
7000	11	12	23	24	9	9	28	30	14	15	10	11	95	100	81
7500	12	12	24	24	9	9	29	29	14	14	11	11	99	100	85
8000	12	12	25	25	9	9	29	29	14	14	12	12	101	100	86
8500	12	11	25	24	9	8	31	29	15	14	14	13	106	100	91
9000	12	11	26	24	10	9	31	29	15	14	14	13	108	100	92
9500	12	11	27	25	11	10	31	28	15	14	14	13	110	100	94
10000	12	11	28	25	11	10	31	28	16	14	14	13	112	100	96
10500	12	11	28	25	11	10	31	27	16	14	15	13	113	100	97
11000	12	11	29	25	11	10	31	27	16	14	15	13	114	100	98
11500	12	11	29	25	11	10	31	27	16	14	15	13	114	100	98
12000	12	11	29	25	11	10	31	27	16	14	15	13	114	100	98
12500	12	10	29	25	11	10	31	27	17	15	15	13	115	100	98
13000	12	10	29	25	12	10	31	27	17	15	15	13	116	100	99
13500	12	10	29	25	12	10	31	27	17	15	15	13	116	100	99
14000	12	10	29	25	12	10	31	27	17	15	15	13	116	100	99
14500	12	10	29	25	12	10	31	27	17	15	15	13	116	100	99
15000	12	10	29	25	12	10	31	27	17	15	15	13	116	100	99
15500	13	10	29	25	12	10	31	27	17	15	15	13	117	100	100

APPENDIX 4 TO
ANNEX C TO
106 FD WKSP R707-1-1
DATED 17 AUG 71

FAILURE BY EXCLUSIVE 1000 MILE MILEAGE BRACKETS

1. The attached Table shows the number of engines which failed in each 1000 mile mileage bracket 0 to 999, 1000 to 1999, 2000 to 2999 and so on.

2. These figures allow the distribution of failure against mileage to be considered for normalcy.

TABLE 1

MILEAGE BRACKET (Incl) LOW-- HIGH LOW - HIGH	COOLANT FAILURE	POWER LOSS, LOW COMP, FAIL STALL TEST	EXCESS OIL CONSUMP	CRACKED CYLINDER LINER	OTHER MECH CAUSE	MISADV & UNKNOWN	ALL CAUSES
0 - 999	6	0	1	9	6	2	24
1000 - 1999	1	7	1	1	1	2	13
2000 - 2999	2	1	1	2	1	3	10
3000 - 3999	0	1	1	4	0	2	8
4000 - 4999	0	5	0	3	1	0	9
5000 - 5999	2	5	1	4	2	1	15
6000 - 6999	0	4	4	5	3	0	16
7000 - 7999	1	2	0	1	0	2	6
8000 - 8999	0	1	1	2	1	2	7
9000 - 9999	0	2	1	0	1	0	4
10000 - 10999	0	1	0	0	0	1	2
11000 - 11999	0	0	0	0	0	0	0
12000 - 12999	0	0	1	0	1	0	2
13000 - 13999	0	0	0	0	0	0	0
14000 - 14999	0	0	0	0	0	0	0
15000 - 15999	1	0	0	0	0	0	1

APPENDIX 5 TO
ANNEX C TO
106 FD WKSP R707-1-1
DATED 17 AUG 71

BREAKDOWN OF FAILURES
UNDER 1000 MILES

FAILURES ATTRIBUTED TO COOLING

1. Details:

a.

Engine Mileage	Date	Assigned Cause of Failure
a. 14	Dec 69	Water in oil - suspect head seals
b. 156	Jan 70	Water in oil - suspect head seals
c. 602	Feb 70	Water in oil - suspect head seals
d. 866	Mar 70	Engine seized- Water in exhaust manifold- suspect crack in block
e. 730	Sep 70	Engine overheated - cylinder seals blown
f. 454	Jun 71	Coolant hose burst - engine overheated & seized.

2. Comment

c. Four of the six failures occurred over the period Dec - Mar 70. It was then six months to the fifth failure and nine months to the last failure, which was caused by a component external to the engine.

b. Most of these failures are probably due to poor engine rebuild standards but they could be due to overheating caused by incorrect operation of the vehicle, poor servicing or poor adjustment by RAEME.

FAILURES DUE TO EXCESSIVE OIL CONSUMPTION

3. Detail:

Engine Mileage	Date	Assigned Cause of Failure
a. 588	Dec 69	Excessive leak via air box drain RH Bank.

4. Comment

a. Poor overhaul aasembly is the probable reason.

.../FAILURES

FAILURES DUE TO CRACKED CYLINDER LINERS

5. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	418	Jun 69	Water in Sump
b.	130	Aug 69	Water in Sump
c.	782	Oct 69	Cracked Liner
d.	12	Jan 70	Water in Oil. Suspect loose cylinder liner RH Bank centre
e.	977	Jul 70	Cracked Liner
f.	898	Aug 70	Cracked Liner No 3 LH cylender
g.	240	Sep 70	No compression No.1 LH cylinder suspect cracked liner
h.	548	Dec 70	No 2 RH cylinder cracked
i.	220	Apr 71	Loss of power - suspect pulled liner.

6. Comments.

a. The most obvious cause of cracked cylinder liners is failure of drivers to bring the engine to 168°F before switching off. In new or rebuilt engines this requirement would be more critical. However poor assembly, bench testing after rebuild or defective liners could also be largely to blame.

b. The Cav Sqn have satisfactory orders issued on the close down procedure. Troop commanders claim to enforce the requirement and there is no reason to believe they do not except perhaps when they go into a night ambush position.

c. If defective cylinder liners are being used this should also result in an abnormally large number of failures at low mileage in Australia. Since few failures occurred in the 1000 - 1999 mileage bracket (one failure only) there is a suspicion that some at least of the cylinder liners were incorrectly cured.

.../FAILURES

FAILURES DUE TO OTHER MECHANICAL FAULTS

7. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	214	Apr 69	Broken front engine cover plate
b.	120	Apr 69	Blower Seal 'U' - uses 6 pts of oil in 20 miles.
c.	205	Jul 70	Transmission Housing Broken
d.	54	Sep 70	RH Cylinder Head not tightened correctly R 3 cylinder seal blown
e.	45	Oct 70	Seized piston
f.	44 442	Apr 71	Oil Cooler 'U'

8. Comments

a. Although the Change Advice Notices do not say, it is probable that the broken front engine cover 7a occurred due to mine damage or by UJ failure. The broken transmission housing probably occurred due to UJ failure.

b. The seized piston para 7c could have been caused by any number of malfunctions. The Change Advice Notice does not provide sufficient information.

c. The other three failures are probably due to poor engine rebuilds..

.../FAILURES

FAILURES DUE TO MISADVENTURE

9. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	789	Jan 71	Mine damage - Front Housing Cracked
b.	143	Mar 71	Mine damage - Sump holed, engine seized.

10. Comments

a. Neither of these failures can be blamed on the engine.

APPENDIX 6 TO
ANNEX C TO
106 FD WKSP R707-1-1
DATED 17 AUG 71

BREAKDOWN OF FAILURES
OVER 1000 MILES BUT UNDER 2000 MILES

FAILURES DUE TO COOLING

1. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	1262	Sep 70	Engine seized.

2. Comment

a. There is insufficient detail on the Change Advice Notice to determine the reason for failure.

POWER LOSS, LOW COMPRESSION AND STALL TEST FAILURES

3. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	1562	Apr 69	Low compression
b.	1363	Sep 69	Low compression/lacks power
c.	1370	Mar 70	Uneven compression ratios 250-575 psi
d.	1946	Apr 70	No.2 LH cylinder 300 psi
e.	1450	Jan 71	Low of compression - worn cylinders and rings.
f.	1014	Apr 71	No compression No 2 RH cylinder
g.	1108	May 71	Loss of power. Failed stall test.

4. Comments

a. If components used during rebuild are at the appropriate standard, the most probable cause of these failures is poor rebuild or lack of adequate rebuild.

b. Incorrect close down procedures could also result in such failures.

.../FAILURE

FAILURE DUE TO EXCESSIVE OIL CONSUMPTION

5. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	1250	Jan 70	Oil leak RH Air box drain Low compression No 3 RH Cylinder

b. Comment

a. This is similar to the failure of the engine under 1000 miles (Appendix paras 3 and 4). Worn cylinders or defective piston rings are the probable cause. Relates to cylinder liner failure.

FAILURE DUE TO CRACKED CYLINDER LINERS

7. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	1134	Feb 71	No 1 L cylinder liner cracked

8. Comment

a. The same comment as for failure under 1000 miles applies - See Appendix 5 para 6.

FAILURE DUE TO OTHER MECHANICAL FAULTS

9. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	1523	Jan 70	Operates on five cylinders - Low compression No 3 R Cylinder.

10. Comment.

a. The Change Advice Notice is not very specific. This fault could have been valves and hence the classification other mechanical failure.

.../FAILURE

FAILURE DUE TO MISADVENTURE

11. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	1320	Feb 71	Mine Damage. Front engine mounts and sump.

12. Comment

a. Operational damage not attributed to the equipment.

FAILURE DUE TO UNSPECIFIED REASONS

13. Details:

	Engine Mileage	Date	Assigned Cause of Failure
a.	1940	Feb 70	Seized engine

14. Comment

a. There are a number of things which could have caused the engine to seize. The Change Advice Notice does not provide adequate information.

ANNEX D TO
106 FD WKSP R707-1-1
DATED 17 AUG 71

MODULES RETURNED TO STORES SECTION

DSN	DESIGNATION	MAY	JUN	JJUL	AUG	TOTAL
5820-00-884-2481	Amplifier Sub Assy A6400				11	11
5820-00-886-3152	Mic Amp Assy A80	3			8	11
5820-00-897-8195	Oscillator RF A15				23	23
5820-00-898-4437	Amplifier				3	3
5820-00-957-1513	Amplifier Sub Assy				12	12
5820-00-973-1476	Oscillator Radio Freq A9	5			23	28
5820-00-973-1477	Power Supply	3			4	7
5820-00-973-1622	Generator Ref Signal A23	4			15	19
5820-00-973-1623	Amplifier DC A23	6			26	32
5820-00-973-1624	Amplifier Audio Freq A25	4			5	9
5820-00-973-3578	Amp Radio Freq RF Receiver	6			20	26
5820-00-973-3579	Amplifier Radio Freq A4	12			5	17
5820-00-973-3580	Mixer Stage Freq	10			21	31
5820-00-973-3581	Amp Sub Assy Transmitter RF A6	2			9	11
5820-00-973-3582	Amplifier RF A7	4			2	6
5820-00-973-3583	Amplifier Radio Freq A8	4			7	11
5820-00-973-3585	Generator Pulse A10	4			44	48
5820-00-973-3586	Control Elect Freq A11				16	16
5820-00-973-3595	Mixer Stage Freq				9	9
5820-00-973-3596	Filter Band Pass A13	2			3	5
5820-00-973-3598	Oscillator	2			6	8
5820-00-973-3600	Comparator Sig A17	4			16	20
5820-00-973-3601	Amplifier I.F.				9	9
5820-00-973-3602	Amp Oscillator A20	10			15	25
5820-00-973-3603	Amp Intermediate Freq A21	11			16	27
5820-00-973-3604	Amp Audio Freq A22				4	4
5820-00-853-5915	Oscillator				30	30
5820-00-853-5916	Mixer Stage Frequency				18	18
5820-00-853-5917	Amplifier R.F. A12				17	17
5820-00-853-5918	Amplifier Radio Frequency				10	10
5820-00-853-5957	Oscillator RF A3100				10	10
5820-00-853-5959	Mixer A3300				4	4
5820-00-853-5960	Amp Audio Freq Mod A5				6	6
5820-00-853-5961	Amp Audio Freq A4				6	6
5820-00-853-5962	Amplifier				3	3

DSN	DESIGNATION	MAY	JUN	JUL	AUG	TOTAL
5820-00-853-5963	Amplifier				13	13
5820-00-853-5968	Module A5 Amp D.C.				15	15
5820-00-853-5969	Control Elect Freq				9	9
5820-00-853-5970	Control Elect Freq				8	8
5820-00-853-6191	Receiver Sub Assy				15	15
5820-00-858-6480	Amplifier Discriminitor	6			24	30
5820-00-858-6498	Radio Rec Assy A2100				3	3
5820-00-884-2475	Amp Control A8400				9	9
5820-00-884-2476	Control Elect Freq				6	6
5820-00-884-2477	Amplifier Audio Freq	3			7	10
5820-00-884-2478	Amplifier				5	5
5820-00-884-2479	Module A1800				13	13
5820-00-884-2480	Oscillitor RX-A6300				13	13
5820-00-973-4335	Quarter Wave Network A19	4			22	26
5820-00-995-8687	Power Supply			2	5	7