

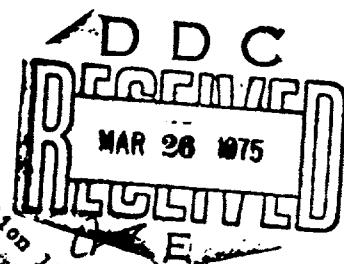
TECHNICAL REPORT NO. 12010

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FIELD SIMULATION ENDURANCE TEST
OF THE L-141 ENGINE

FEBRUARY 1975



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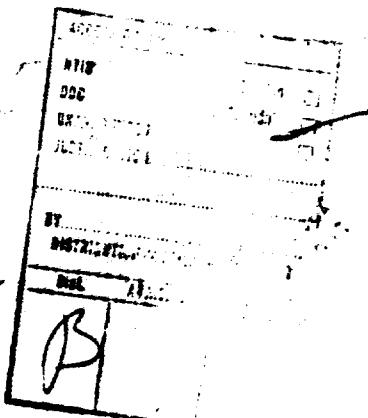
MOBILITY SYSTEMS LABORATORY

U. S. ARMY TANK AUTOMOTIVE COMMAND Warren, Michigan

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Tank Automotive Command.

J. E. Caudill
26 March '75



TECHNICAL REPORT NO. 12010

(6) FIELD SIMULATION ENDURANCE TEST
OF THE L-141 ENGINE

(9) Final rept.,

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Mobility Systems Laboratory
Engineering Science Division
Test Methodology Sub-Function

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ABSTRACT

Field data was acquired on the L-141 engine over selected courses at Aberdeen Proving Ground. A laboratory simulation test was developed from the data and a 10,000 mile equivalent endurance test was conducted. Purpose was to establish a base from which a short, severe test procedure could be developed. A total of 548 test hours was required to accumulate the 10,000 mileage equivalent. Performance tests were made each 100 hours and oil sample analyses were made approximately every six hours of test time. No engine mechanical failures were experienced during the test. Engine wear was not considered excessive. It was concluded that a short severe test could be developed.

FOREWORD

This report has been prepared and submitted in accordance with the requirements of Data Item Descriptions DI-S-1800 and DI-S-1907, and DD Form 1423 dated 28 March 1974. It is designed to provide a summary of the Contractor's efforts on the L-141 Engine Field Simulation Endurance Test performed under Contract DAAE07-74-C-0235, and the results of these efforts.

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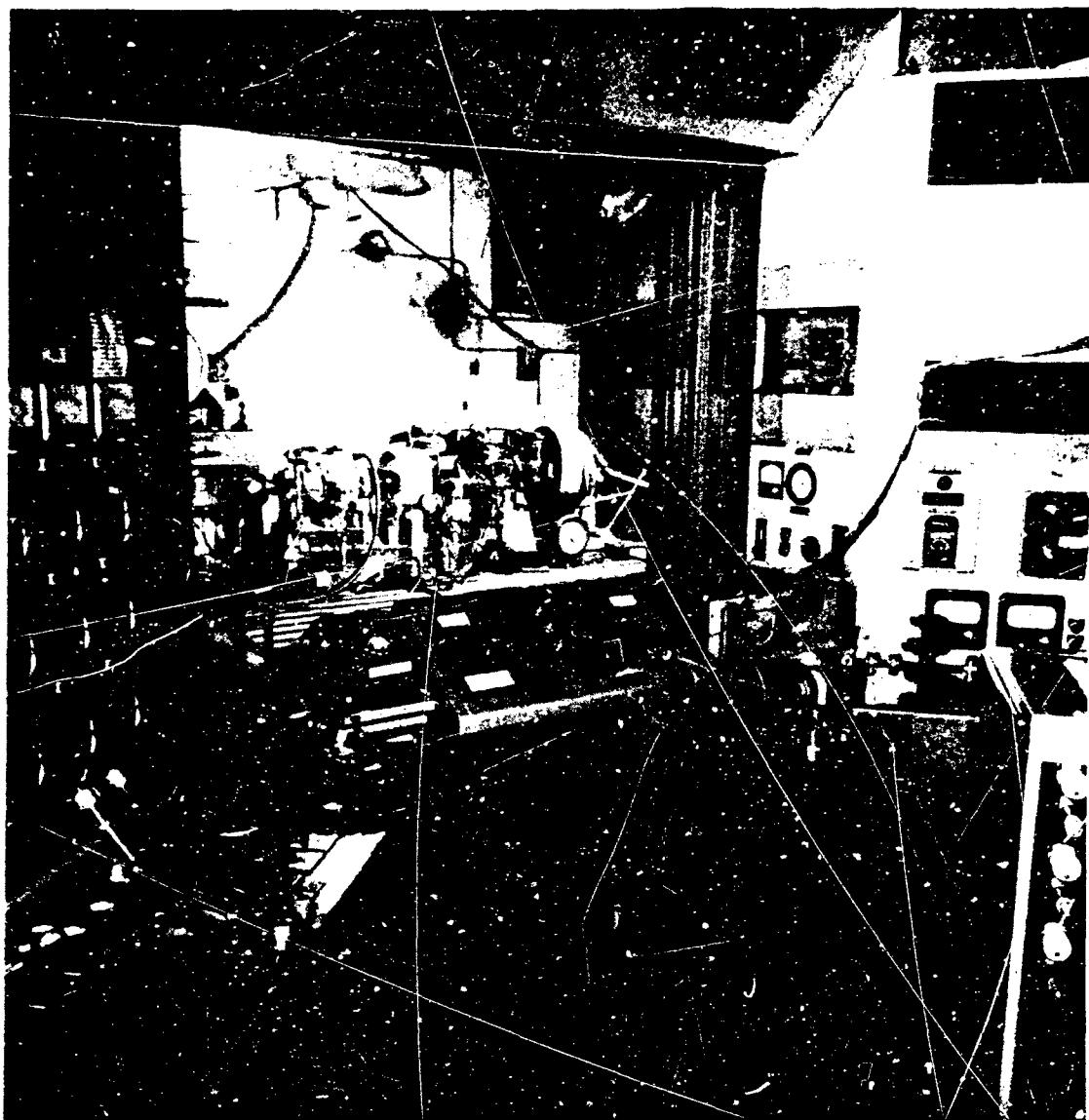
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L-141 Engine Endurance Test

SECTION 1

INTRODUCTION

1.1 PROGRAM OBJECTIVE

The objective of this program, as stated in the contract scope of work, was to determine endurance capabilities of the L-141 Engine under simulated field conditions, in order to establish an applicable, short severe test procedure for the L-141 Engine.

1.2 DATE AND PLACE OF TEST

Engine tests were performed during the period 14 August - 25 October 1974. These tests were conducted at USATA COM, Warren, Michigan, utilizing Test Cell 3A in Building 212.

SECTION 2

ENGINE AND TEST INSTALLATION

2.1 PHYSICAL DESCRIPTION OF ENGINE

A physical description of the engine used in this test is listed below. This engine was factory new.

Engine	L-141
Type	In-Line
No. of Cylinders	4
Bore and Stroke	3.875 x 3
Displacement	141.5
Compression Ratio	7.5-1

2.2 DESCRIPTION OF ENGINE TEST INSTALLATION

The L-141 engine was installed in Test Cell 3A utilizing standard engine test cell mounts, and connected to an Eddy Current Dynamometer. The engine used was complete with air cleaner, generator, engine cooling fan, flywheel, exhaust pipe and muffler, and radiator. General views of the installation are shown in figures 1-1 through 1-6. Inasmuch as the flow of ventilation air in the test cell was opposite to the normal flow of air through the radiator, an auxiliary cooling fan was placed in front of the radiator as shown in figure 1-4. Instrumentation was provided for the following parameters:

Fuel Flow (lb./hr.)	0-40
Fuel Temperature (°F)	50-151
Engine Output Speed (RPM)	0-4000
Dynamometer Load (lb. - ft.)	0-120
Manifold Vacuum (in. Hg.)	0 to -30
Oil Gallery Pressure (p.s.i.)	0-100
Engine Coolant Out Temperature (°F)	50-250
Air - Air Cleaner Inlet Temperature (°F)	50-150

Automatic engine visual warning and shutdown equipment was installed to protect the engine from damage due to low oil gallery pressure or high engine coolant temperature.

SECTION 3

TEST PREPARATION

The following paragraphs describe the tasks performed in preparation for the engine tests, and details pertaining thereto where significant.

3.1 ENGINE INSTALLATION AND INSTRUMENTATION

The engine was uncrated, installed on engine mounts, and aligned with and connected to the dynamometer. Sensors and the throttle actuator were then installed as depicted in figures 1-4 through 1-10 and 2-1, and the necessary hook-ups made for instrumentation, automatic cycling equipment, fuel, electrical power, and exhaust gas pick-up.

After servicing, engine adjustments were then made to the following criteria:

Spark Advance	6° BTDC \pm 1/2°
Breaker Points, in.	.020 \pm .001
Sparkplug Gap, in.	.029 - .032
Valve Lash (exhaust & intake)	.015 \pm .001 (hot)
Idle Speed, rpm	450 \pm 10
Idle Mixture - (not adjustable)	
Choke - locked in wide-open position	
Coolant Thermostat - normal working condition	

3.2 INSTRUMENTATION CALIBRATION

All test cell instrumentation was checked for proper operation, and calibrated to insure valid test results.

3.3 ENGINE BREAK-IN AND INITIAL PERFORMANCE TEST

Engine break-in was performed as follows:

Run	Duration Minutes	Engine RPM	Intake Manifold Vacuum In. Hg.
1		Idle	Idle
2	15	1500	19
3	15	2000	16
4	15	2500	13
5	15	3000	10

<u>Run</u>	<u>Duration Minutes</u>	<u>Engine RPM</u>	<u>Intake Manifold Vacuum In. Hg.</u>
6	15	3500	7
7	15	4000	5
8	15	4000	Power Check WOT
9	15	1800	Power Check WOT
10	15	450	Idle

The initial performance test was conducted as follows:

- a. Starting at 1800 rpm, conducted full-load power curve "up only" in 400-rpm increments to 4000 rpm. Took complete set of readings as listed under paragraph 2.2 at each speed increment. Readings obtained are shown in figure 3-1.
- b. Operating conditions during full-load performance tests were maintained as follows:
 - Air cleaner inlet temp. (70° - 90°F)
 - Air cleaner inlet pressure, atmospheric
 - Engine coolant (170° - 200°F)
 - Oil sump max. (240°F)

3.4 CHECK-OUT OF CYCLING SYSTEM AIR ACTUATOR AND CONTROLS

After installation, the air actuator system and controls were checked to insure proper operation. To provide proper operation, the air actuator was replaced, and the solenoid valves and air pressure regulators were overhauled. No initial maintenance was required on the control tape reader or dynamometer load controls.

3.5 DEVELOPMENT OF FIELD SIMULATION CYCLE

Field Simulation Data provided by the government consisted of figure 4-1 (five sheets), which are in analog form. Since this data was in analog form, it was necessary to hand-scale the traces and transfer this information to worksheets to develop the field simulation cycle. Figure 4-1 (sheets 2 through 4) have vertical time-lines at 5-second intervals, so readings transferred to the worksheets were taken at points where the traces intersect the time lines. The two parameters transferred were engine speed (RPM) and torque (ft. lbs.) as measured at the rear prop shaft. Engine RPM was used as recorded. Prop shaft torque was converted to engine torque when the vehicle was being operated in 1st through 3rd gears by using the following ratios:

<u>GEAR</u>	<u>RATIO</u>
1st	5.712
2nd	3.179
3rd	1.674

After conversion of prop shaft torque to engine torque, the worksheet data (figures 5-1 through 5-4) was analyzed to determine the various RPM and torque combinations contained in the data. Once this was done, the RPM and torque combinations were divided into ranges which could be covered by the number of throttle positions and dynamometer loads provided by the automatic cycling system. Calibration tapes and program tapes were then punched to reflect the RPM and load selections made, and proofed against the data. Prior to preparation of the program tapes, the calibration tapes were run to determine the response time required to reach the RPM and load levels required. To precisely simulate the field mission, a response time of 5 seconds was needed. It was determined that the response time which could be achieved was on the order of 15 seconds, due to equipment limitations. The dynamometer response time was felt to be the primary limiting factor. Based upon this limitation and after discussions with the TACOM Technical Representative, the tapes were programmed to provide commands to the throttle and dynamometer controls at 15-second intervals. The amount of time to be run in each of the prescribed courses was determined by utilizing the following factors:

- a. The engine RPM per MPH in each gear
 - 1st = 324.0
 - 2nd = 180.3
 - 3rd = 94.9
 - 4th = 56.7
- b. The average RPM in each gear reflected in the field simulation data.
- c. The Simulation Program data provided by the Government, which is as follows:

<u>Lap Mileage/Mission</u>	<u>Course</u>
15.6	Hilly Cross-Country
25.2	Level Cross-Country
29.022	Secondary Road
<u>30.024</u>	Highway
99.846 Miles/Mission	

Based upon the preceding factors, the time to be run in each course was as follows:

<u>%</u>	<u>TERRAIN</u>	<u>MILEAGE</u>	<u>AVG. SPD.</u>	=	<u>HRS. RQD.</u>
16%	Hilly C/C	1,600	17.29	=	92.54
25%	Level C/C	2,500	11.77	=	212.35
29%	Secondary Rds.	2,900	16.33	=	177.55
30%	Highway	3,000	45.52	=	65.91
<hr/> 100%		<hr/> 10,000			<hr/> 548.35

3.6 CORRELATION OF FIELD SIMULATION DATA

After completion of preliminary response-time tests and control tape development, preliminary cycling runs were performed to determine correlation of control tape data with field data. Changes were made in the tape where required and where possible to obtain closer correlation, and reviewed with the TACOM Technical Representative to obtain approval to start the tests. Typical continuous strip recordings of each course are shown in figures 6-1 through 6-4.

SECTION 4

ENDURANCE TEST

4.1 METHOD OF TEST

Throughout the test, the following tasks were performed:

- a. Prior to start of tests each day, the air throttle actuator and dynamometer controls were calibrated to correct RPM and load levels.
- b. Missions were performed per the developed cycles.
- c. A complete set of data was recorded for each mission as shown in figure 7-1. Miles traveled, fuel consumption, and time were recorded as shown in figure 8-1.
- d. The engine was serviced and power checks performed after each 100 hours of endurance. Power check results are shown in figure 3-2 through 3-7.
- e. As tests progressed, correlation of lab data with field data was continuously checked.
- f. At endurance completion, the engine was disassembled and inspected.
- g. Spectrometric oil analyses were conducted at 5-6 hour intervals throughout the tests to warn of unusual wear patterns, or impending engine failure.

Summary report results are contained in figure 9-1.

4.2 FUELS AND LUBRICANTS

Lubricant used was Referee oil, Grade 30, conforming to military specification MIL-L-2104C.

Fuel used was gasoline, Referee Grade, conforming to military specification MIL-G-46105 (MR) and Referee limits as of 8 October 1967.

4.3 RESULTS OF TEST

Following are pertinent details relative to the results of the tests:

- a. No engine mechanical failures were experienced during the test.
- b. Engine wear as a result of this 10,000 mile test was not considered excessive.
- c. Based upon the spectrometric oil analyses, wear rates were highest during the highway terrain cycles, which represented the most severe portion of the overall cycle in terms of steady-state engine loads and engine RPM.

- d. Observed power degradation during the test was less than 5 percent.
- e. Average fuel consumption observed during the test was as follows:

Level Cross Country	8.26 MPG
Secondary Roads	12.25 MPG
Hilly Cross Country	8.09 MPG
Highway	14.17 MPG

SECTION 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The following conclusions have been reached as a result of the test activity performed:

- a. With the exception of certain features of power-train dynamics, such as clutch engagement/disengagement and drive-train shock transients, field engine usage can be simulated in the test lab.
- b. Better simulation of field data could be achieved with a greater number of throttle position and load combinations, and additional study of simulation techniques coupled with related experimentation. Further, it is felt that dynamometer response time could be improved through the use of solid-state dynamometer control electronics.
- c. A shortened, more severe test cycle can be developed, which would consist of a high percentage of the highway terrain portion of the field cycle.

5.2 RECOMMENDATIONS

Based upon the experience gained in this program, it is recommended:

- a. That further study and tests be conducted utilizing a larger engine to determine more general feasibility of the concept from a broader data base, and that the number of throttle and dynamometer controls be expanded to allow a closer reproduction of the field cycle of the engine selected.
- b. That the concept of field simulation be pursued to develop field simulation programs for use in In-Production Tests on production engines, and initial tests and "de-bugging" of developmental engines prior to field tests.

SECTION 6
ILLUSTRATIONS



figure 1-1. Engine Test Control Consoles

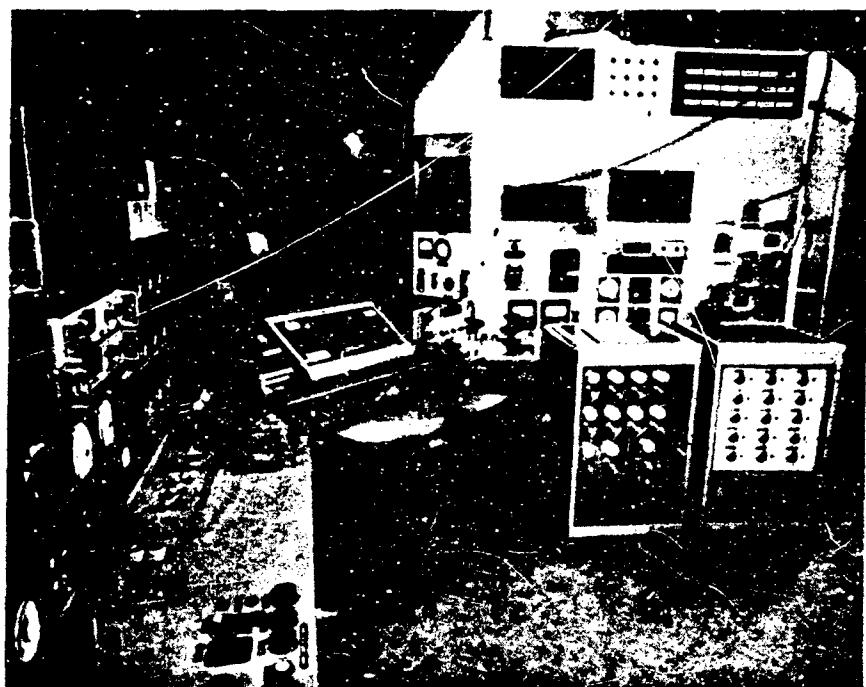


figure 1-2. Test Cell Control Room Installation



figure 1-3. Control Room and Test Cell

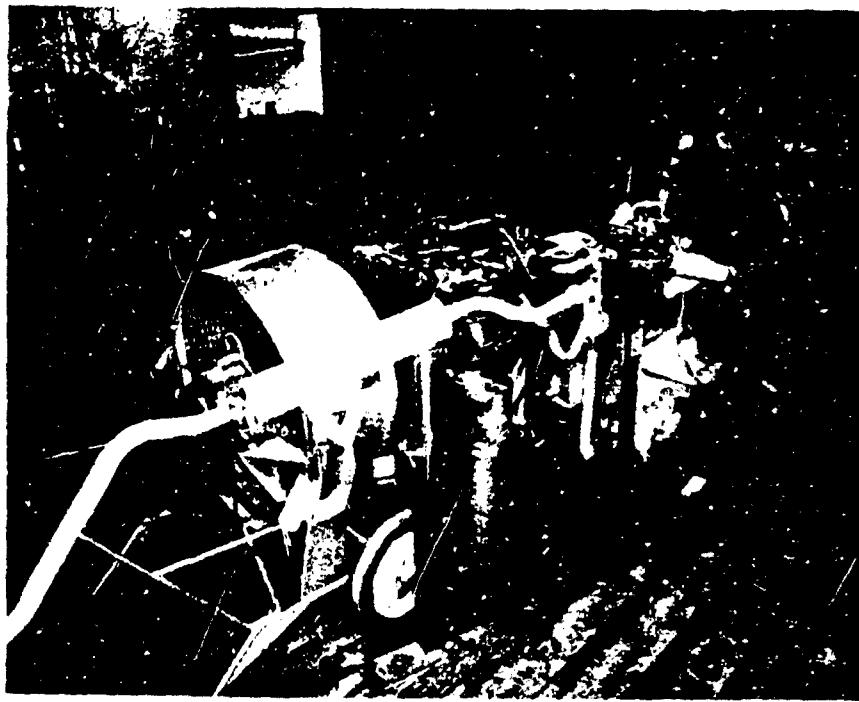


figure 1-4. Test Engine with Auxiliary Radiator Fan Installed
(Left Front Quarter View)

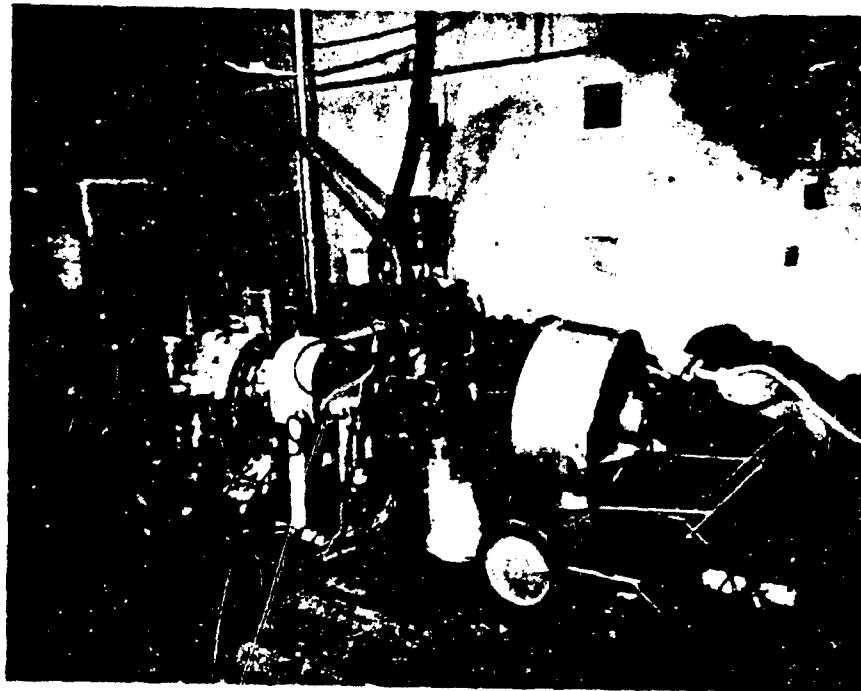


figure 1-5. Test Engine Installation (Right Front Quarter View)

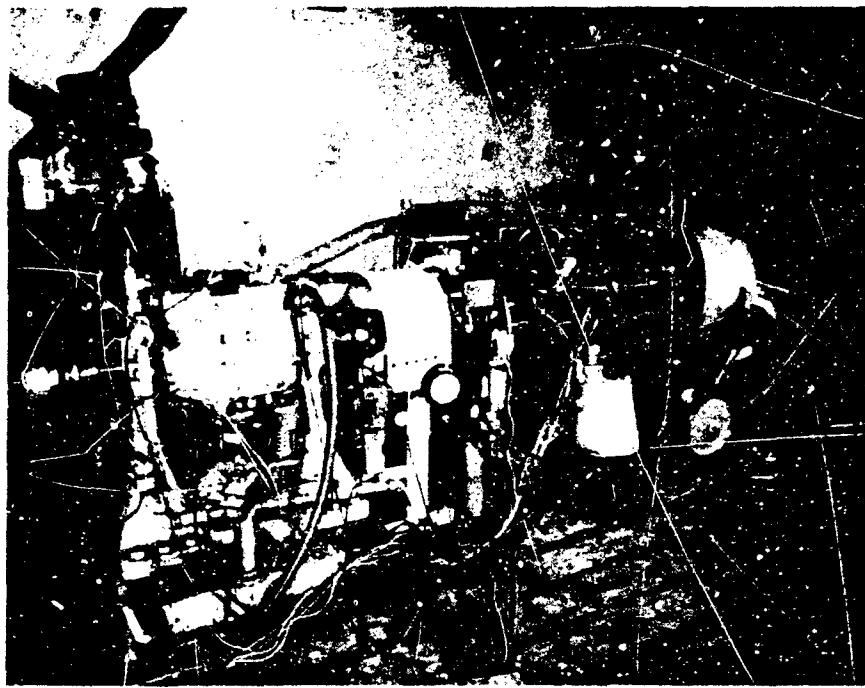


figure 1-6. Test Engine Installation Showing Dynamometer
View (Right Rear Quarter)

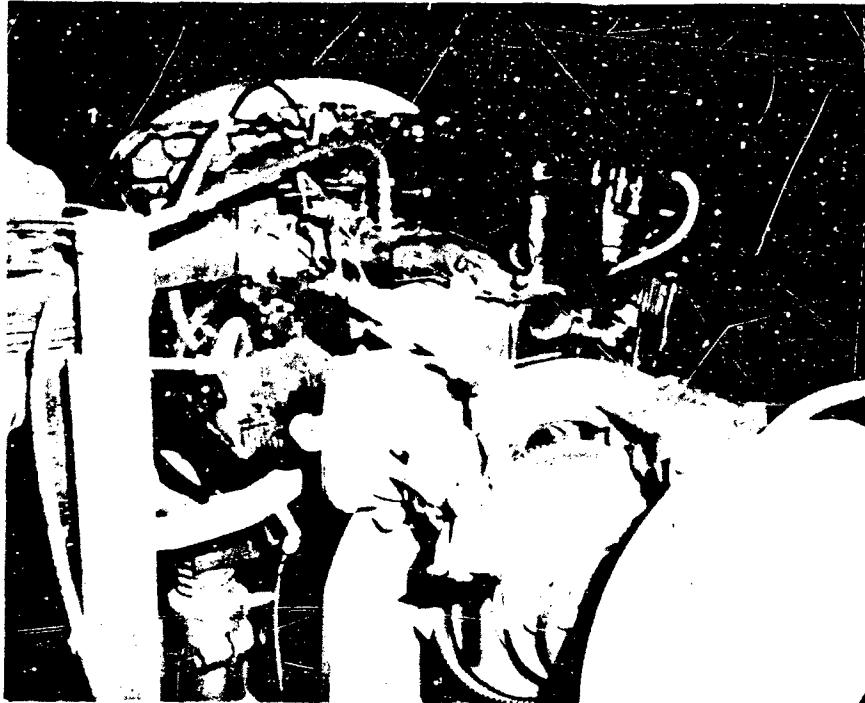


figure 1-7. Engine Test Installation Showing Air
Throttle Actuator

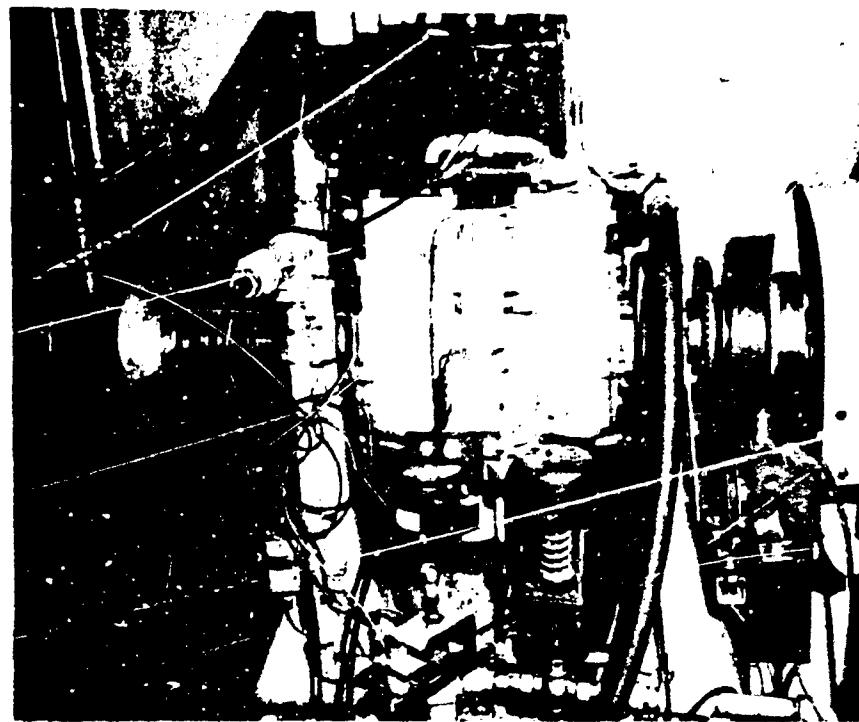


figure 1-8. Engine Test Dynamometer

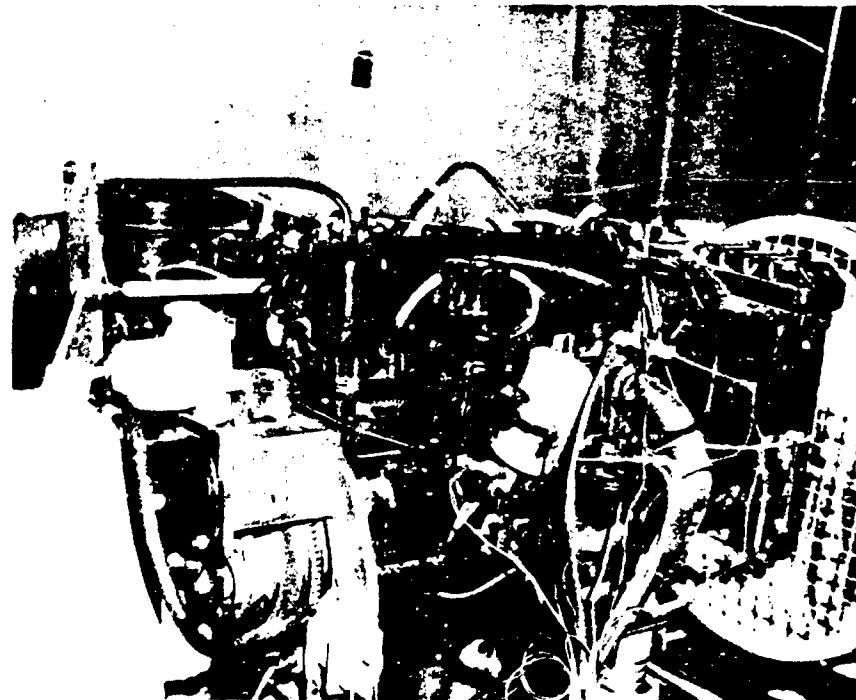
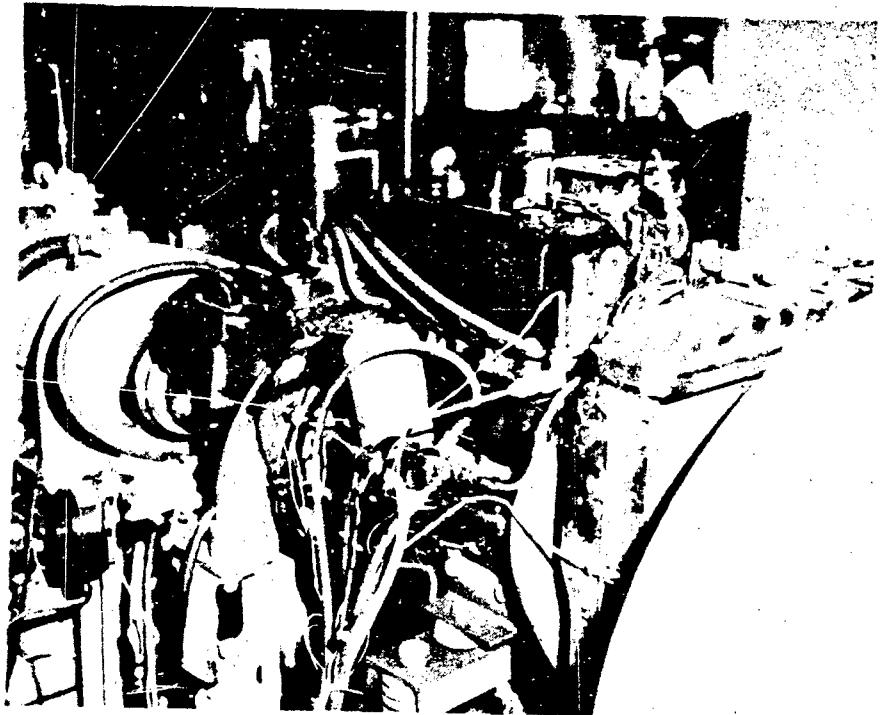
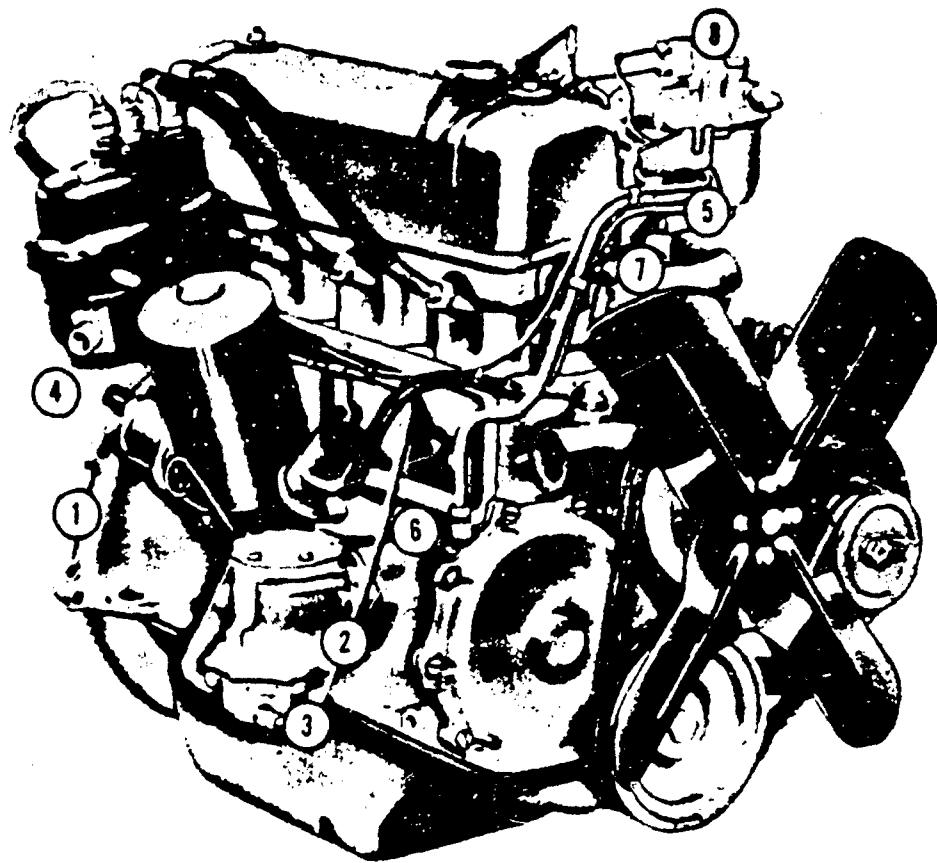


figure 1-9. Engine Right Rear View Showing
Instrumentation Connections



**figure 1-10. Engine Right Front View Showing
Instrumentation Connections**



<u>SENSOR LOCATION</u>	<u>DATA ACQUIRED BY SENSOR</u>
1	ENGINE SPEED
2	FUEL FLOW
3	FUEL TEMPERATURE
4	DYNAMOMETER LOAD
5	MANIFOLD PRESSURE
6	OIL PRESSURE
7	ENGINE COOLANT TEMPERATURE
8	CARBURETOR AIR INLET TEMPERATURE

figure 2-1. L-141 Engine Instrumentation

DATE 5 AUGUST 1974 HOURS 5.0
BAROMETRIC PRESSURE 30.08

INITIAL/PERFORMANCE CHECK

FUEL FLOW (lb/hr)	FUEL TEMP (°F)	ENGINE SPEED (rpm)	ENGINE LOAD (ft.lb)	MANIFOLD VACUUM (in.Hg)	OIL PRESSURE (PSI)	COOLANT TEMP. (°F)	AIR INLET TEMP. (°F)
21.6	71	1800	106.4	.5	44	174	70
25.7	69	2200	105.6	.8	44	181	70
28.1	69	2600	103.7	1.5	45	183	70
31.1	69	3000	93.4	1.5	46	186	70
33.1	70	3400	82.4	1.8	47	190	70
33.5	70	3800	74.0	2.0	47	196	70
31.9	70	4000	70.7	2.0	47	198	70

figure 3-1A. Initial Performance Test and Power Check Data

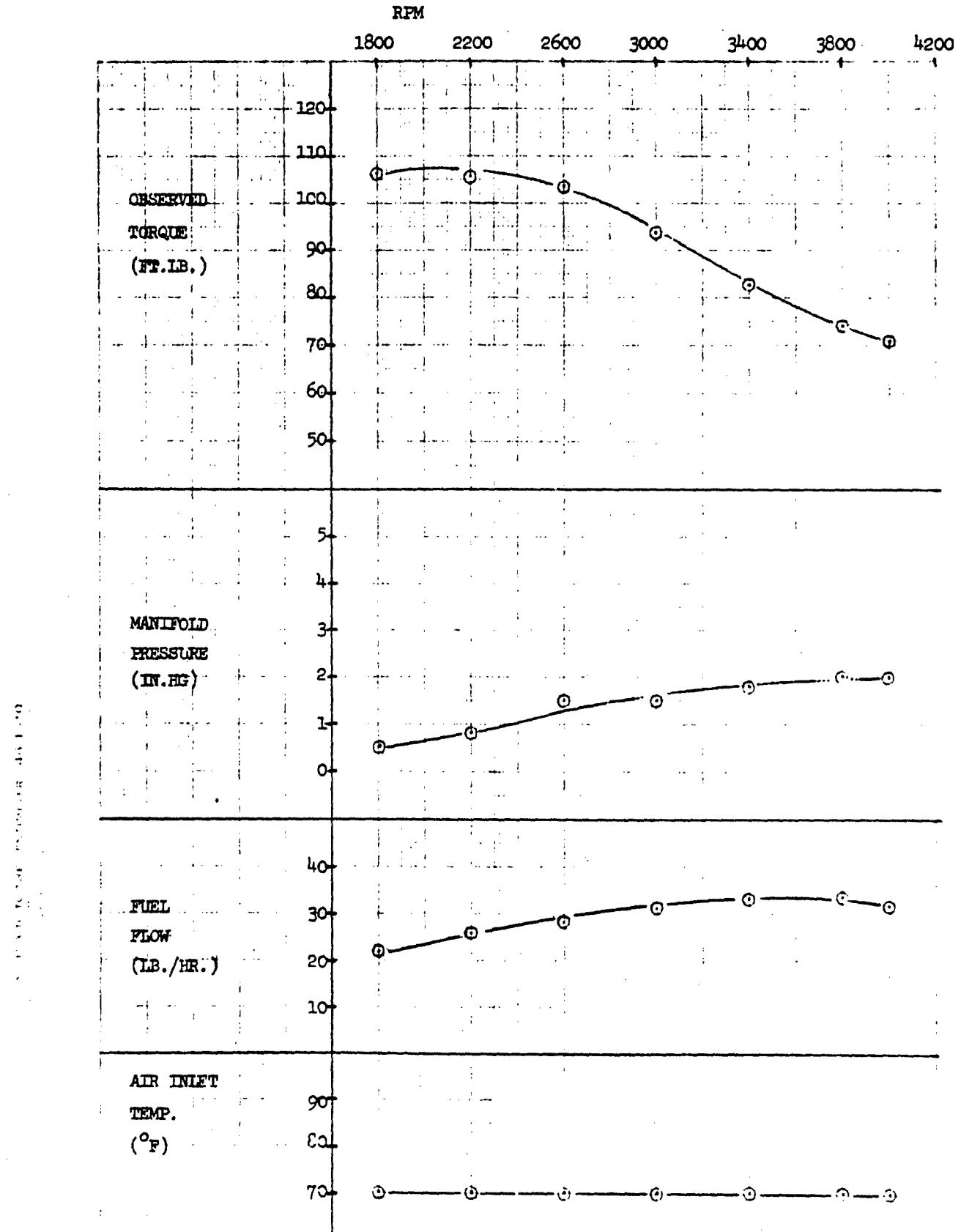


figure 3-1B. Initial Performance Test and Power Check Data

DATE 26 AUGUST 1974 HOURS 100
BAROMETRIC PRESSURE 29.19

POWER CHECK

FUEL FLOW (lb/hr)	FUEL TEMP (°F)	ENGINE SPEED (rpm)	ENGINE LOAD (ft.lb)	MANIFOLD VACUUM (in.Hg)	OIL PRESSURE (PSI)	COOLANT TEMP. (°F)	AIR INLET TEMP. (°F)
21.0	97	1800	96.6	.5	44	170	90
25.3	96	2200	95.2	.8	44	178	90
28.0	96	2600	94.6	1.5	45	180	90
31.0	96	3000	89.3	1.5	46	186	90
32.9	96	3400	79.8	1.7	46	190	90
33.1	96	3800	70.2	2.0	46	193	90
31.5	96	4000	68.3	2.0	46	194	90

figure 3-2A. Power Check (100-hour duration)

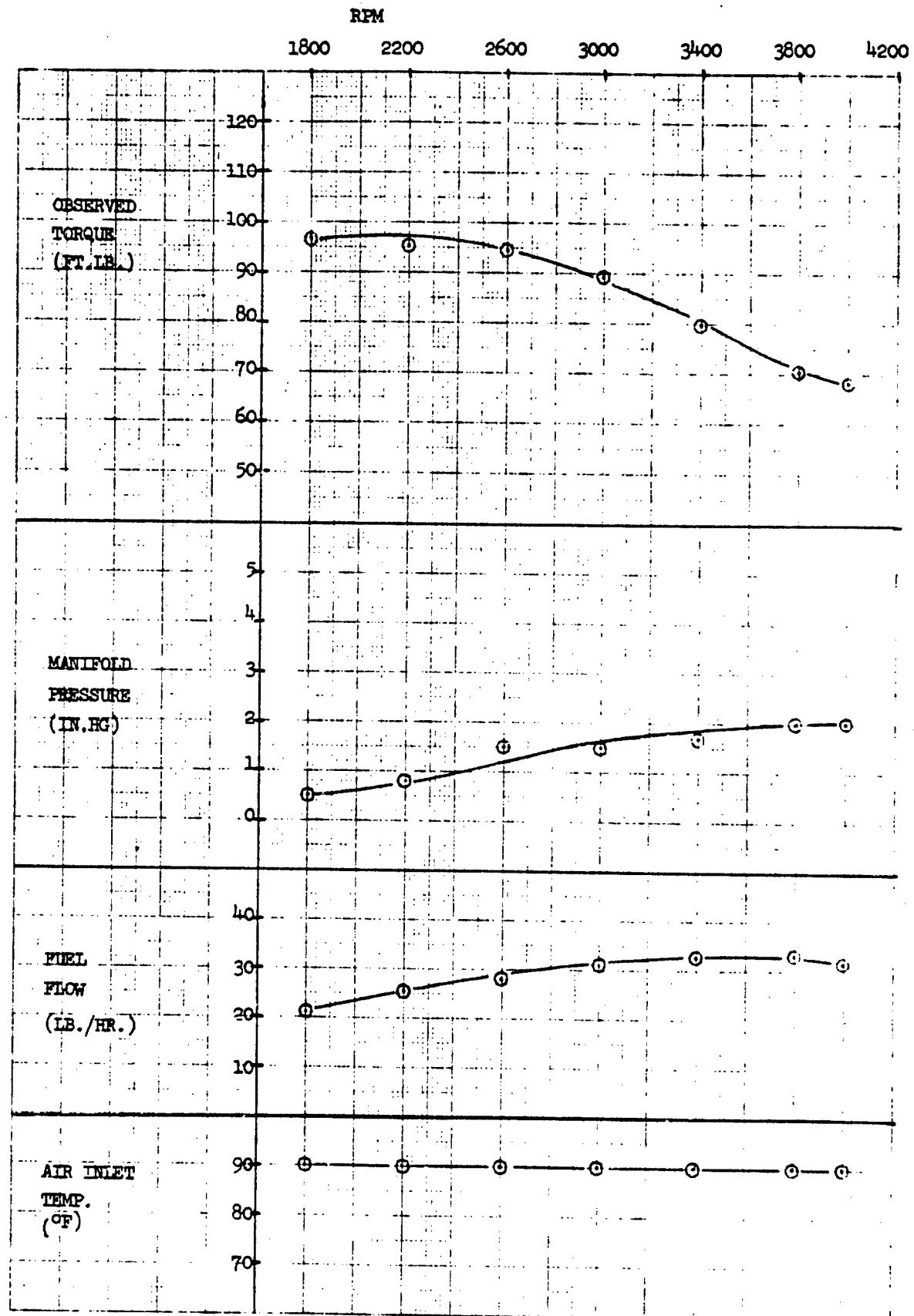


figure 3-2B. Power Check: (100-hour duration)

DATE 6 SEPTEMBER 1974 HOURS 200
BAROMETRIC PRESSURE 30.25

POWER CHECK

FUEL FLOW (lb/hr)	FUEL TEMP (°F)	ENGINE SPEED (rpm)	ENGINE LOAD (ft.lb)	MANIFOLD VACUUM (in.Hg)	OIL PRESSURE (PSI)	COOLANT TEMP. (°F)	AIR INLET TEMP. (°F)
21.5	78	1800	105.1	.5	43	170	73
25.1	77	2200	104.6	.8	44	177	73
27.9	77	2600	98.1	1.5	45	180	73
30.8	77	3000	90.3	1.5	46	184	73
32.9	77	3400	82.1	1.8	47	187	73
33.0	77	3800	72.0	2.0	47	190	73
31.0	77	4000	69.3	2.0	47	197	73

figure 3-3A. Power Check (200-hour duration)

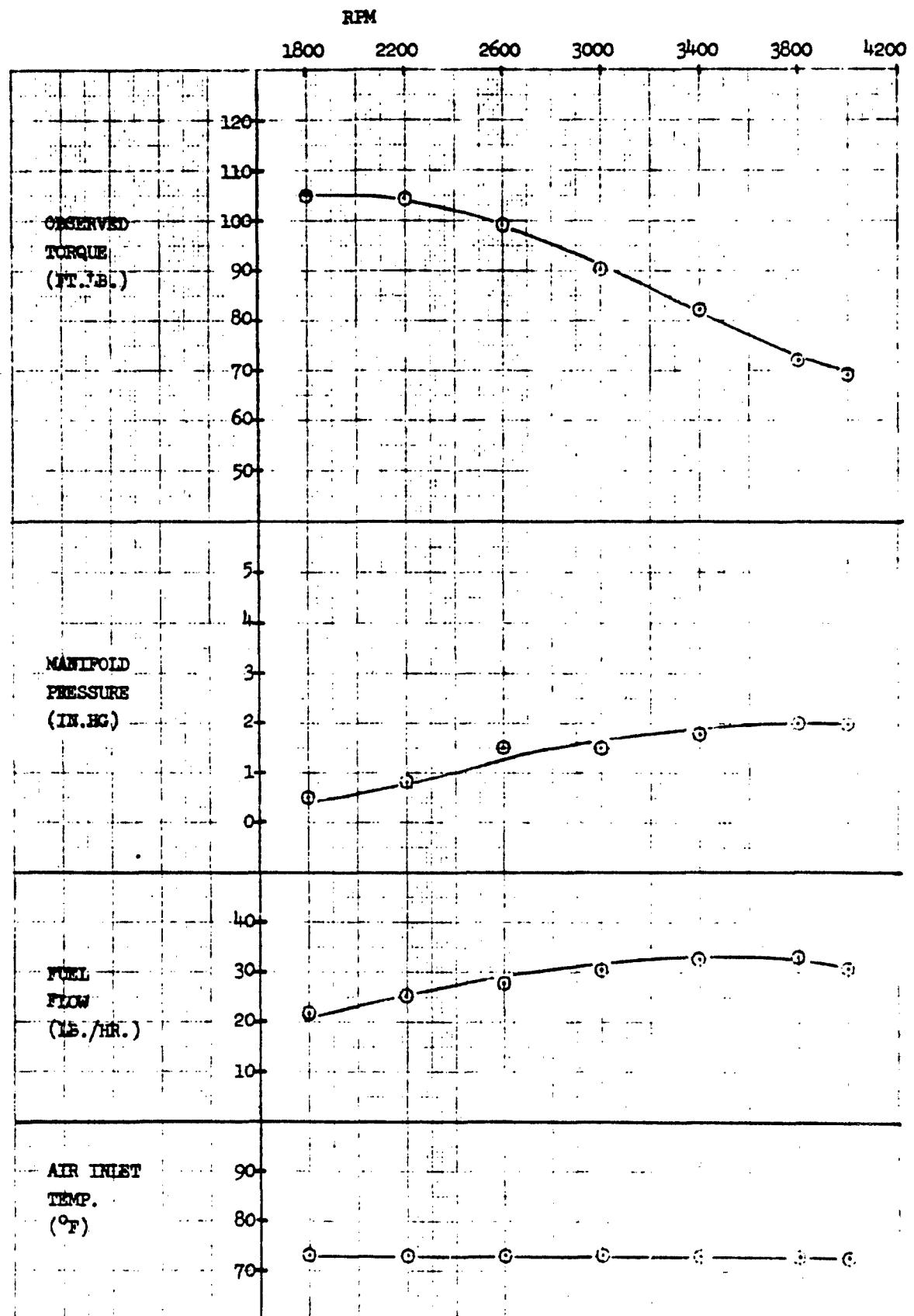


figure 3-3B. Power Check (200-hour duration)

DATE 23 SEPTEMBER 1974 HOURS 300
BAROMETRIC PRESSURE 30.40

POWER CHECK

FUEL FLOW (lb/hr)	FUEL TEMP (°F)	ENGINE SPEED (rpm)	ENGINE LOAD (ft.lb)	MANIFOLD VACUUM (in.Hg)	OIL PRESSURE (PSI)	COOLANT TEMP. (°F)	AIR INLET TEMP. (°F)
21.0	68	1800	106.1	.5	44	170	70
25.5	67	2200	105.0	.7	44	180	70
28.0	67	2600	98.0	1.5	45	184	70
31.2	67	3000	93.0	1.5	46	186	70
33.0	67	3400	82.0	1.8	47	191	70
33.5	67	3800	73.0	2.0	47	195	70
32.0	67	4000	69.1	2.0	47	199	70

figure 3-4A. Power Check (300-hour duration)

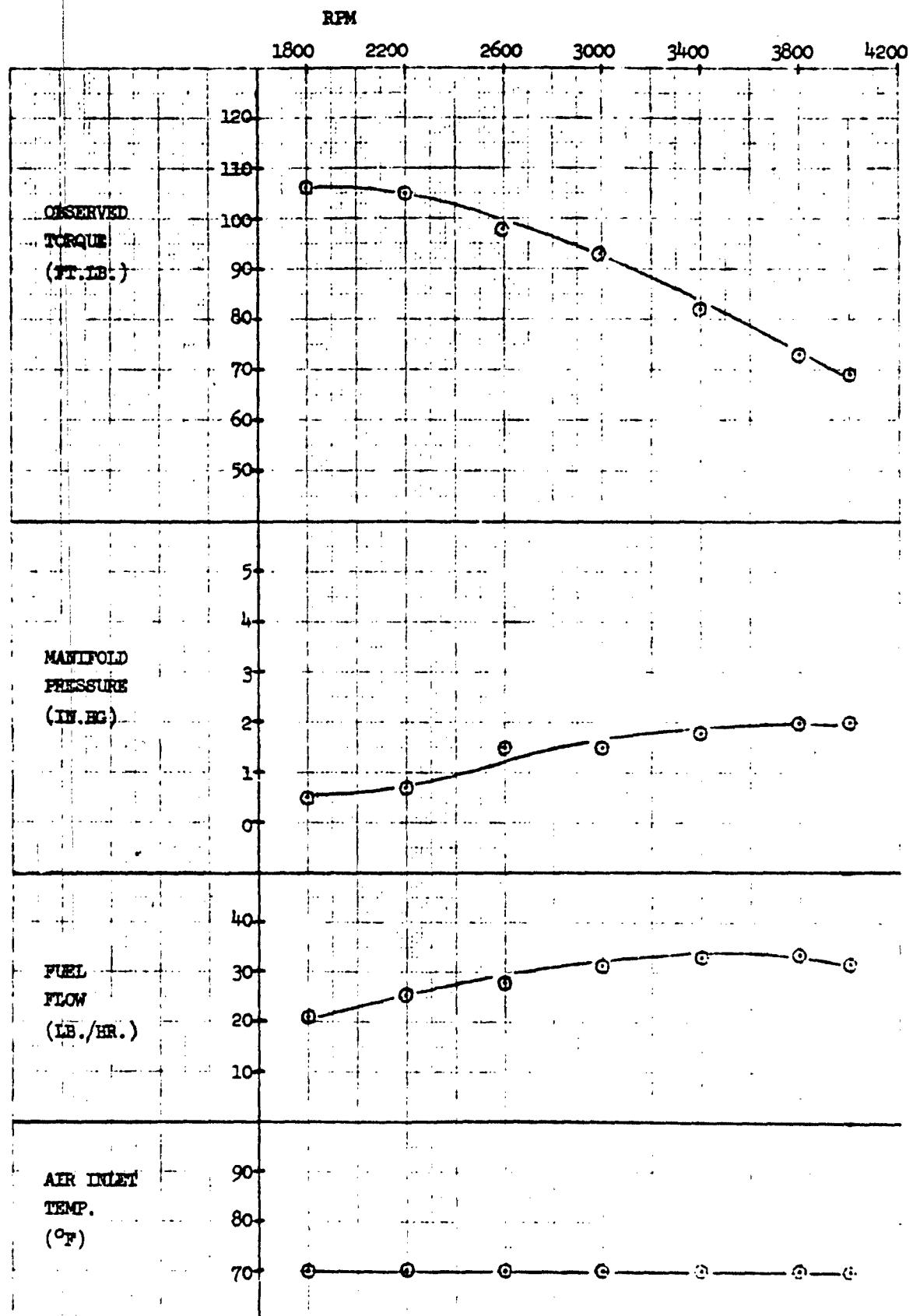


figure 3-4B. Power Check (300-hour duration)

DATE 9 OCTOBER 1974 HOURS 400
BAROMETRIC PRESSURE 30.01

POWER CHECK

FUEL FLOW (lb/hr)	FUEL TEMP (°F)	ENGINE SPEED (rpm)	ENGINE LOAD (ft.lb)	MANIFOLD VACUUM (in.Hg)	OIL PRESSURE (PSI)	COOLANT TEMP. (°F)	AIR INLET TEMP. (°F)
20.9	65	1800	104.1	.5	44	172	70
25.4	64	2200	103.0	.5	44	179	70
27.9	64	2600	97.0	1.3	45	183	70
31.0	64	3000	91.0	1.5	46	187	70
32.9	64	3400	79.9	1.8	47	191	70
33.5	64	3800	71.3	2.0	47	195	70
32.0	64	4000	67.0	2.0	47	199	70

figure 3-5A. Power Check (400-hour duration)

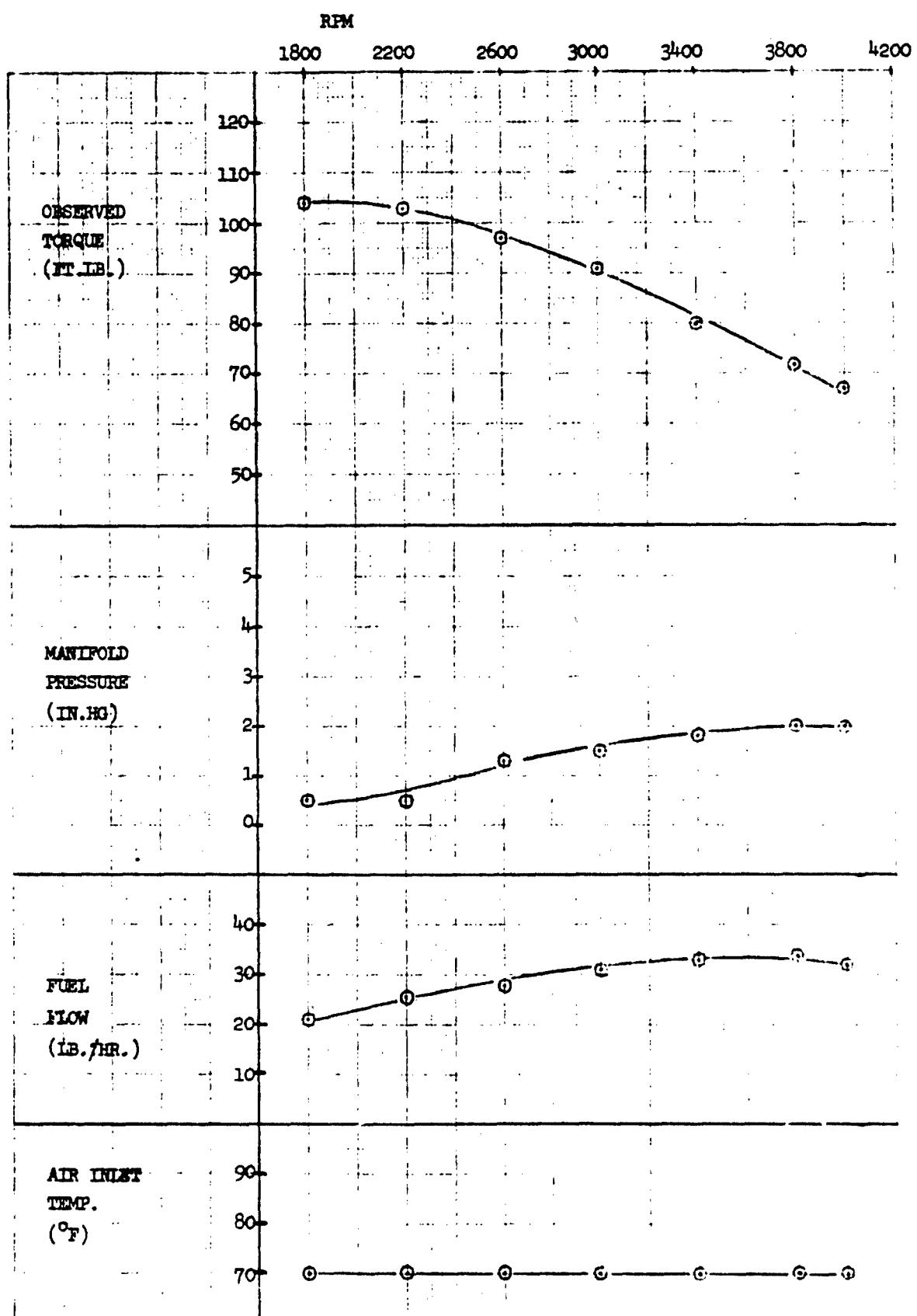


figure 3-5B. Power Check (400-hour duration)

DATE 19 OCTOBER 1974 HOURS 500
BAROMETRIC PRESSURE 30.21

POWER CHECK

FUEL FLOW (lb/hr)	FUEL TEMP (°F)	ENGINE SPEED (rpm)	ENGINE LOAD (ft.lb)	MANIFOLD VACUUM (in.Hg)	OIL PRESSURE (PSI)	COOLANT TEMP. (°F)	AIR INLET TEMP. (°F)
21.1	71	1800	103.0	.5	44	170	70
25.1	69	2200	102.0	.8	44	177	70
28.1	69	2600	97.0	1.5	45	181	70
31.1	69	3000	90.0	1.5	46	187	70
33.0	69	3400	79.5	1.8	47	190	70
33.4	69	3800	71.0	2.0	47	195	70
32.0	69	4000	68.0	2.0	47	199	70

figure 3-6A. Power Check (500-hour duration)

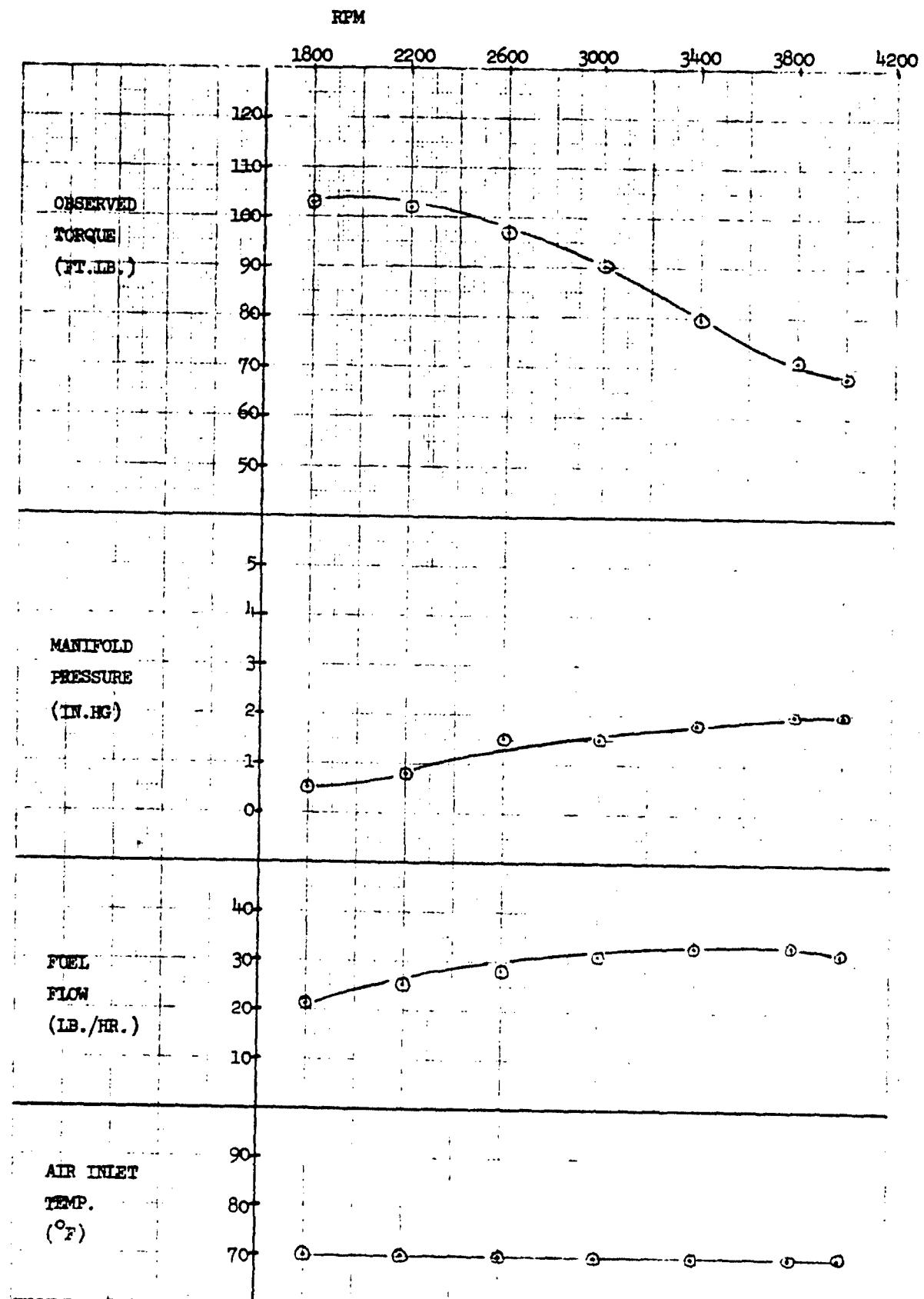


figure 3-6B. Power Check (500-hour duration)

DATE 25 OCTOBER 1974 HOURS 549
BAROMETRIC PRESSURE 30.19

POWER CHECK

FUEL FLOW (lb/hr)	FUEL TEMP (°F)	ENGINE SPEED (rpm)	ENGINE LOAD (ft.lb)	MANIFOLD VACUUM (in.Hg)	OIL PRESSURE (PSI)	COOLANT TEMP. (°F)	AIR INLET TEMP. (°F)
21.1	70	1800	102.6	.5	44	170	70
25.3	70	2200	101.8	.8	44	177	70
28.0	70	2600	97.8	1.5	45	181	70
31.0	70	3000	89.0	1.5	46	187	70
33.0	70	3400	79.5	1.8	47	192	70
33.5	71	3800	70.9	2.0	47	196	70
32.0	72	4000	68.0	2.0	47	200	70

figure 3-7A. Power Check (549-hour duration)

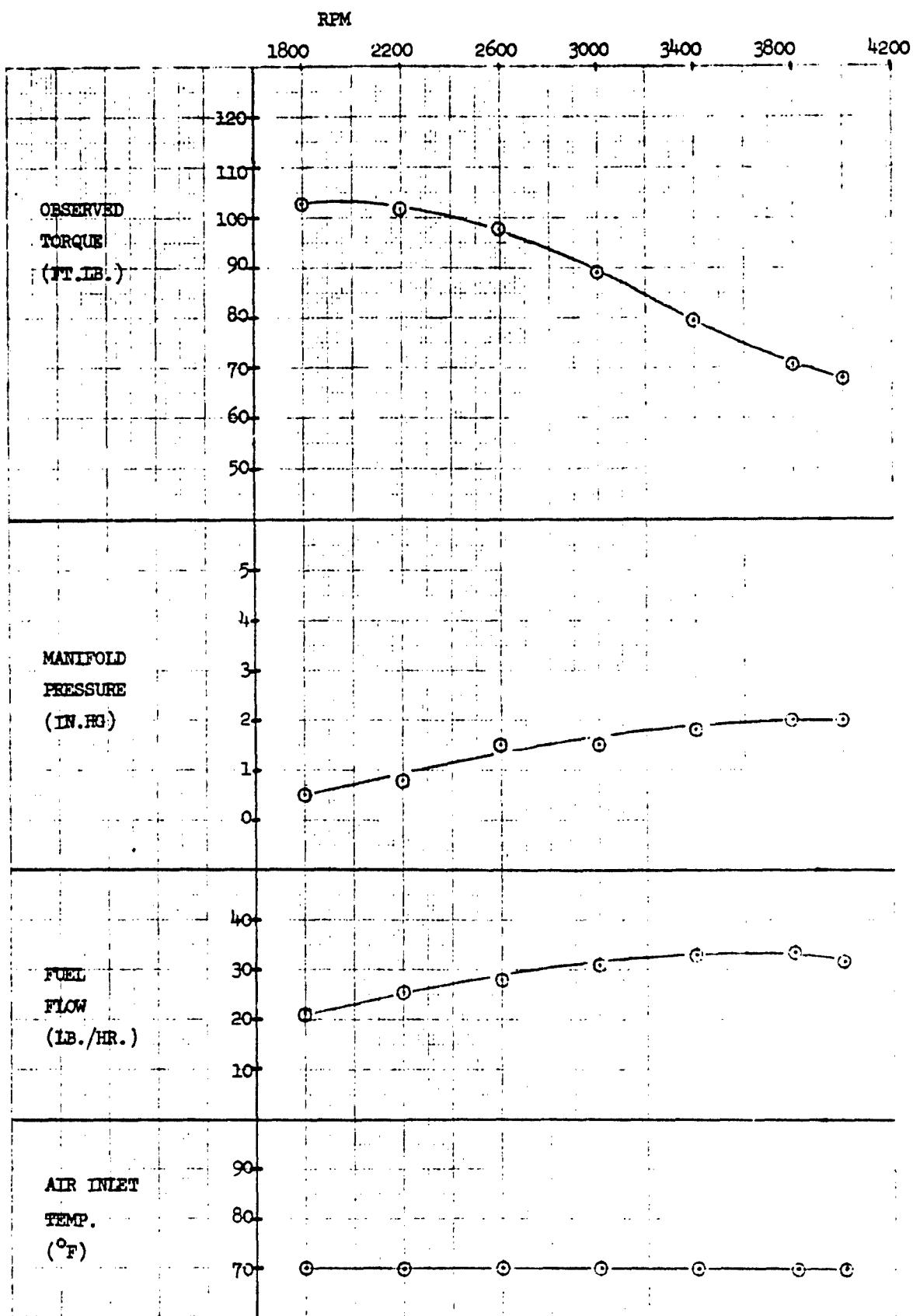


figure 3-7B. Power Check (549-hour duration)

100 MILE SIMULATED FIELD MISSION

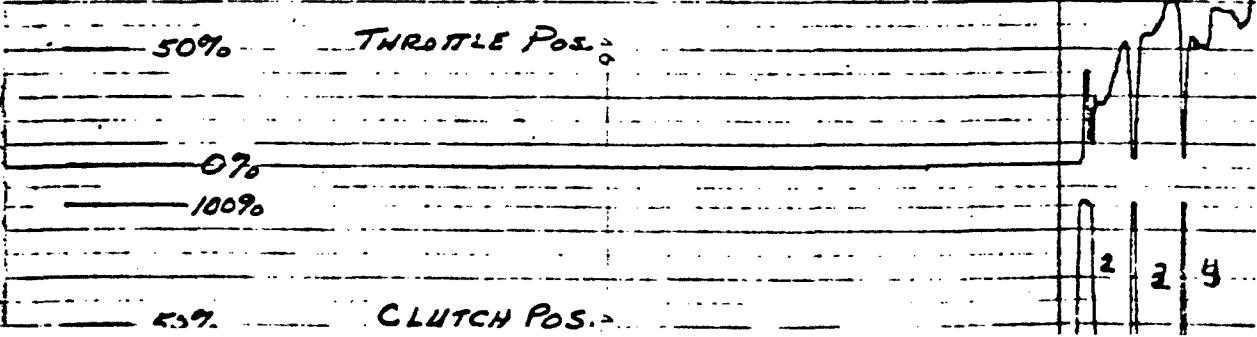
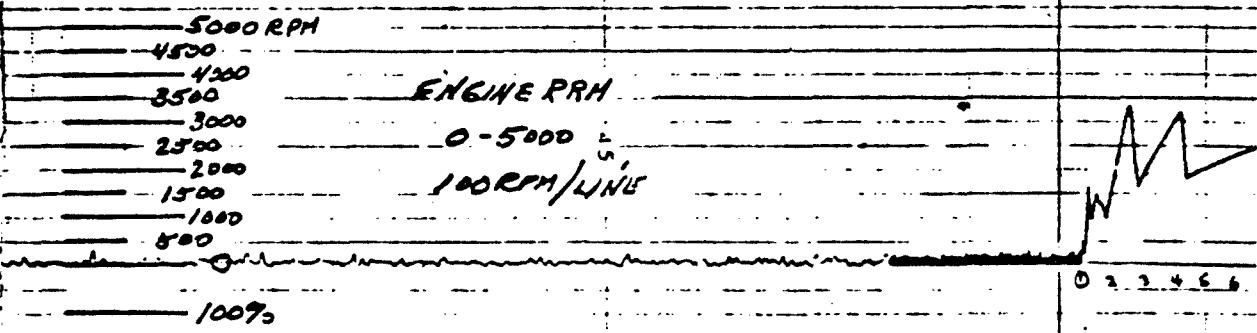
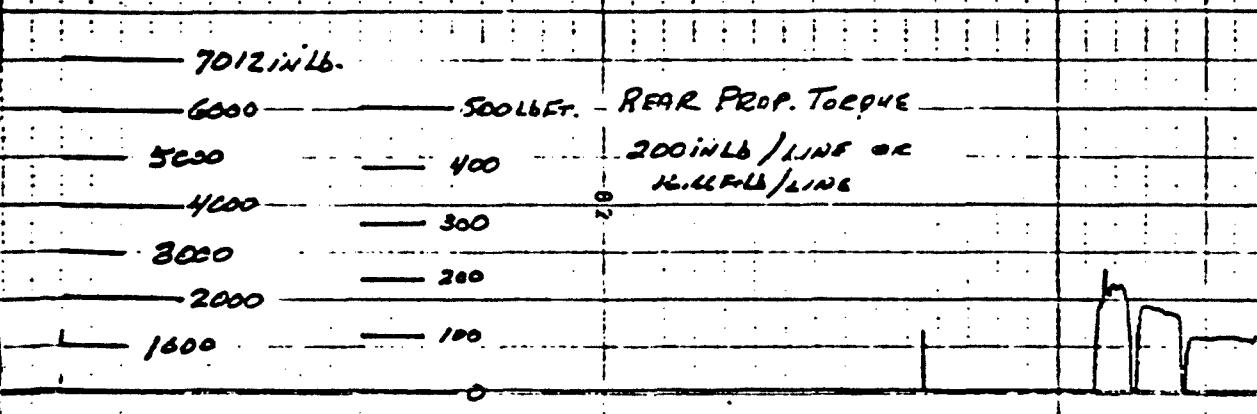
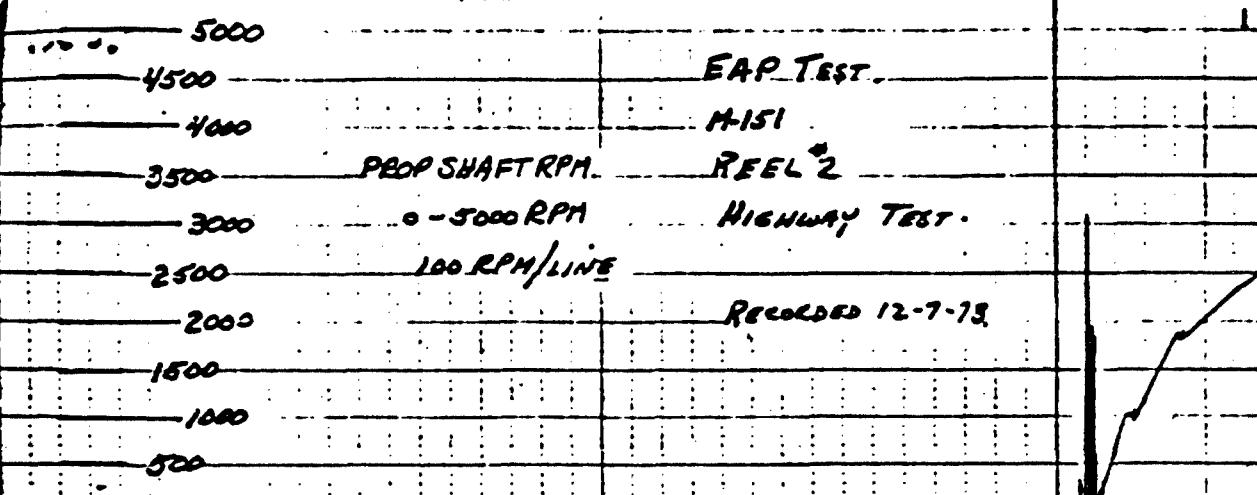
M151 VEHICLE

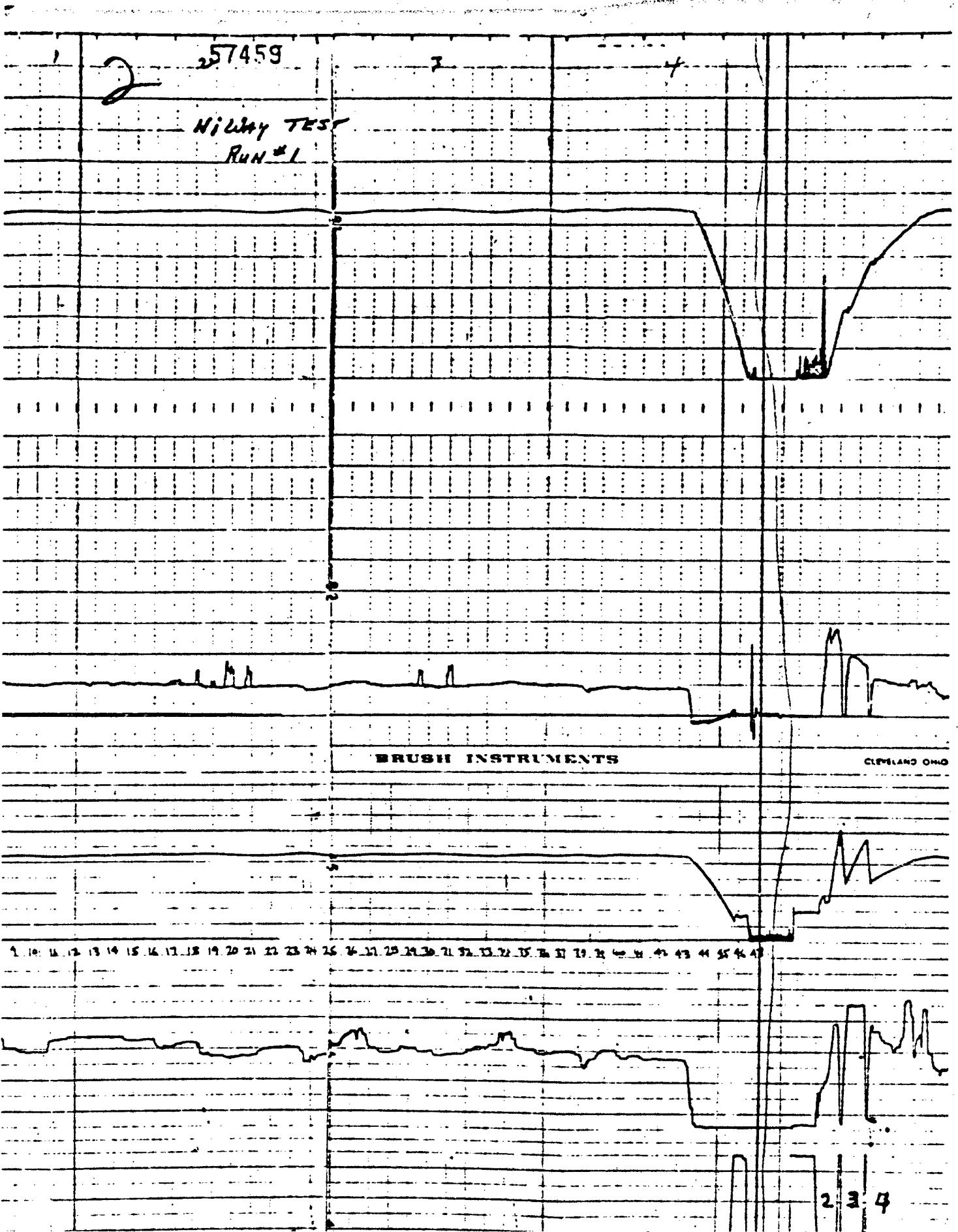
<u>%</u>	<u>Course</u>
30	Hard Surface
29	Secondary Road
41	Hilly and Level Cross-Country

Simulation Program

<u>Laps/Mission</u>	<u>Lap Mileage/Mission</u>	<u>Course</u>
4	15.6	Hilly Cross-Country
14	25.2	Level Cross-Country
7	29.022	Secondary Road
72	30.024	Highway
<hr/>		99.846 Miles/Mission

figure 4-1. Field Simulation Data (Sheet 1 of 5)

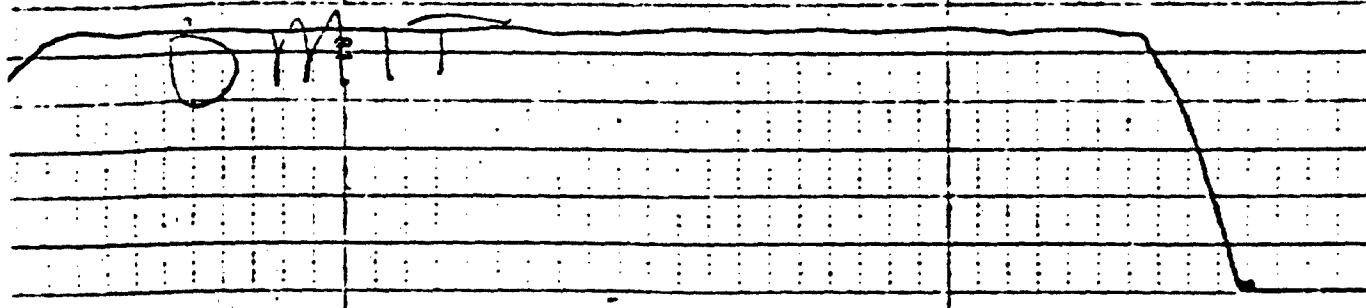




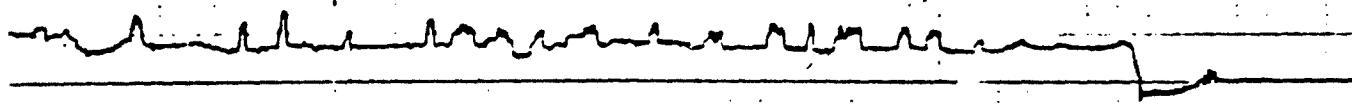
3

57460

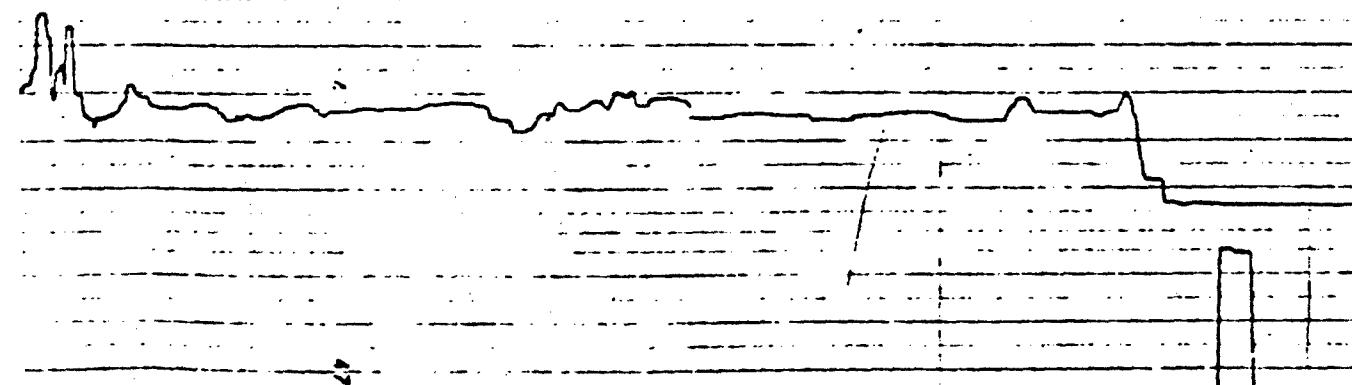
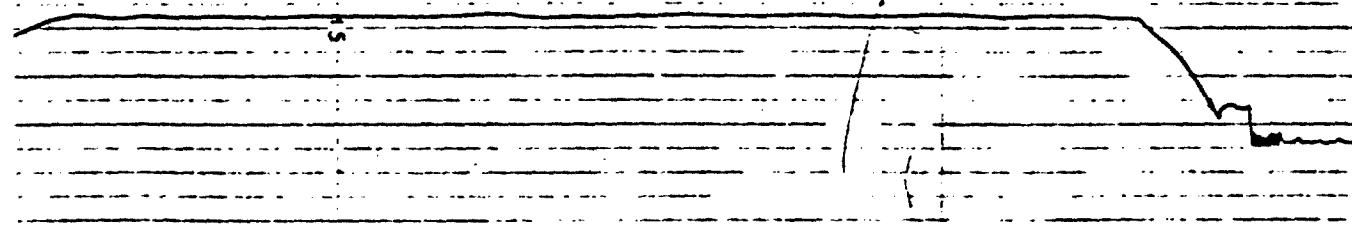
HILWAY TEST
RUN #2

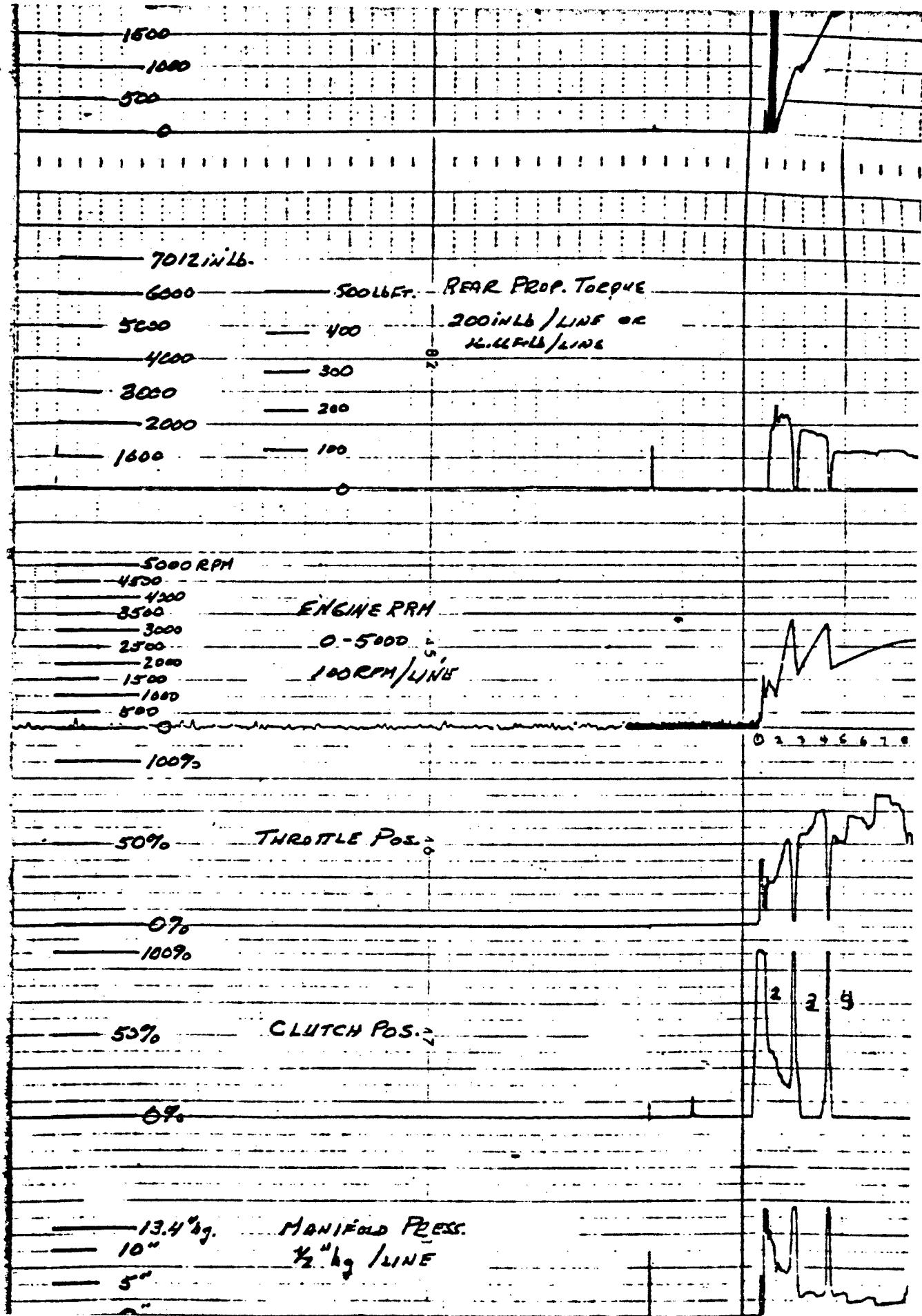


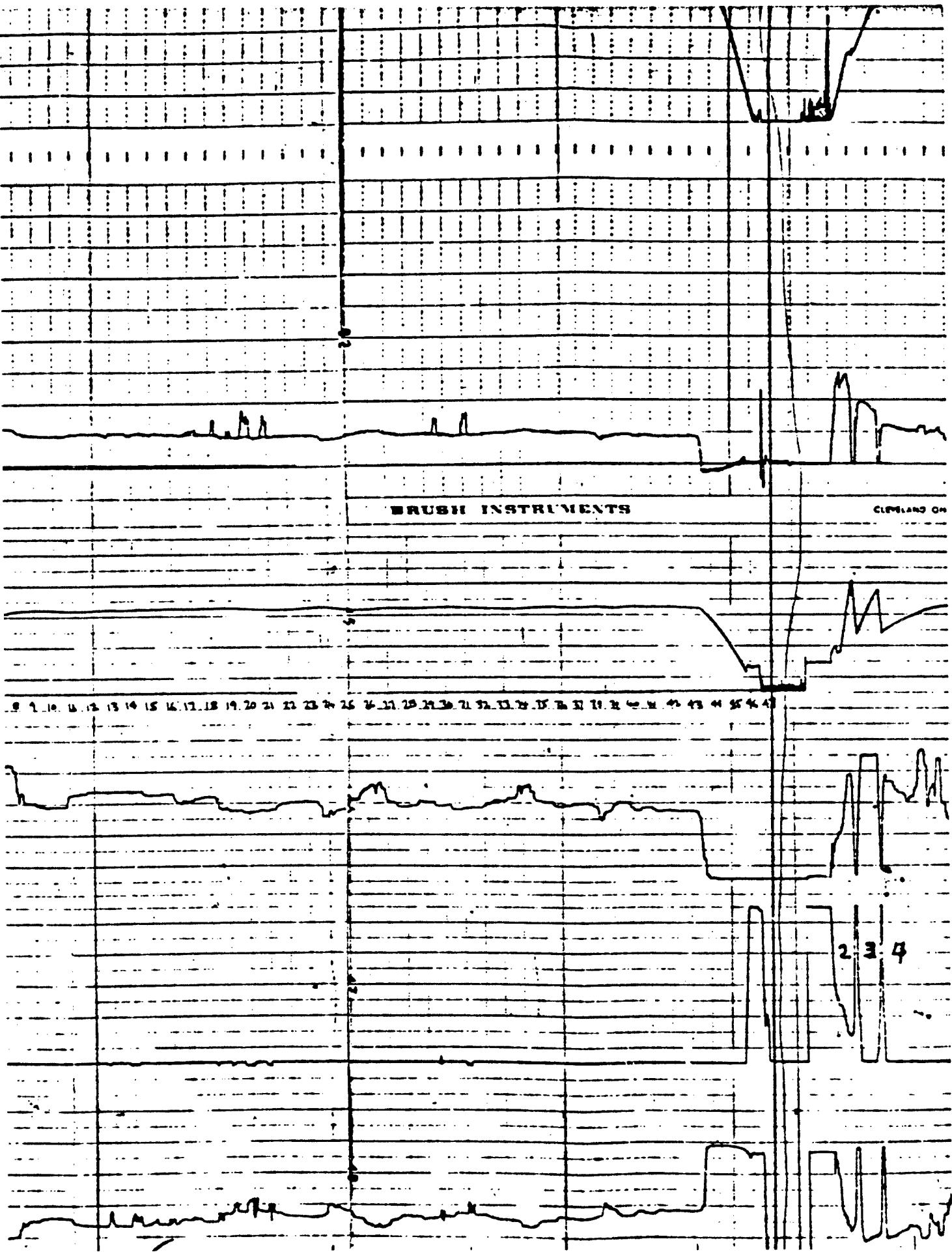
2



LAND OHIO PRINTED IN U.S.A.







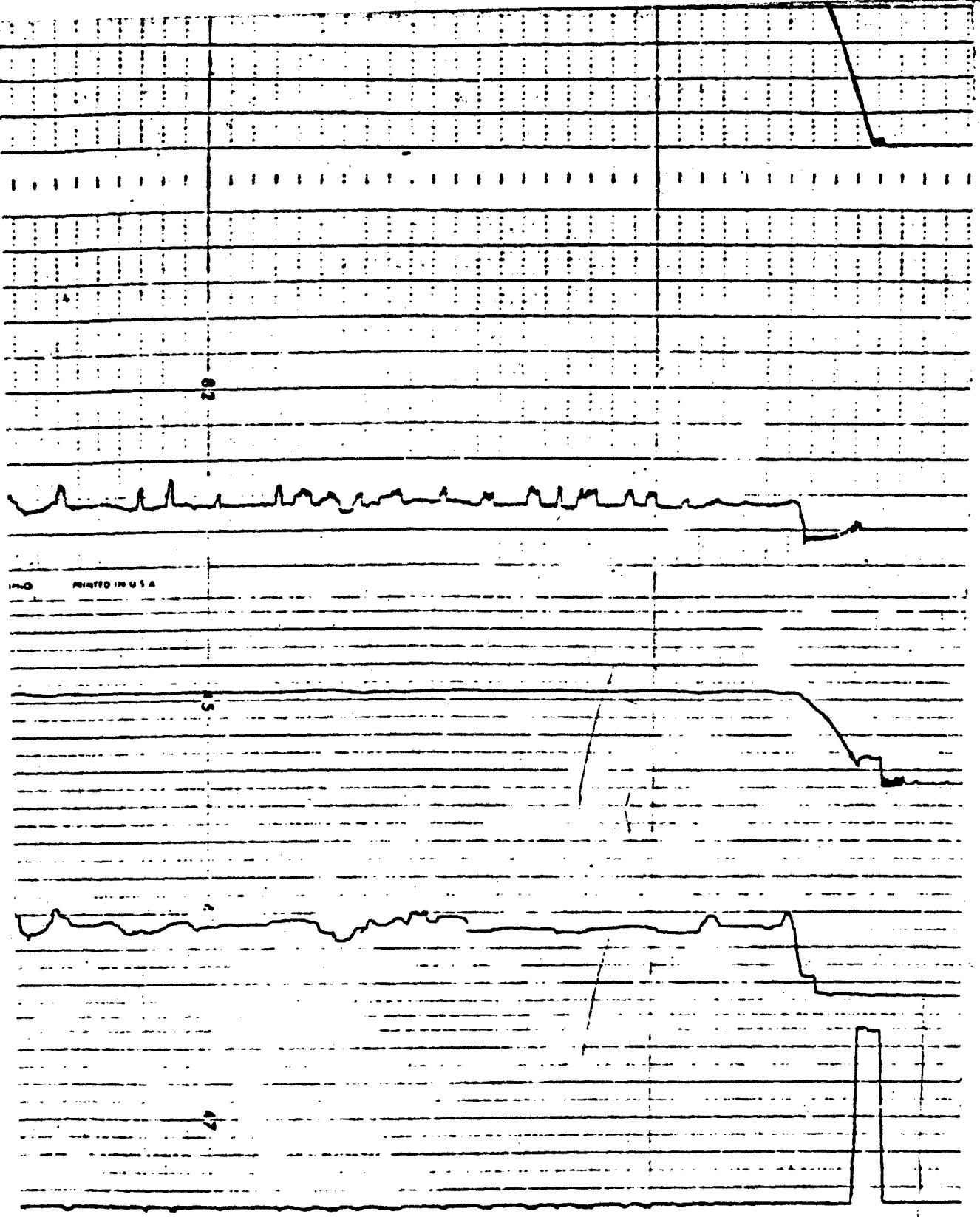


figure 4-1. Field Simulation Data (Sheet 2 of 5)

6-22

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57483

EAP TEST At APC.

M-151.

Rec "3

Perceyman #2 Cross Country.

Test Run in 2nd GEAR

4WHEEL DRIVE

5000RPM

4900

4000

3500

3000

2500

2000

1500

1000

800

0

PROPSHAFT RPM

0-5000

1000 RPM/SEC

7012 IN LB

Rear Pneu Torque

6000 — 500 FT LB.

200 IN LB/LIN FEET

5000 — 400

16.66 FT LB/LIN FEET

4000 — 300

3000 — 200

2000 — 100

1000 — 0

0 — 0

BRUSH INSTRUMENTS

5000RPM

4500

4000

3500

3000

2500

2000

1500

1000

500

0

ENGINE RPM

100 RPM/LIN FEET

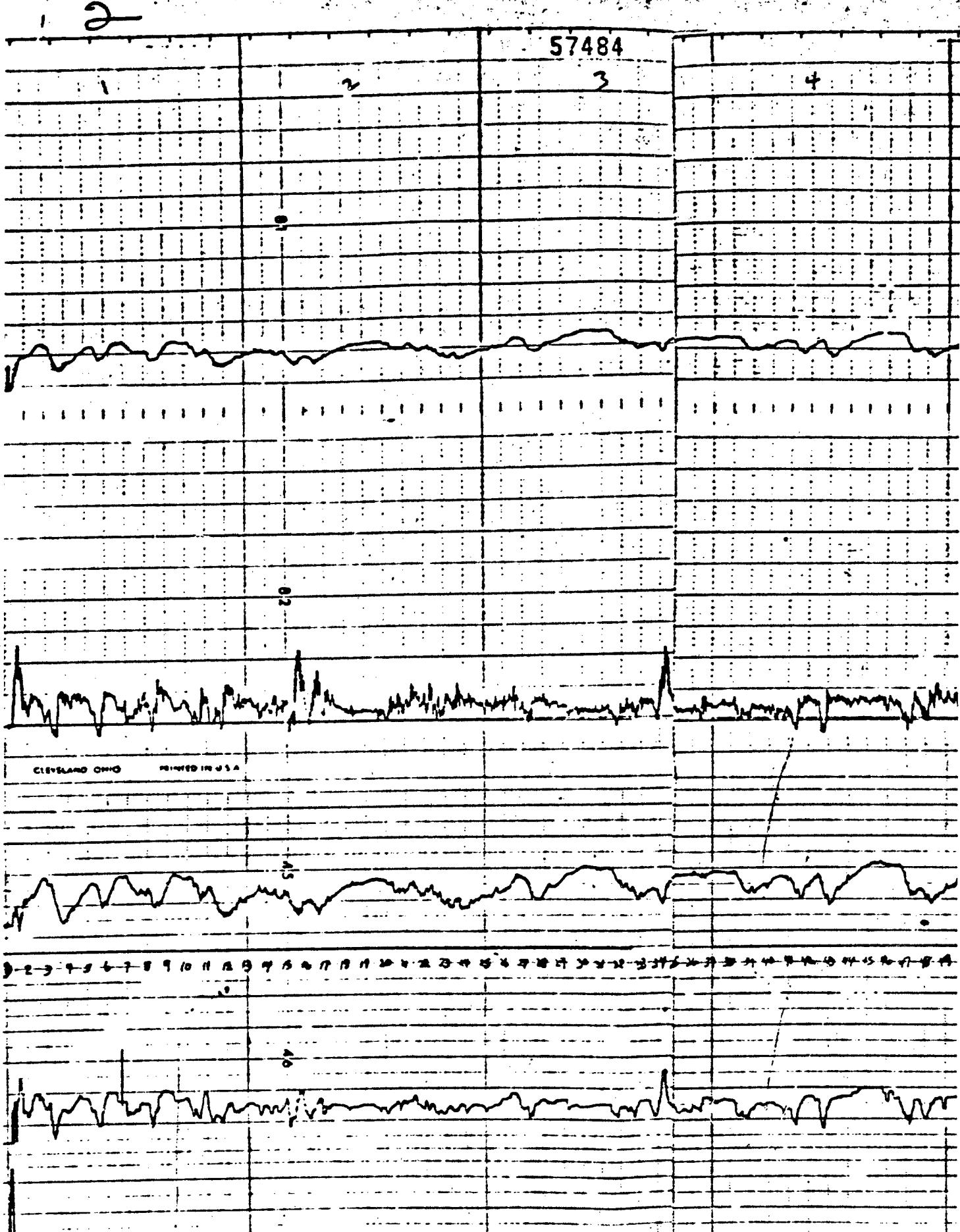
100%

THROTTLE Pos.

50%

0

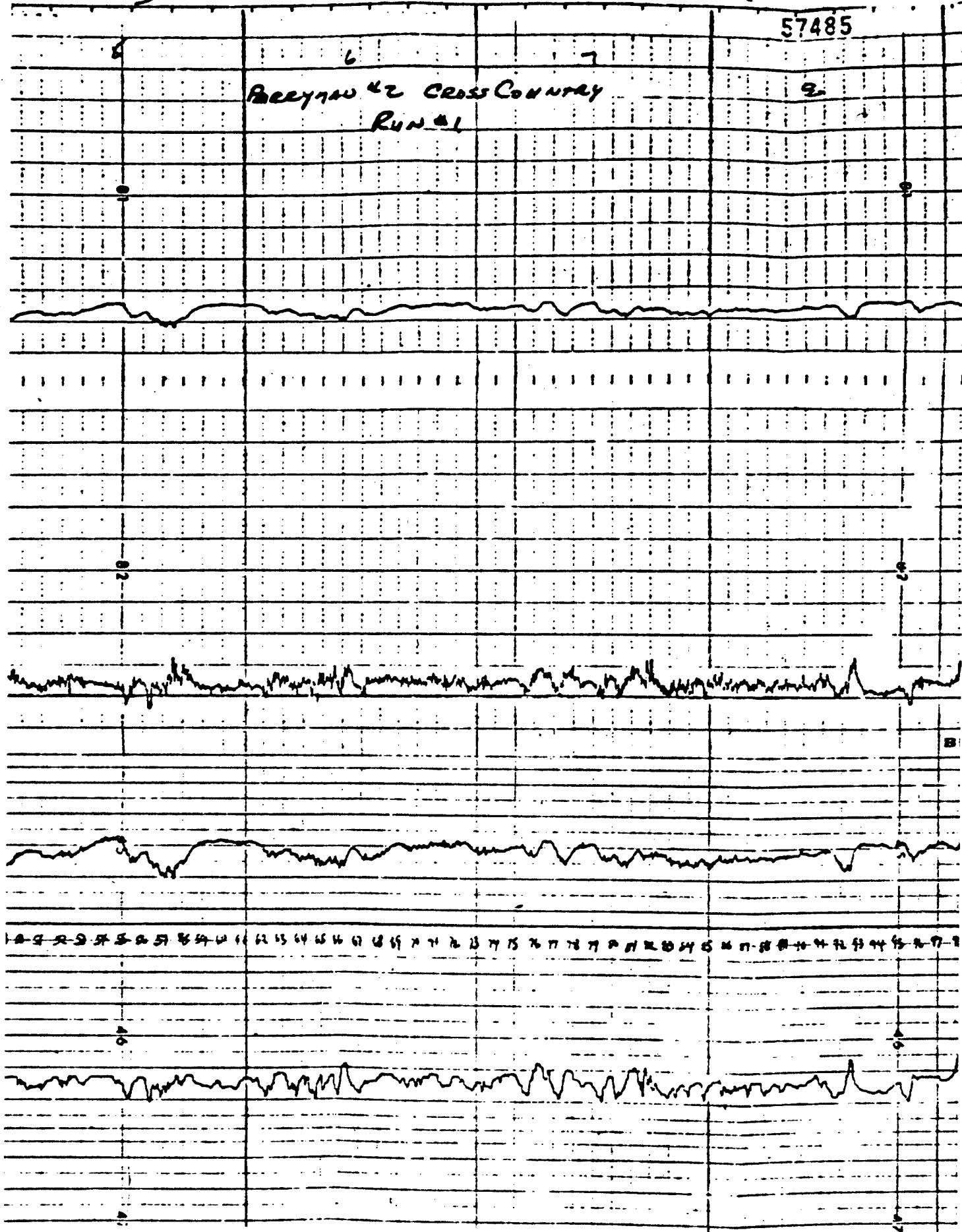
100%



3

57485

Beechwood Cross Country
Run #1



Test Run in 2nd Gear
-- 4WHEEL DRIVE

2000

1500

1000

500

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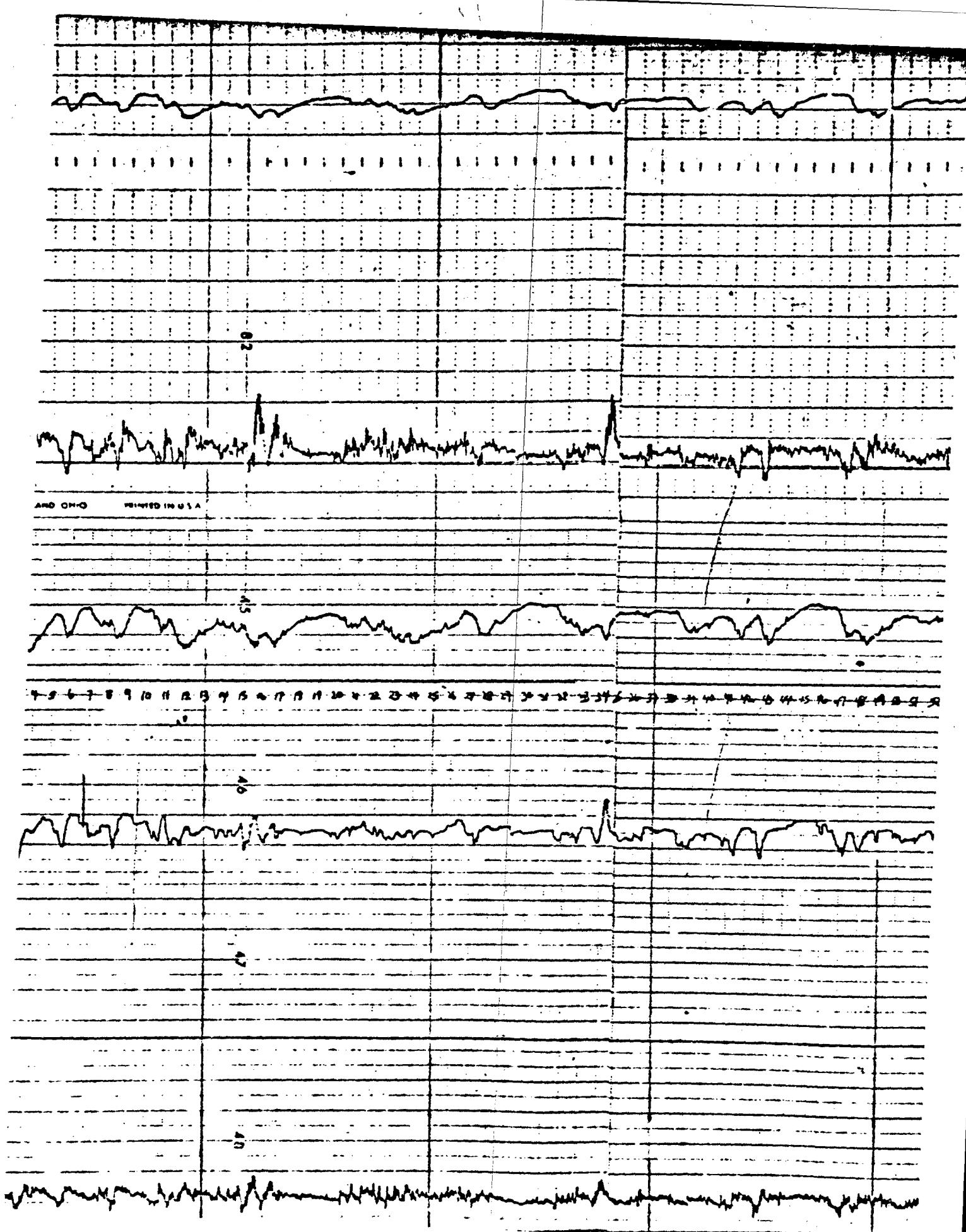
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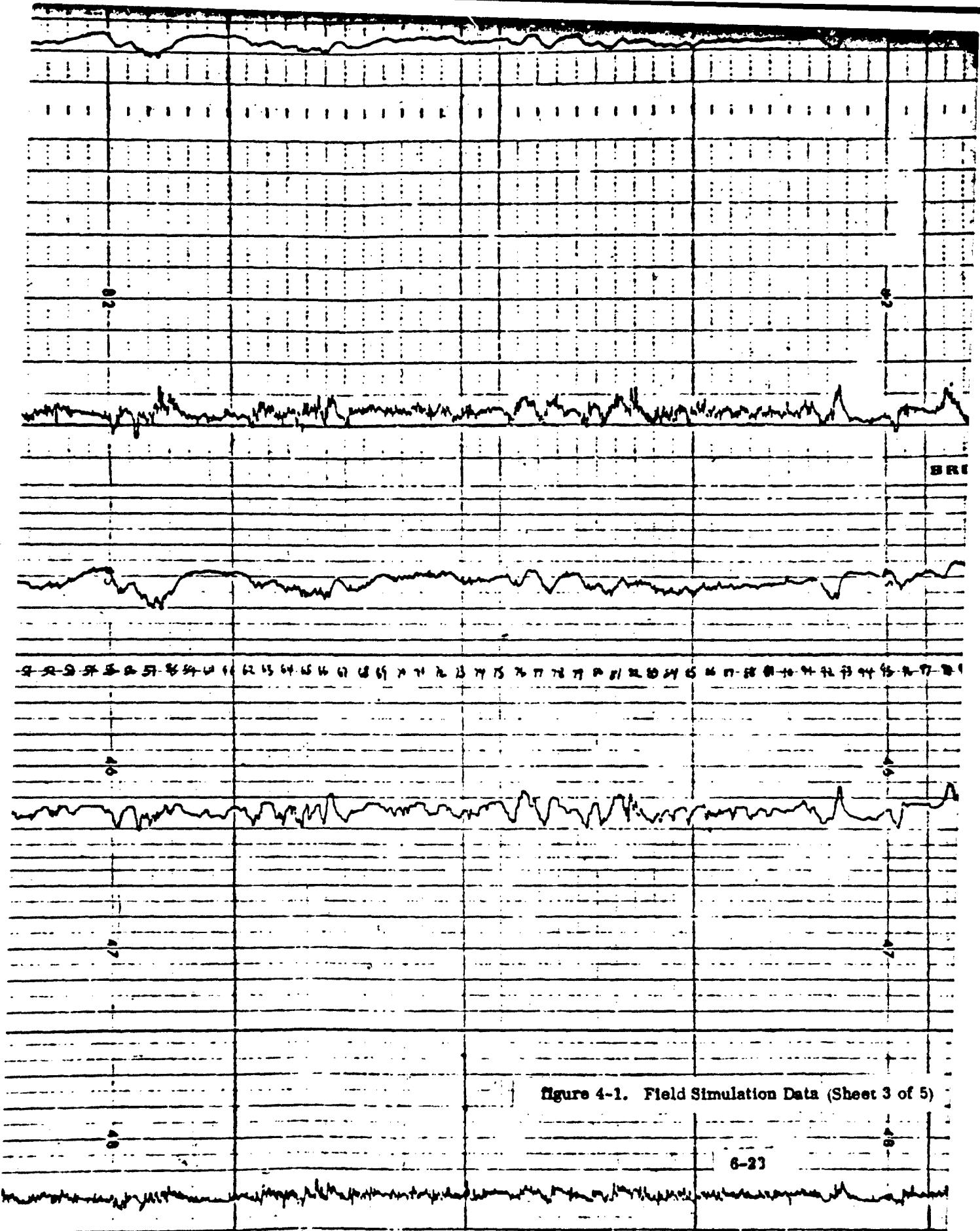


Figure 4-1. Field Simulation Data (Sheet 3 of 5)

6-23

BEST

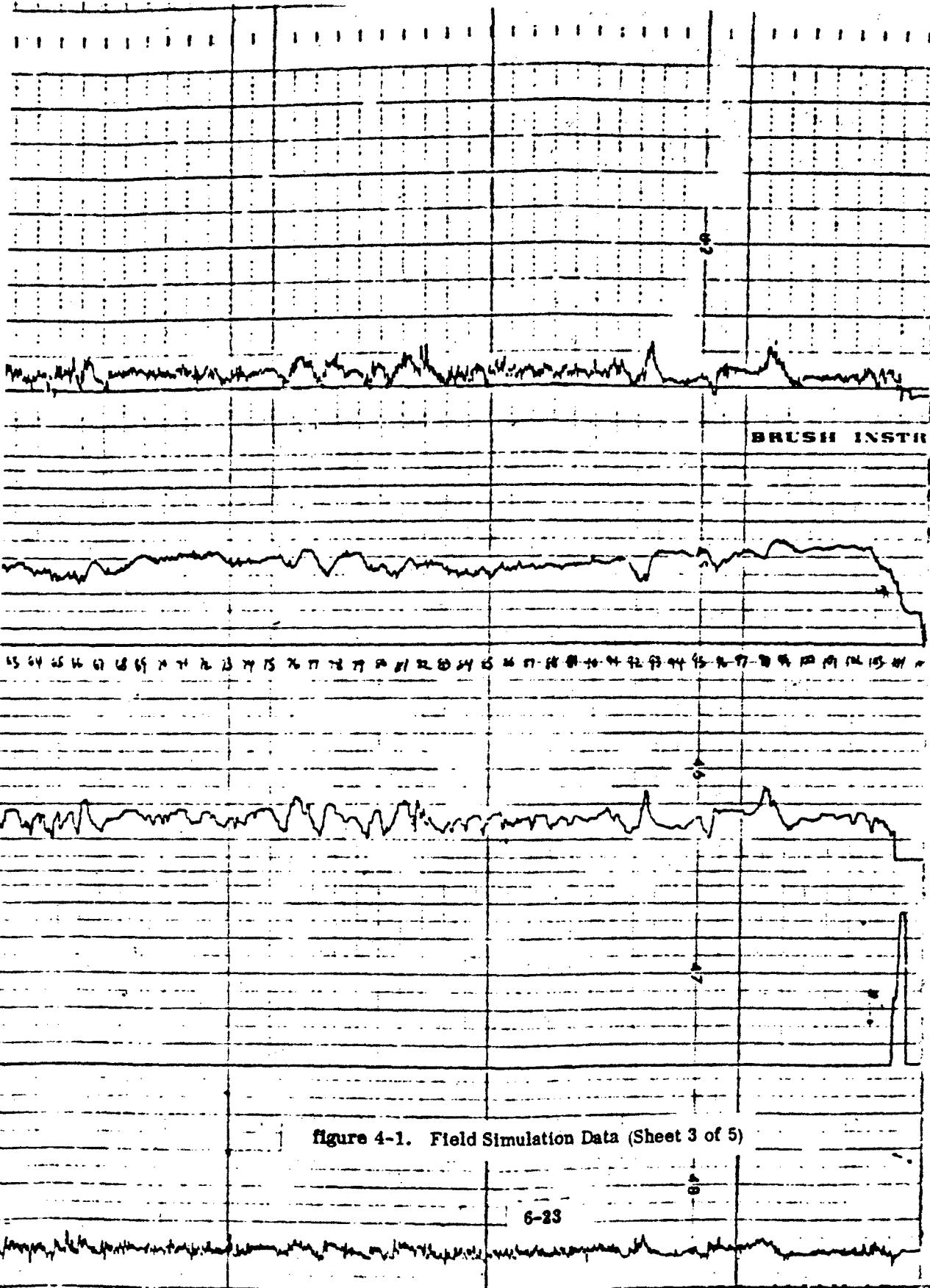


figure 4-1. Field Simulation Data (Sheet 3 of 5)

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EAR TEST At APG

Mo 151

REEL 4

Hilly Cross Country

CHUECHVILLE

B Course

Tot Ran in 4WHEEL DRIVE

DEC. 1973

5000 RPM

4500

4000

3500

3000

2500

2000

1500

1000

500

0

57501

GRADI

PropSHPD RPM.

100RPM/LINE

7012 IN LB

6000 — 800 IN LB REAR Prop. Torque

5000 — 400 — 200 IN LB/LINE

4000 — 300 — 16.67 Fr LB/LIN

3000

2000

1000

0 — 0

BRUS

5000 RPM

4500

4000

3500

3000

2500

2000

1500

1000

500

0

ENGINE RPM

100RPM/LINE

100%

50%

50%

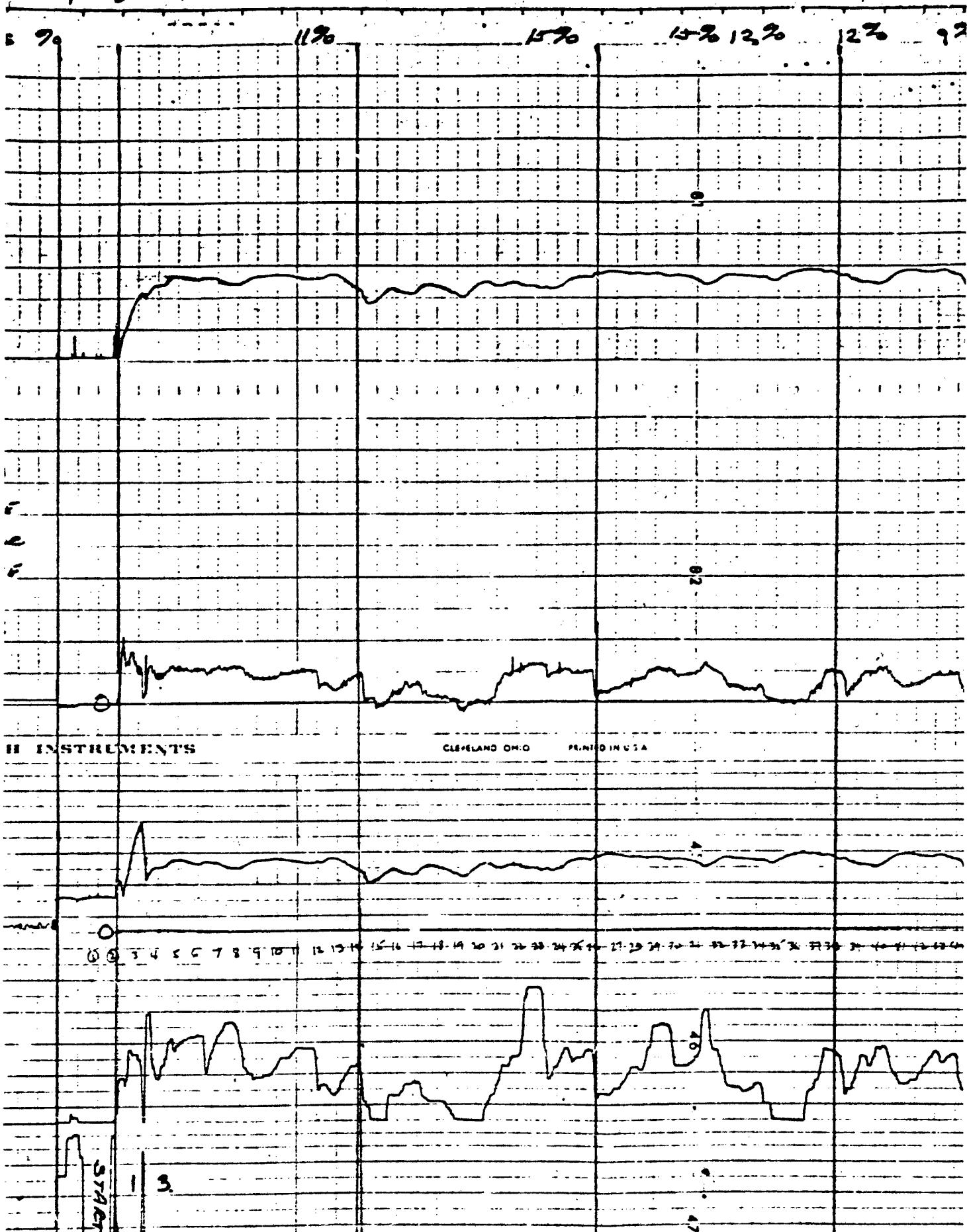
THROTTLE POS.

100%

0

50%

Clutch Pos.



5

17502

19.70

OBSTACLES.

083

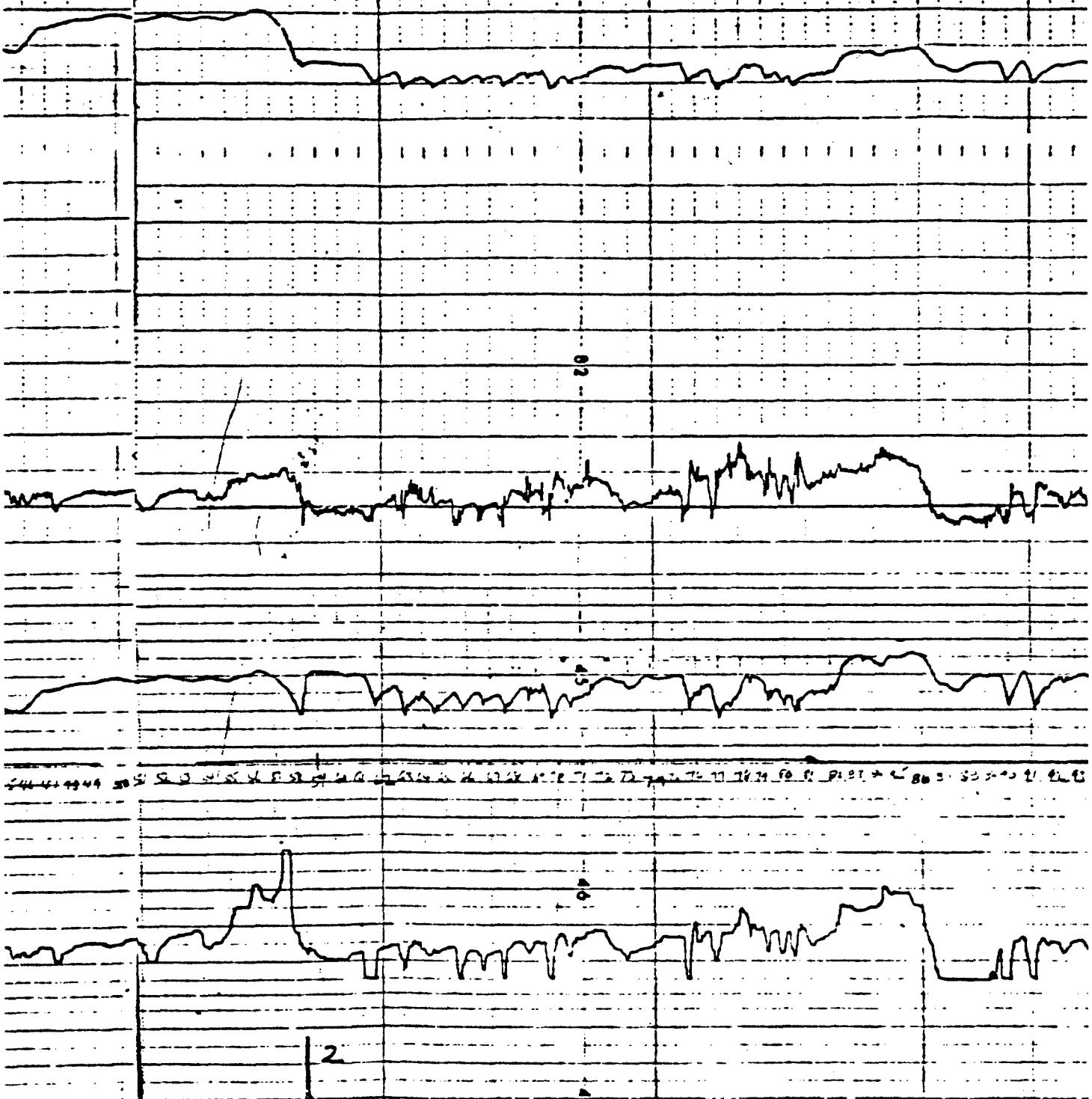
17.590

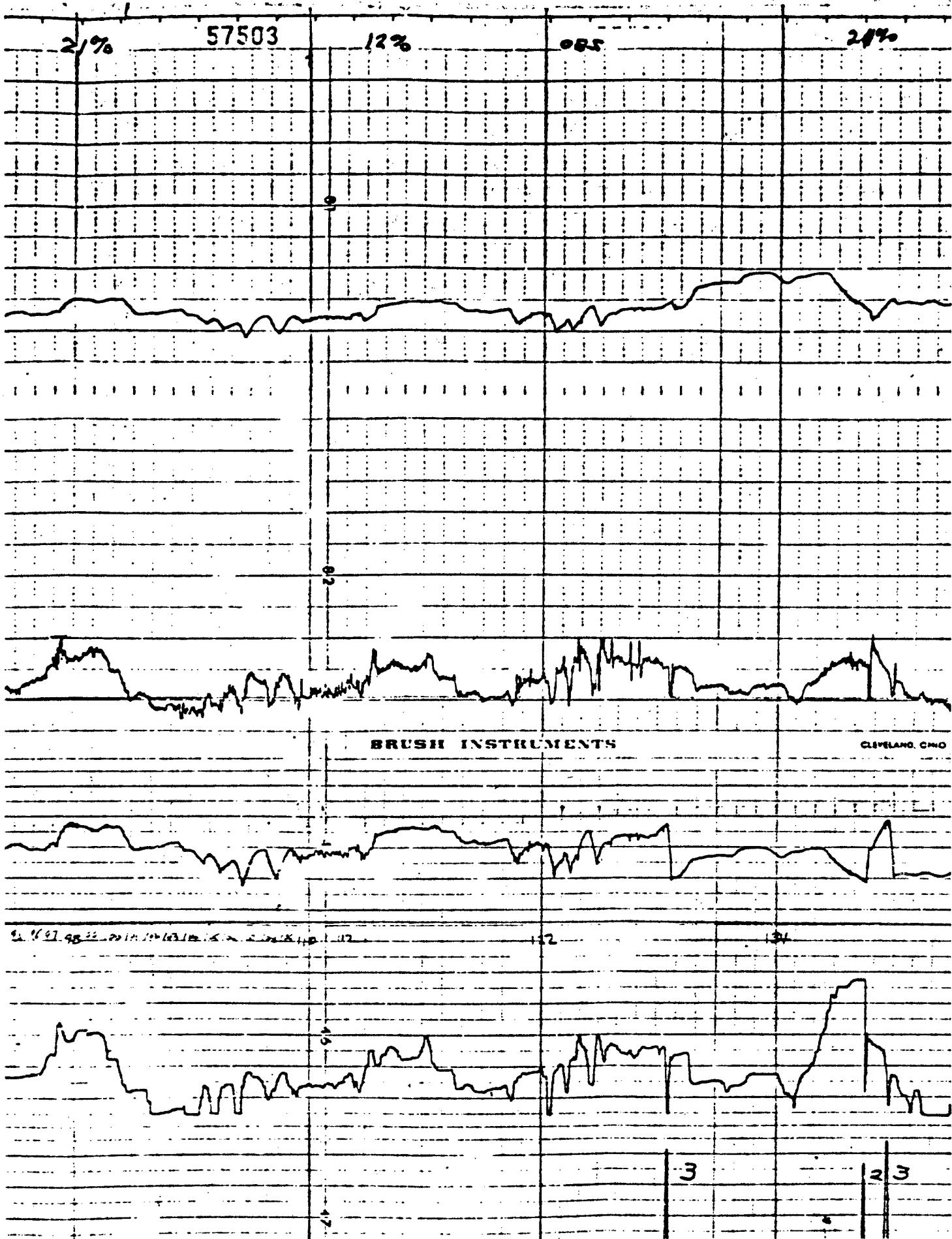
053

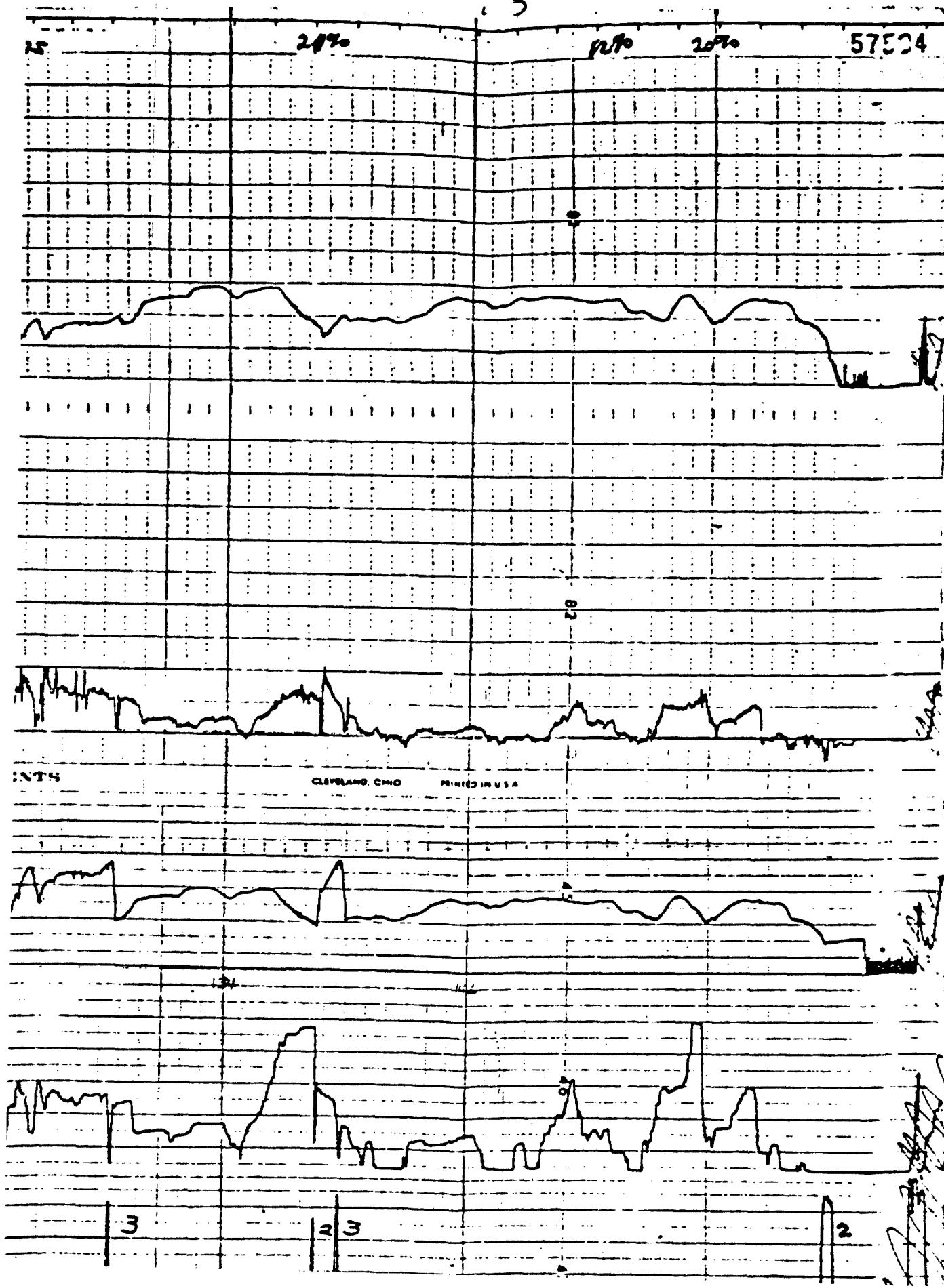
CHURCHVILLE Hilly Cross Country

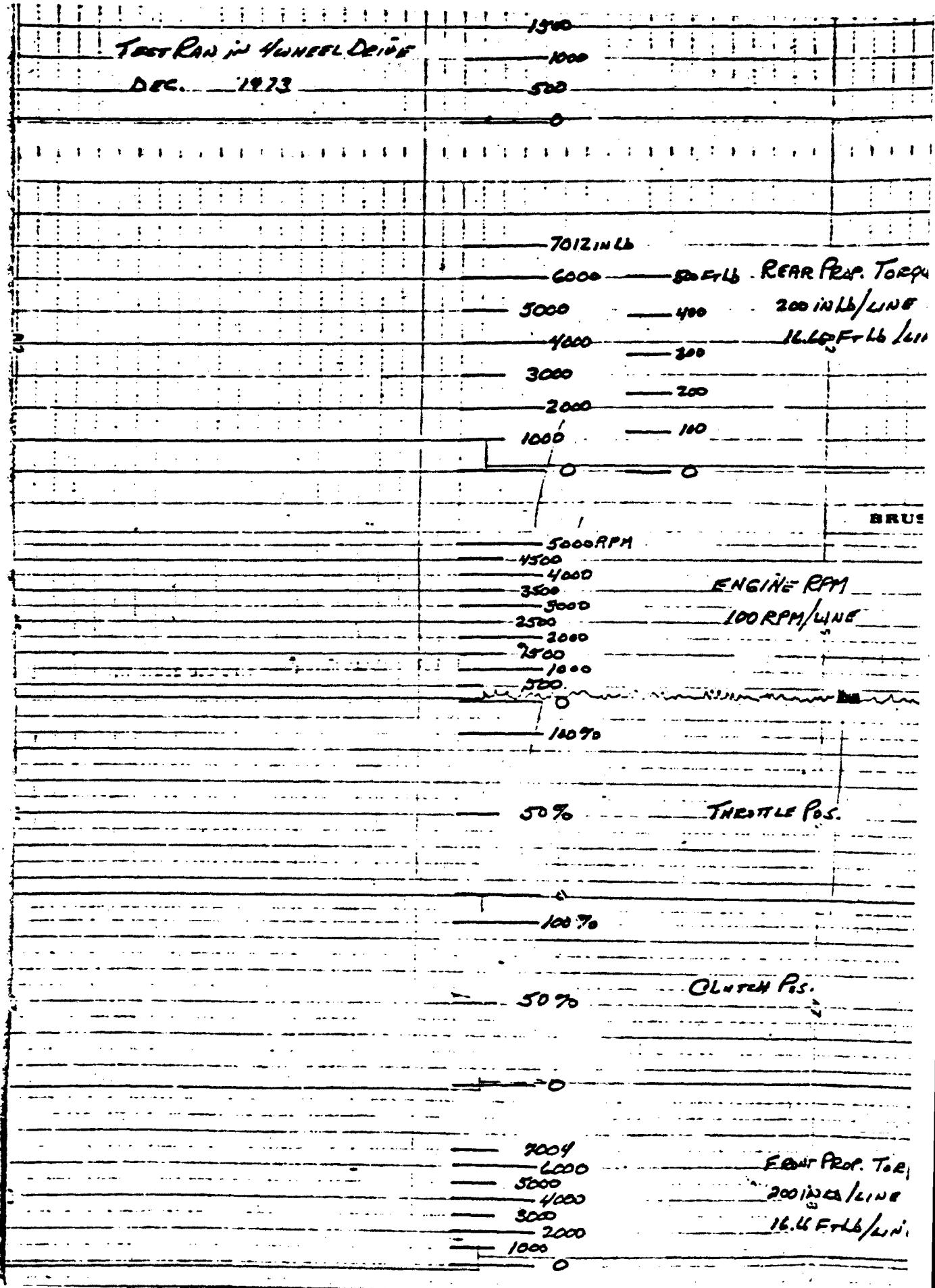
"B" Course

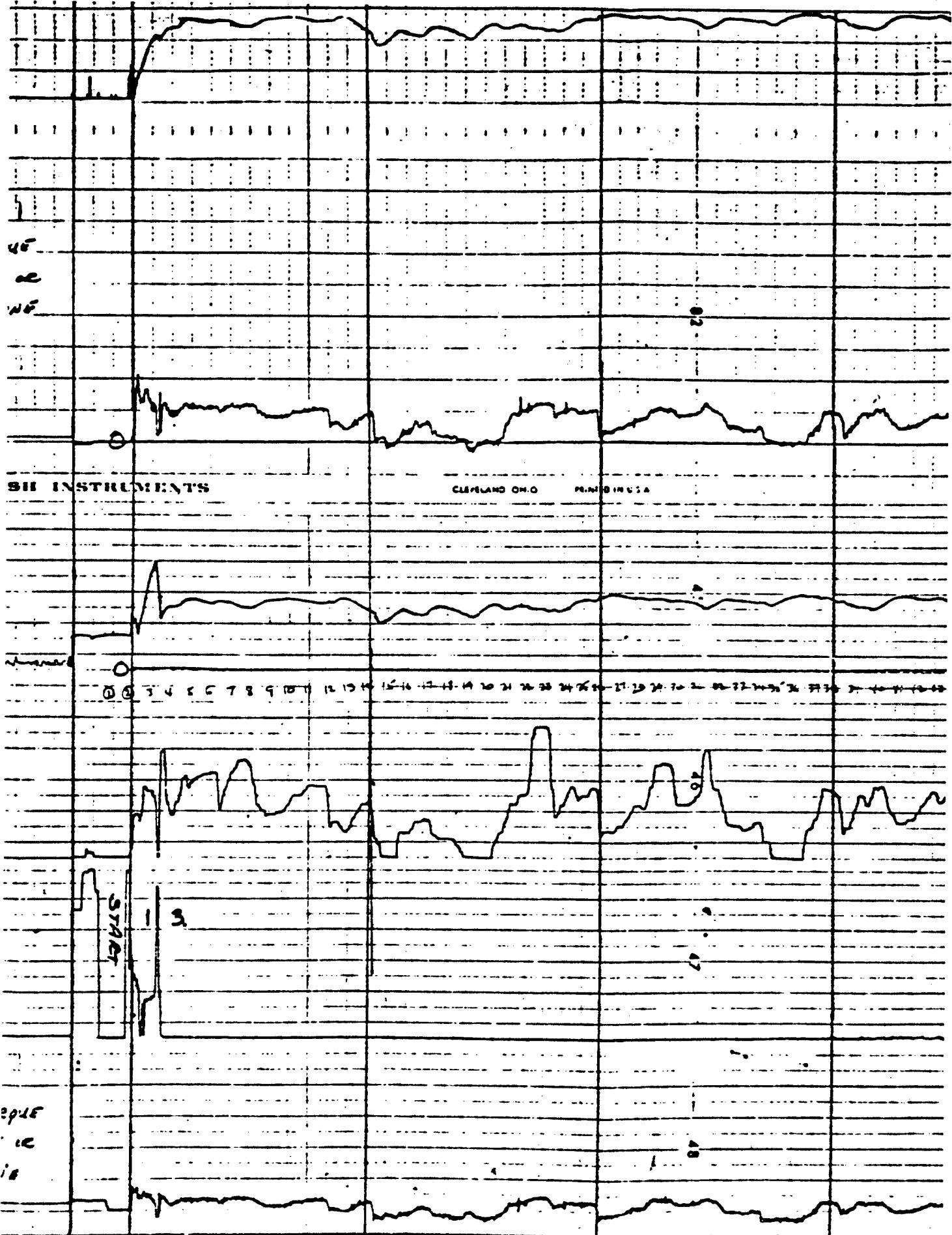
Run #1

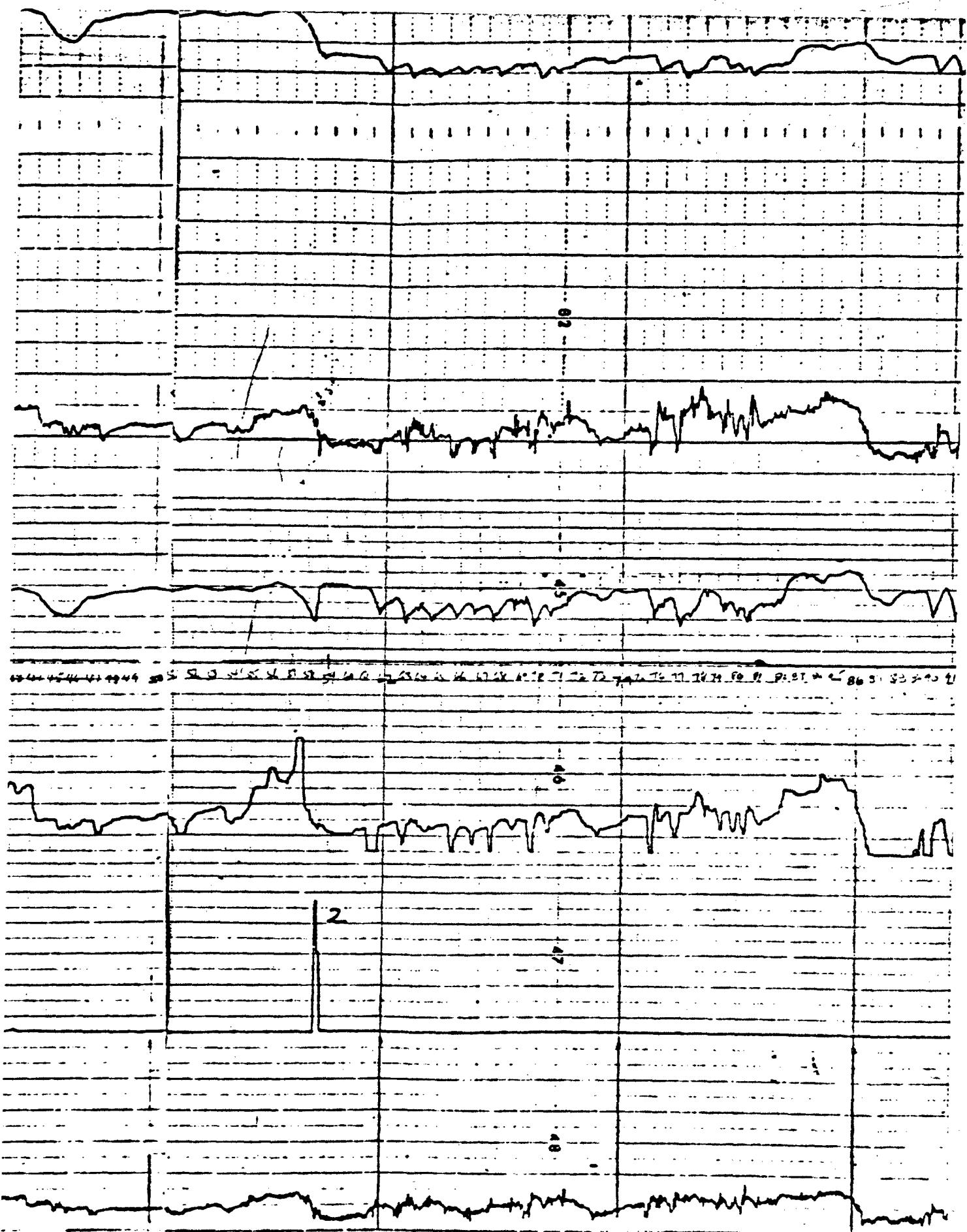


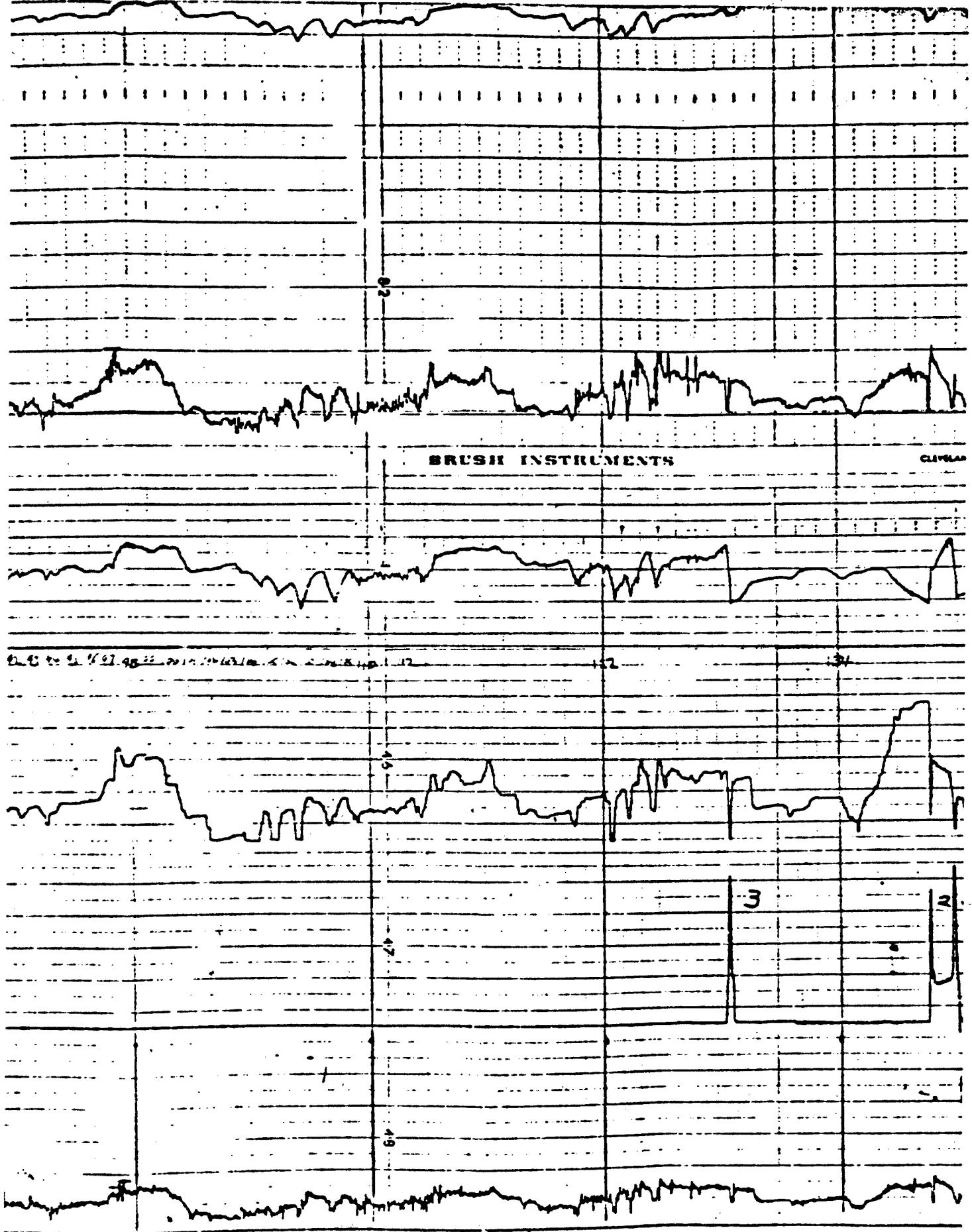












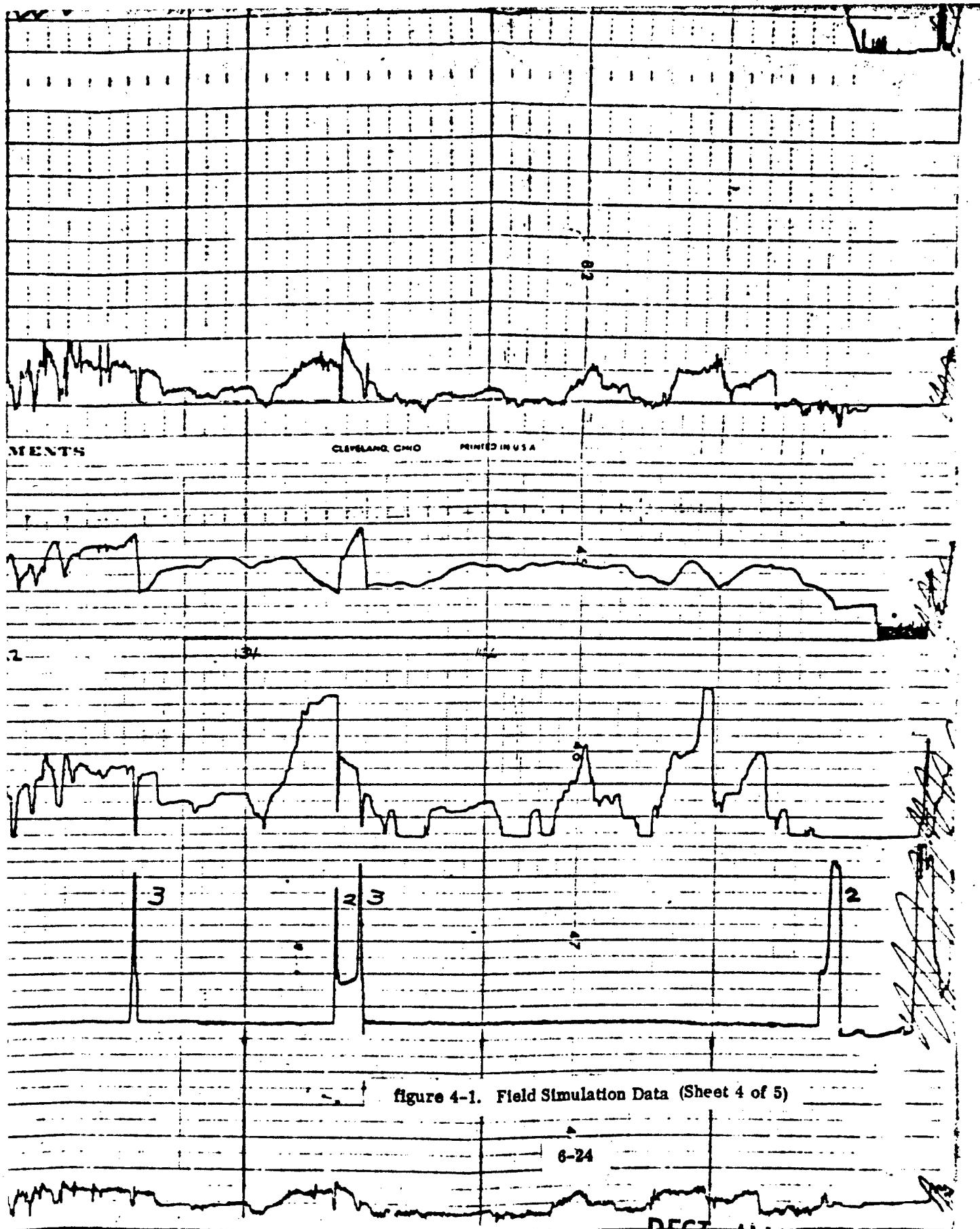
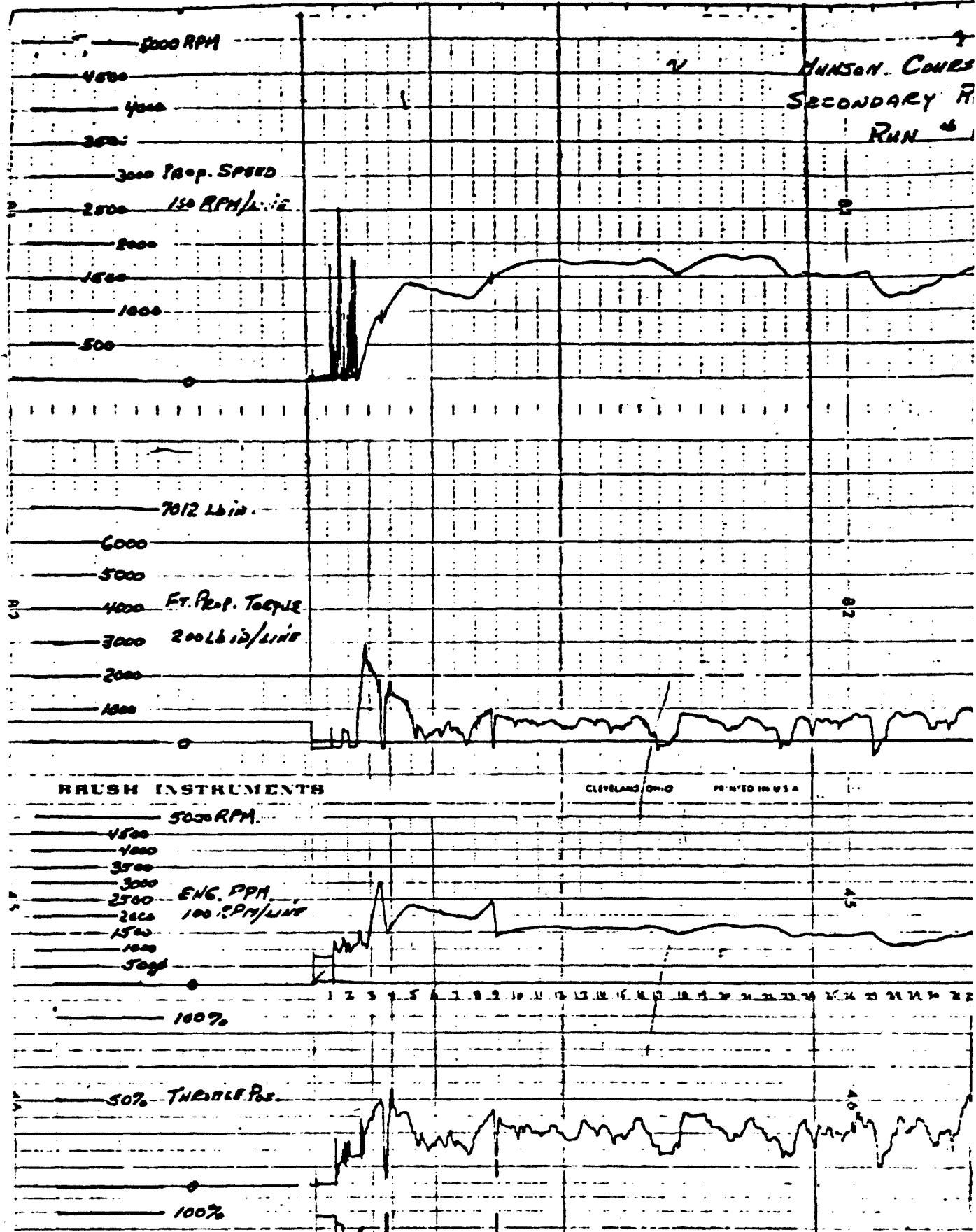
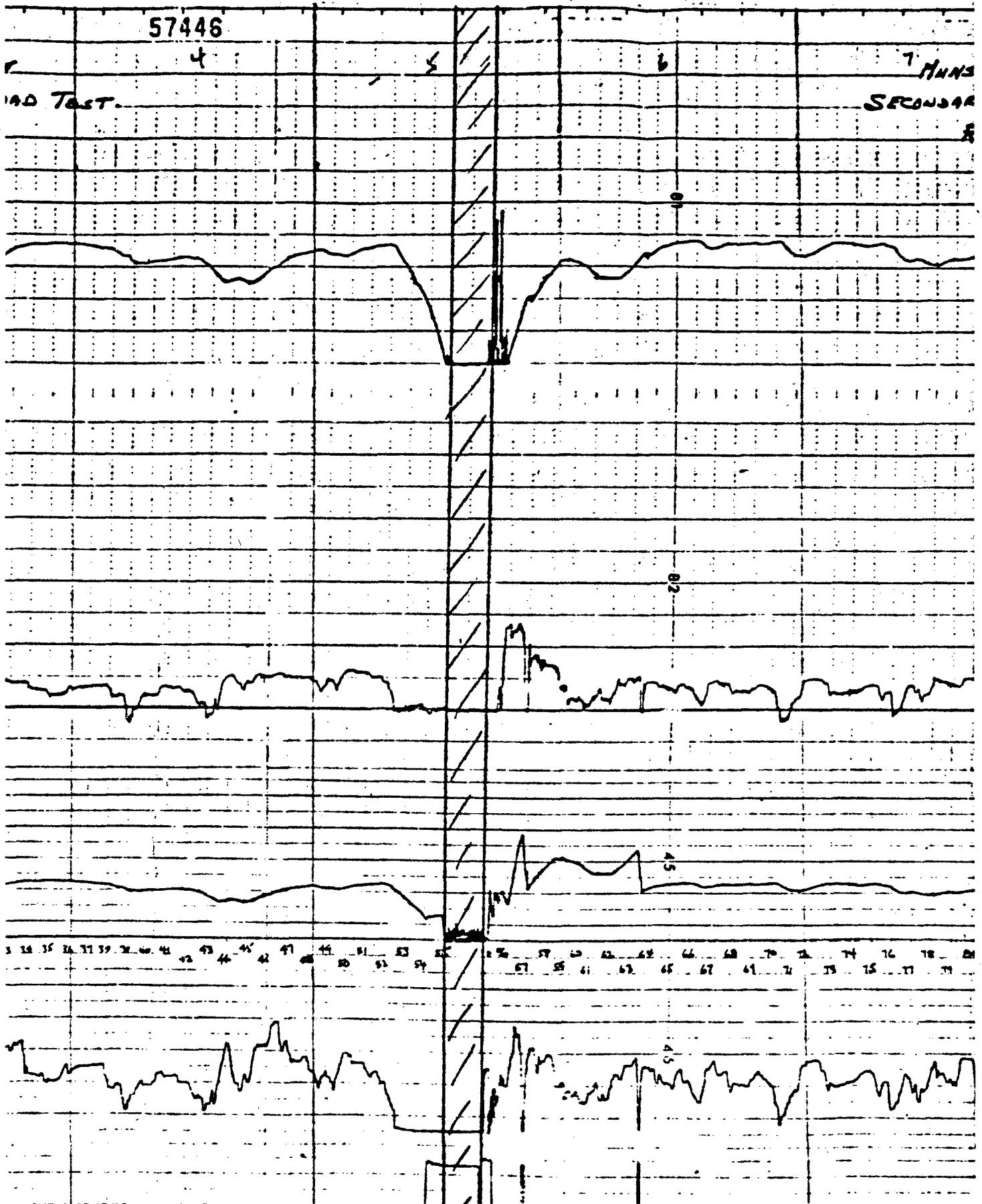


figure 4-1. Field Simulation Data (Sheet 4 of 5)

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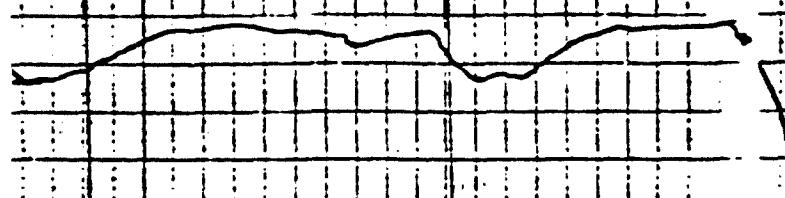
57447

4-COURSE 8

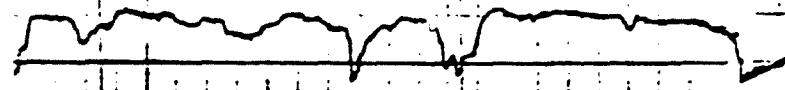
1. Rear Test

242

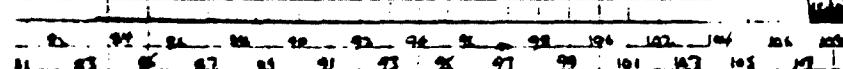
REAR 1



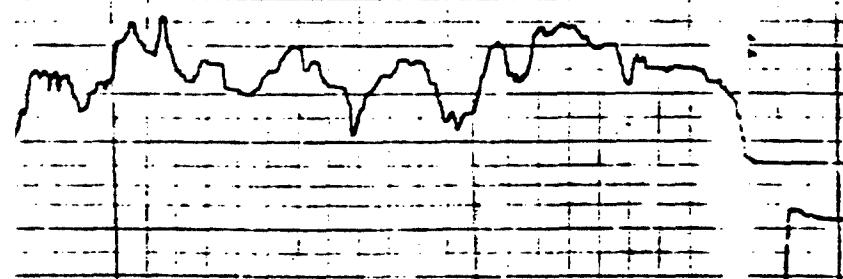
REAR



BRUSH INSTRUMENTS



ENGINE



THRO

4

57448

EAP - M151 TEST

AT APG.

REEL #1.

REAR PROPSHAFT SPEED SECONDARY LOAD TEST.

RECORDED 12-6-73.

AMB TEMP = 45°F

REAR PROPSHAFT TORQUE.

8

CLEVELAND OHIO PRINTED IN USA

ENGINE RPM.

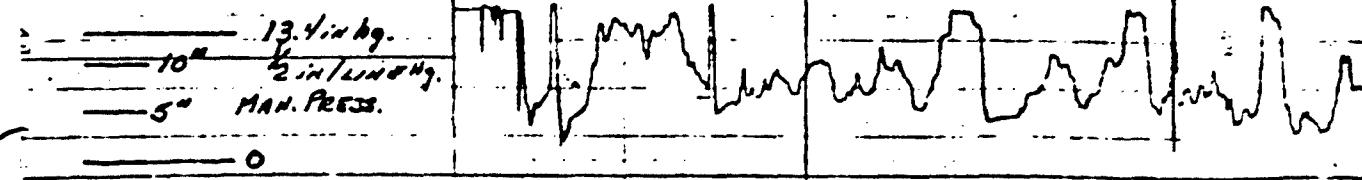
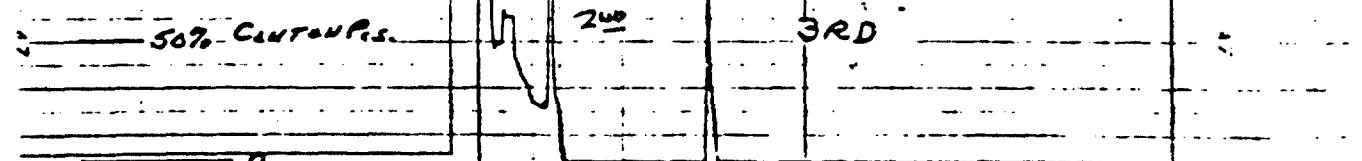
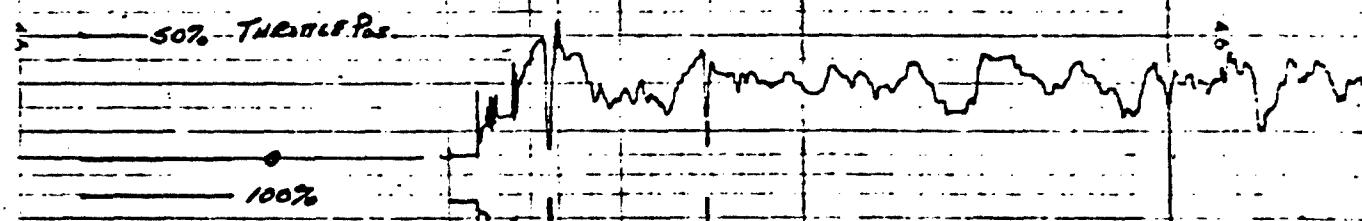
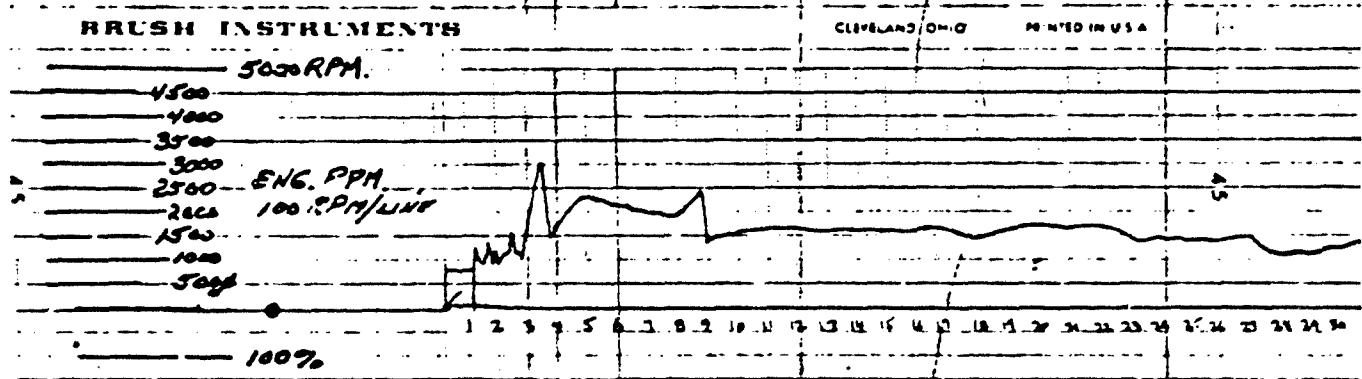
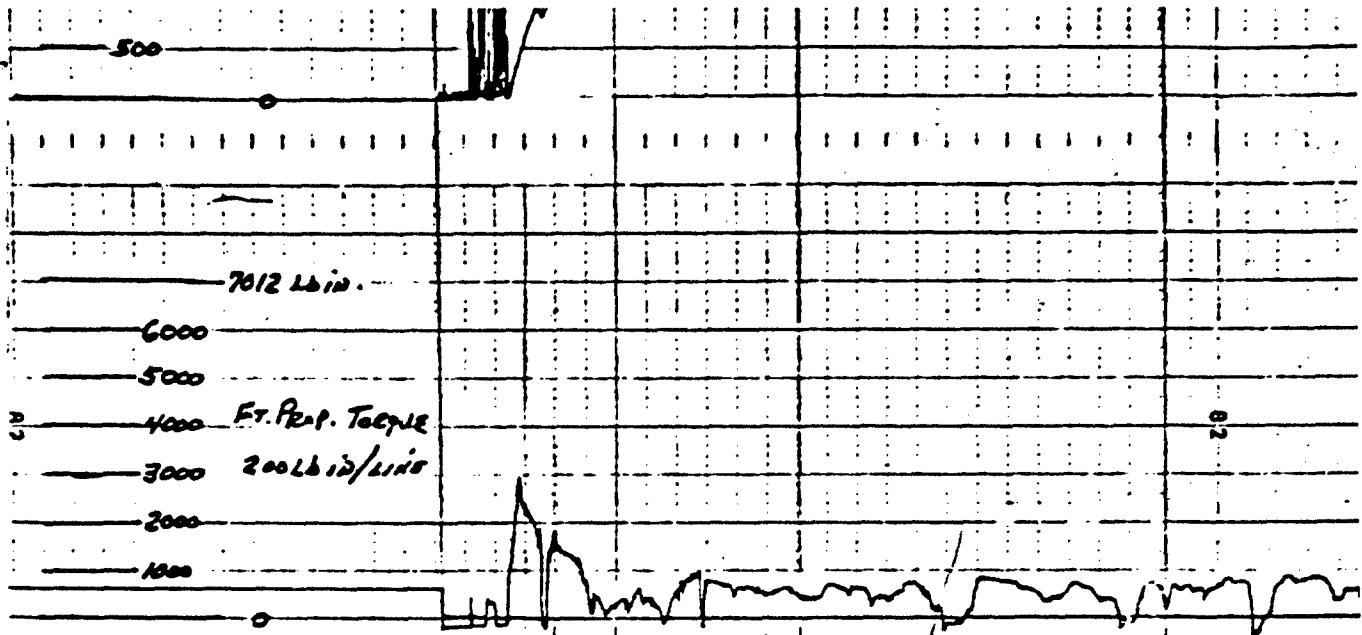
8

THROTTLE POS.

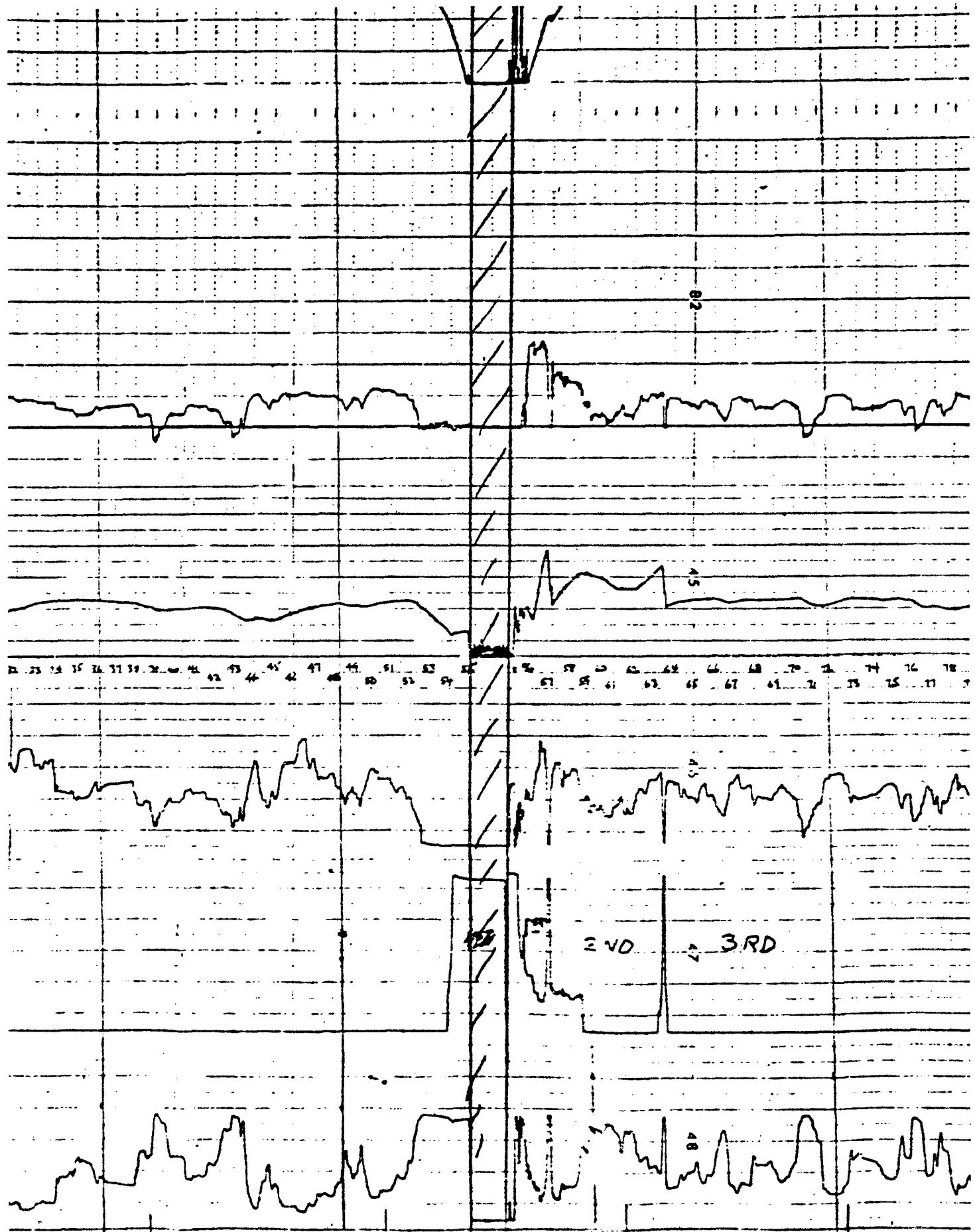
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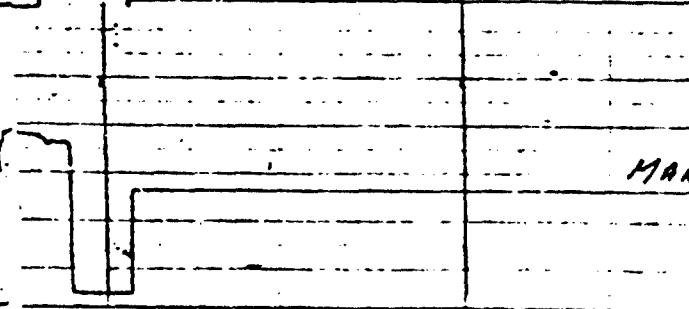
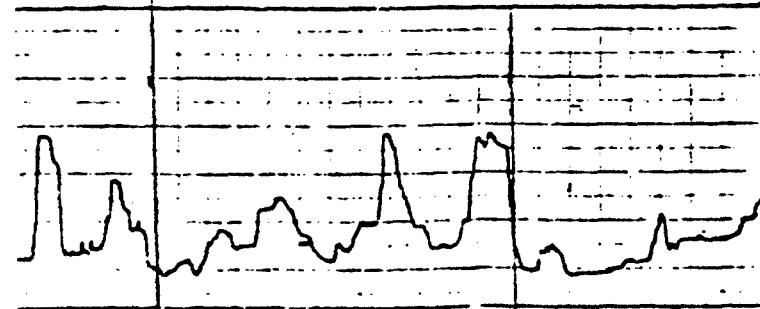
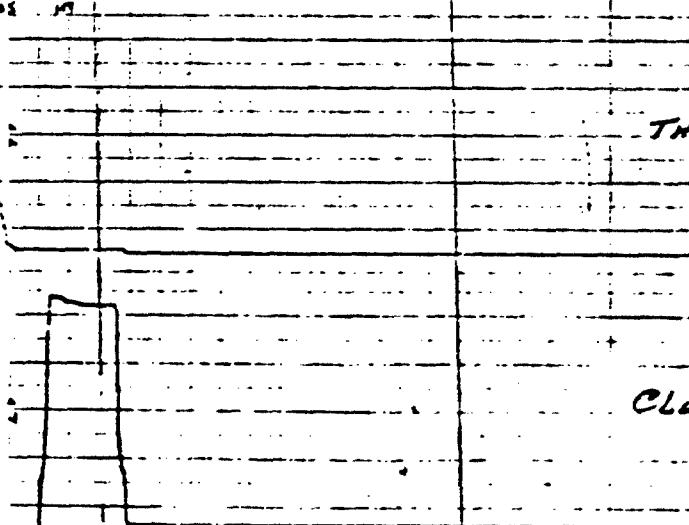
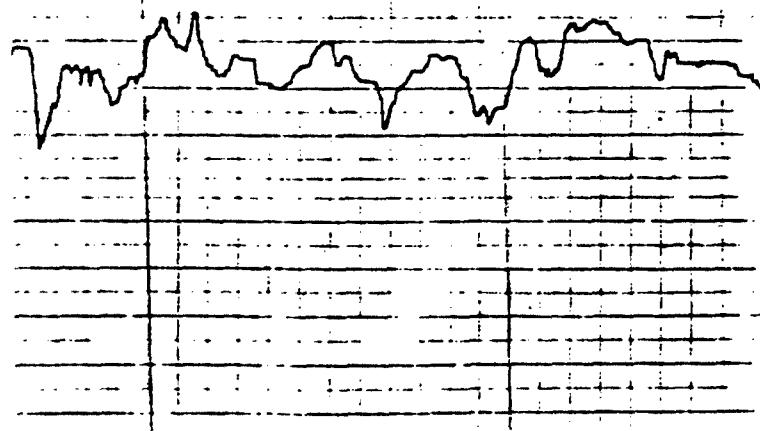
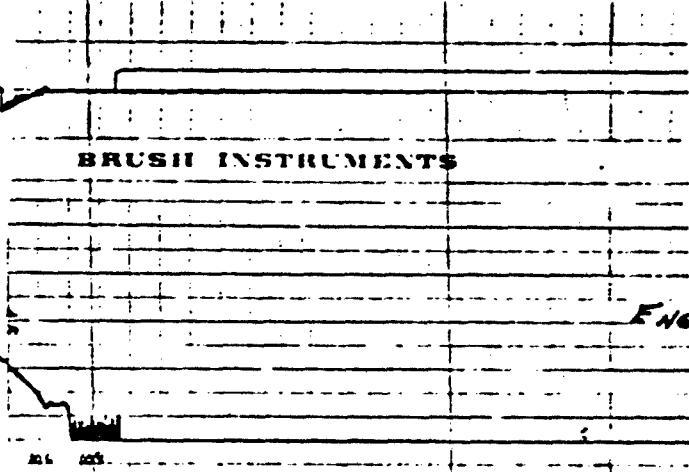
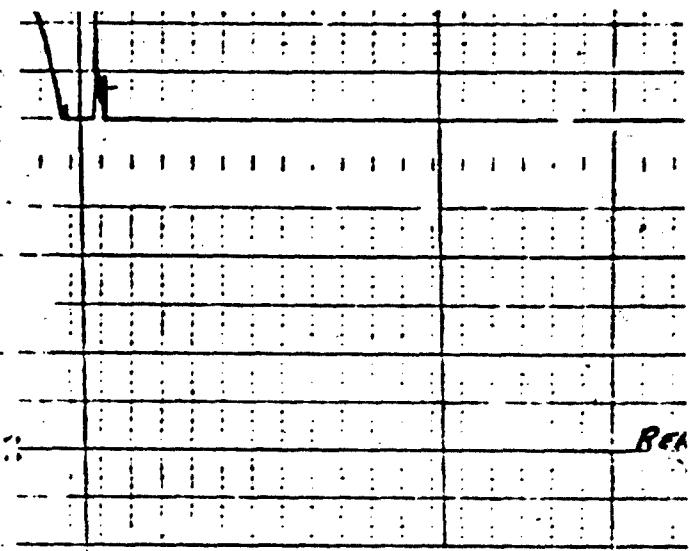
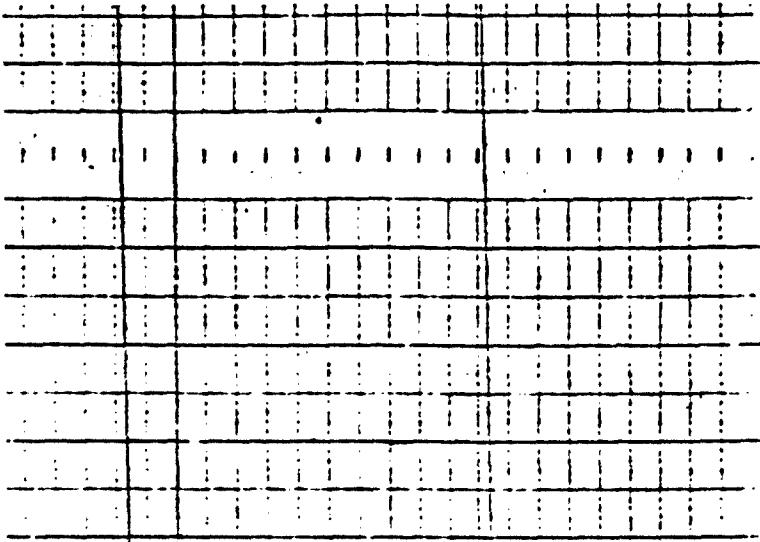
CLUTCH POS.

8



5





BRUSH INSTRUMENTS

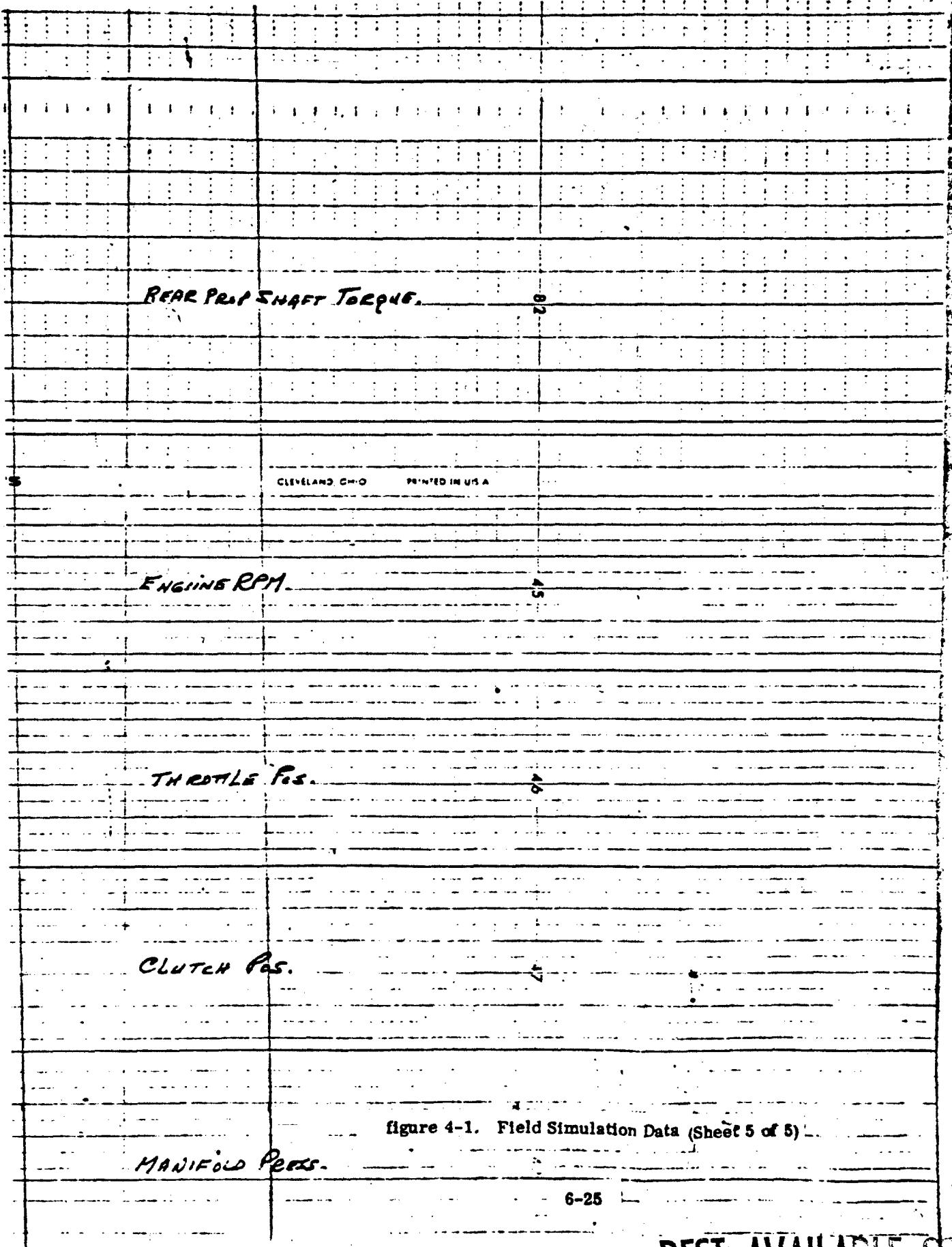
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DATA REDUCTION WORKSHEET
LEVEL CROSS COUNTRY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
900	0	2ND	3.179	0
1750	60	2ND	3.179	18.87
2400	50	2ND	3.179	15.73
1000	80	2ND	3.179	25.17
2000	80	2ND	3.179	25.17
1650	80	2ND	3.179	25.17
2450	60	2ND	3.179	18.87
2000	80	2ND	3.179	25.17
2200	90	2ND	3.179	28.31
2300	60	2ND	3.179	18.87
1900	70	2ND	3.179	22.02
1100	98	2ND	3.179	30.83
1700	60	2ND	3.179	18.87
1900	50	2ND	3.179	15.73
1800	55	2ND	3.179	17.30
1500	100	2ND	3.179	31.46
1400	25	2ND	3.179	7.86
2000	40	2ND	3.179	12.58
2100	30	2ND	3.179	9.44
2100	25	2ND	3.179	7.86
1900	40	2ND	3.179	12.58
1700	75	2ND	3.179	23.59
1500	25	2ND	3.179	7.86
1250	75	2ND	3.179	23.59

figure 5-1. Level Cross Country Data Reduction Worksheet (Sheet 1 of 5)

DATA REDUCTION WORKSHEET
LEVEL CROSS COUNTRY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1650	50	2ND	3.179	15.73
1800	50	2ND	3.179	15.73
2250	50	2ND	3.179	15.73
1500	38	2ND	3.179	11.95
2100	25	2ND	3.179	7.86
2500	25	2ND	3.179	7.86
2500	38	2ND	3.179	11.95
2100	50	2ND	3.179	15.73
1750	50	2ND	3.179	15.73
1800	0	2ND	3.179	0
2250	35	2ND	3.179	11.01
2250	25	2ND	3.179	7.86
2400	30	2ND	3.179	9.44
2400	38	2ND	3.179	11.95
1800	15	2ND	3.179	4.72
1900	25	2ND	3.179	7.86
2200	25	2ND	3.179	7.86
2000	50	2ND	3.179	15.73
1600	0	2ND	3.179	0
2250	50	2ND	3.179	15.73
2500	50	2ND	3.179	15.73
2600	50	2ND	3.179	15.73
2400	0	2ND	3.179	0

figure 5-1. Level Cross Country Data Reduction Worksheet (Sheet 2 of 5)

DATA REDUCTION WORKSHEET
LEVEL CROSS COUNTRY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1750	0	2ND	3.179	0
1800	50	2ND	3.179	15.73
2250	45	2ND	3.179	14.16
2250	25	2ND	3.179	7.86
2250	40	2ND	3.179	12.58
2400	40	2ND	3.179	12.58
2600	30	2ND	3.179	9.44
2600	25	2ND	3.179	7.86
2250	30	2ND	3.179	9.44
1500	0	2ND	3.179	0
2000	75	2ND	3.179	23.59
2500	25	2ND	3.179	7.86
2600	20	2ND	3.179	6.29
2500	25	2ND	3.179	7.86
2500	10	2ND	3.179	3.16
2250	40	2ND	3.179	12.58
2100	45	2ND	3.179	14.16
1900	50	2ND	3.179	15.73
1800	0	2ND	3.179	0
2250	20	2ND	3.179	6.29
2250	40	2ND	3.179	12.58
2500	40	2ND	3.179	12.58
2400	45	2ND	3.179	14.16
2500	50	2ND	3.179	15.73

figure 5-1. Level Cross Country Data Reduction Worksheet (Sheet 3 of 5)

DATA REDUCTION WORKSHEET
LEVEL CROSS COUNTRY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
2600	50	2ND	3.179	15.73
2400	40	2ND	3.179	12.58
2500	25	2ND	3.179	7.86
2500	40	2ND	3.179	12.58
2250	40	2ND	3.179	12.58
2700	25	2ND	3.179	7.86
2250	75	2ND	3.179	23.59
2600	30	2ND	3.179	9.44
2250	50	2ND	3.179	15.73
2000	100	2ND	3.179	31.46
2250	100	2ND	3.179	31.46
2200	0	2ND	3.179	0
2000	50	2ND	3.179	15.73
2000	45	2ND	3.179	14.16
2100	35	2ND	3.179	11.01
2200	35	2ND	3.179	11.01
2250	25	2ND	3.179	7.86
2250	40	2ND	3.179	12.58
2500	50	2ND	3.179	15.73
2250	40	2ND	3.179	12.58
2000	25	2ND	3.179	7.86
2500	25	2ND	3.179	7.86
2500	10	2ND	3.179	3.15
2600	25	2ND	3.179	7.86

figure 5-1. Level Cross Country Data Reduction Worksheet (Sheet 4 of 5)

DATA REDUCTION WORKSHEET
LEVEL CROSS COUNTRY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
2250	50	2ND	3.179	15.73
2600	25	2ND	3.179	7.86
2500	50	2ND	3.179	15.73
2600	25	2ND	3.179	7.86
2700	25	2ND	3.179	7.86
2750	25	2ND	3.179	7.86
2750	25	2ND	3.179	7.86
2500	0	2ND	3.179	0
1800	(-) 25	2ND	3.179	7.86
1000	(-) 20	2ND	3.179	6.29
0	0	0	0	0

figure 5-1. Level Cross Country Data Reduction Worksheet (Sheet 5 of 5)

DATA REDUCTION WORKSHEET
SECONDARY ROADS

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
800	0	1ST	5.712	0
1200	30	1ST	5.712	5.25
1500	200	1ST	5.712	35.01
1700	160	2ND	3.179	50.33
2400	60	2ND	3.179	18.87
2100	25	2ND	3.179	7.86
2000	40	2ND	3.179	12.58
2000	50	2ND	3.179	15.73
1500	60	2ND	3.179	18.87
1600	50	3RD	1.674	29.87
1700	40	3RD	1.674	23.89
1700	30	3RD	1.674	17.92
1600	50	3RD	1.674	29.87
1600	50	3RD	1.674	29.87
1600	30	3RD	1.674	17.92
1600	50	3RD	1.674	29.87
1700	20	3RD	1.674	0
1500	50	3RD	1.674	29.87
1600	60	3RD	1.674	35.84
1750	40	3RD	1.674	23.89
1600	50	3RD	1.674	29.87
1750	25	3RD	1.674	14.93
1500	0	3RD	1.674	0
1500	50	3RD	1.674	29.87
1500	50	3RD	1.674	29.87
1500	50	3RD	1.674	29.87

figure 5-2. Secondary Roads Data Reduction Worksheet (Sheet 1 of 5)

DATA REDUCTION WORKSHEET
SECONDARY ROADS

ENGINE SPEED (RPM)	PROP. SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1500	50	3RD	1.674	0
1100	50	3RD	1.674	29.87
1100	60	3RD	1.674	35.84
1250	30	3RD	1.674	17.92
1400	40	3RD	1.674	23.89
1500	75	3RD	1.674	44.80
1700	70	3RD	1.674	41.82
1750	55	3RD	1.674	32.86
1800	40	3RD	1.674	23.89
1750	50	3RD	1.674	29.87
1750	50	3RD	1.674	29.87
1700	50	3RD	1.674	29.87
1500	30	3RD	1.674	0
1500	0	3RD	1.674	0
1500	25	3RD	1.674	14.93
1500	50	3RD	1.674	29.87
1300	(-) 25	3RD	1.674	0
1200	80	3RD	1.674	47.79
1100	70	3RD	1.674	41.82
1400	75	3RD	1.674	44.80
1500	80	3RD	1.674	47.79
1600	75	3RD	1.674	44.80
1600	75	3RD	1.674	44.80
1600	100	3RD	1.674	59.74
1700	95	3RD	1.674	56.75

figure 5-2. Secondary Roads Data Reduction Worksheet (Sheet 2 of 5)

DATA REDUCTION WORKSHEET
SECONDARY ROADS

ENGINE SPEED (RPM)	PROP. SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1750	75	3RD	1.674	44.80
1250	0	3RD	1.674	0
700	0	3RD	1.674	0
750	0	3RD	1.674	0
1500	225	1ST	5.712	39.39
2500	220	1ST	5.712	38.52
2300	115	2ND	3.179	36.17
2600	60	2ND	3.179	18.87
2600	25	2ND	3.179	7.86
2250	10	2ND	3.179	3.15
2150	25	2ND	3.179	7.86
2500	75	2ND	3.179	23.59
1700	70	3RD	1.674	41.82
1750	50	3RD	1.674	29.87
1750	50	3RD	1.674	29.87
1700	70	3RD	1.674	41.82
1750	50	3RD	1.674	29.87
1750	50	3RD	1.674	29.87
1750	50	3RD	1.674	29.87
1500	25	3RD	1.674	14.93
1600	75	3RD	1.674	44.80
1750	50	3RD	1.674	29.87
1750	50	3RD	1.674	29.87
1750	70	3RD	1.674	41.82
1650	40	3RD	1.674	23.89

figure 5-2. Secondary Roads Data Reduction Worksheet (Sheet 3 of 5)

DATA REDUCTION WORKSHEET
SECONDARY ROADS

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1500	60	3RD	1.674	35.84
1400	60	3RD	1.674	35.84
1500	70	3RD	1.674	41.82
1500	75	3RD	1.674	44.80
1250	25	3RD	1.674	14.93
1200	75	3RD	1.674	44.80
1250	30	3RD	1.674	17.92
1400	60	3RD	1.674	35.84
1600	75	3RD	1.674	44.80
1750	75	3RD	1.674	44.80
1750	75	3RD	1.674	44.80
1750	50	3RD	1.674	29.87
1750	60	3RD	1.674	35.84
1750	75	3RD	1.674	44.80
1600	10	3RD	1.674	5.97
1700	60	3RD	1.674	35.84
1700	75	3RD	1.674	44.80
1500	15	3RD	1.674	8.96
1300	10	3RD	1.674	5.97
1250	90	3RD	1.674	53.76
1250	75	3RD	1.674	44.80
1600	90	3RD	1.674	53.76
1750	80	3RD	1.674	47.79
1750	60	3RD	1.674	35.84
1800	75	3RD	1.674	44.80

figure 5-2. Secondary Roads Data Reduction Worksheet (Sheet 4 of 5)

DATA REDUCTION WORKSHEET
SECONDARY ROADS

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1800	75	3RD	1.674	44.80
1800	60	3RD	1.674	35.84
1500	(-) 25	3RD	1.674	0
800	(-) 15	3RD	1.674	0
800	(-0-)	3RD	1.674	0
0	0	0	0	0

figure 5-2. Secondary Roads Data Reduction Worksheet (Sheet 5 of 5)

L-141 DATA REDUCTION WORKSHEET
HILLY CROSS COUNTRY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
800	0	0	0	0
1700	175	1	5.712	30.64
3500	100	3RD	1.674	59.74
2000	75	3RD	1.674	44.80
2250	87	3RD	1.674	51.97
2100	87	3RD	1.674	51.97
2200	85	3RD	1.674	50.78
2000	90	3RD	1.674	53.76
2250	62	3RD	1.674	37.04
2250	62	3RD	1.674	37.04
2200	75	3RD	1.674	44.80
2150	37	3RD	1.674	22.10
2250	30	3RD	1.674	17.92
1900	74	3RD	1.674	44.21
1700	-12	3RD	1.674	0
1800	25	3RD	1.674	14.93
1900	50	3RD	1.674	29.87
2000	15	3RD	1.674	8.96
1800	0	3RD	1.674	0
2000	0	3RD	1.674	0
2000	11	3RD	1.674	6.57
2000	75	3RD	1.674	44.80
1900	90	3RD	1.674	53.76

figure 5-3. Hilly Cross Country Data Reduction Worksheet (Sheet 1 of 5)

L-141 DATA REDUCTION WORKSHEET
HILLY CROSS COUNTRY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1900	95	3RD	1.674	56.75
2200	75	3RD	1.674	44.80
2300	20	3RD	1.674	11.95
2300	30	3RD	1.674	17.92
2400	50	3RD	1.674	29.87
2300	85	3RD	1.674	50.78
2300	75	3RD	1.674	44.80
2100	75	3RD	1.674	44.80
2100	75	3RD	1.674	44.80
2250	40	3RD	1.674	23.90
2200	30	3RD	1.674	17.92
2100	0	3RD	1.674	0
2450	0	3RD	1.674	0
2400	32	3RD	1.674	19.12
2250	75	3RD	1.674	44.80
2000	37	3RD	1.674	22.10
2000	87	3RD	1.674	51.97
2300	50	3RD	1.674	29.87
2400	37	3RD	1.674	22.10
2300	75	3RD	1.674	44.80
2100	75	3RD	1.674	44.80
1500	37	3RD	1.674	22.10
1500	25	3RD	1.674	14.93
2000	25	3RD	1.674	14.93

figure 5-3. Hilly Cross Country Data Reduction Worksheet (Sheet 2 of 5)

L-141 DATA REDUCTION WORKSHEET
HILLY CROSS COUNTRY

ENGINE SPEED (RPM)	PROP. SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
2100	25	3RD	1.674	14.93
2200	25	3RD	1.674	14.93
2300	25	3RD	1.674	14.93
2300	37	3RD	1.674	22.10
2300	25	3RD	1.674	14.93
2300	37	3RD	1.674	22.10
2300	25	3RD	1.674	14.93
2300	50	3RD	1.674	29.87
2450	65	3RD	1.674	38.83
2500	62	3RD	1.674	37.04
1700	62	3RD	1.674	37.04
2500	-12	2ND	3.179	0
2500	-12	2ND	3.179	0
2400	-12	2ND	3.179	0
1800	0	2ND	3.179	0
1700	0	2ND	3.179	0
1800	25	2ND	3.179	7.86
1750	25	2ND	3.179	7.86
1700	0	2ND	3.179	0
1750	0	2ND	3.179	0
1700	25	2ND	3.179	7.86
2000	25	2ND	3.179	7.86
1500	62	2ND	3.179	19.56
1800	48	2ND	3.179	15.10

figure 5-3. Hilly Cross Country Data Reduction Worksheet (Sheet 3 of 5)

**L-141 DATA REDUCTION WORKSHEET
HILLY CROSS COUNTRY**

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
2250	50	2ND	3.179	15.72
2000	-12	2ND	3.179	0
2300	50	2ND	3.179	15.72
2300	37	2ND	3.179	11.63
1800	100	2ND	3.179	31.45
1500	0	2ND	3.179	0
2000	140	2ND	3.179	44.03
2200	75	2ND	3.179	23.59
1800	62	2ND	3.179	19.50
2000	62	2ND	3.179	19.50
2000	75	2ND	3.179	23.59
3000	75	2ND	3.179	23.59
2800	87	2ND	3.179	27.36
2900	105	2ND	3.179	33.03
3000	62	2ND	3.179	19.50
2200	-50	2ND	3.179	0
2000	-35	2ND	3.179	0
2900	-37	2ND	3.179	0
1700	-35	2ND	3.179	0
2000	-25	2ND	3.179	0
2300	25	2ND	3.179	7.86
2300	25	2ND	3.179	7.86
2400	0	2ND	3.179	0
2500	25	2ND	3.179	7.86

figure 5-3. Hilly Cross Country Data Reduction Worksheet (Sheet 4 of 5)

L-141 DATA REDUCTION WORKSHEET
HILLY CROSS COUNTRY

ENGINE SPEED (RPM)	PROP. SHAFT TORQUE (FT. LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT. LB.)
2300	50	2ND	3.179	15.72
2500	100	2ND	3.179	31.45
3250	100	2ND	3.179	31.45
3000	137	2ND	3.179	43.10
3200	75	2ND	3.179	23.59
2500	0	2ND	3.179	0
2450	-12	2ND	3.179	0
2600	-12	2ND	3.179	0
2300	-37	2ND	3.179	0
2700	-25	2ND	3.179	0
2000	37	2ND	3.179	11.63
1500	0	2ND	3.179	0
2400	-25	2ND	3.179	0
2100	50	2ND	3.179	15.72
2000	25	2ND	3.179	7.86
2100	25	2ND	3.179	7.86
2200	25	2ND	3.179	7.86

figure 5-3. Hilly Cross Country Data Reduction Worksheet (Sheet 5 of 5)

DATA REDUCTION WORKSHEET

HIGHWAY

ENGINE SPEED (RPM)	PROP. SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
1500	75	2ND	3.179	23.59
1000	190	2ND	3.179	59.76
1750	150	3RD	1.674	89.61
3000	140	3RD	1.674	83.63
2000	90	4TH	1.0	90.00
2250	90	4TH	1.0	90.00
2500	90	4TH	1.0	90.00
2600	90	4TH	1.0	90.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	80	4TH	1.0	80.00
2700	85	4TH	1.0	85.00
2700	80	4TH	1.0	80.00
2700	80	4TH	1.0	80.00
2700	80	4TH	1.0	80.00
2700	80	4TH	1.0	80.00
2700	75	4TH	1.0	75.00
2700	80	4TH	1.0	80.00
2700	125	4TH	1.0	75.00
2700	100	4TH	1.0	75.00
2700	75	4TH	1.0	75.00

figure 5-4. Highway Data Reduction Worksheet (Sheet 1 of 2)

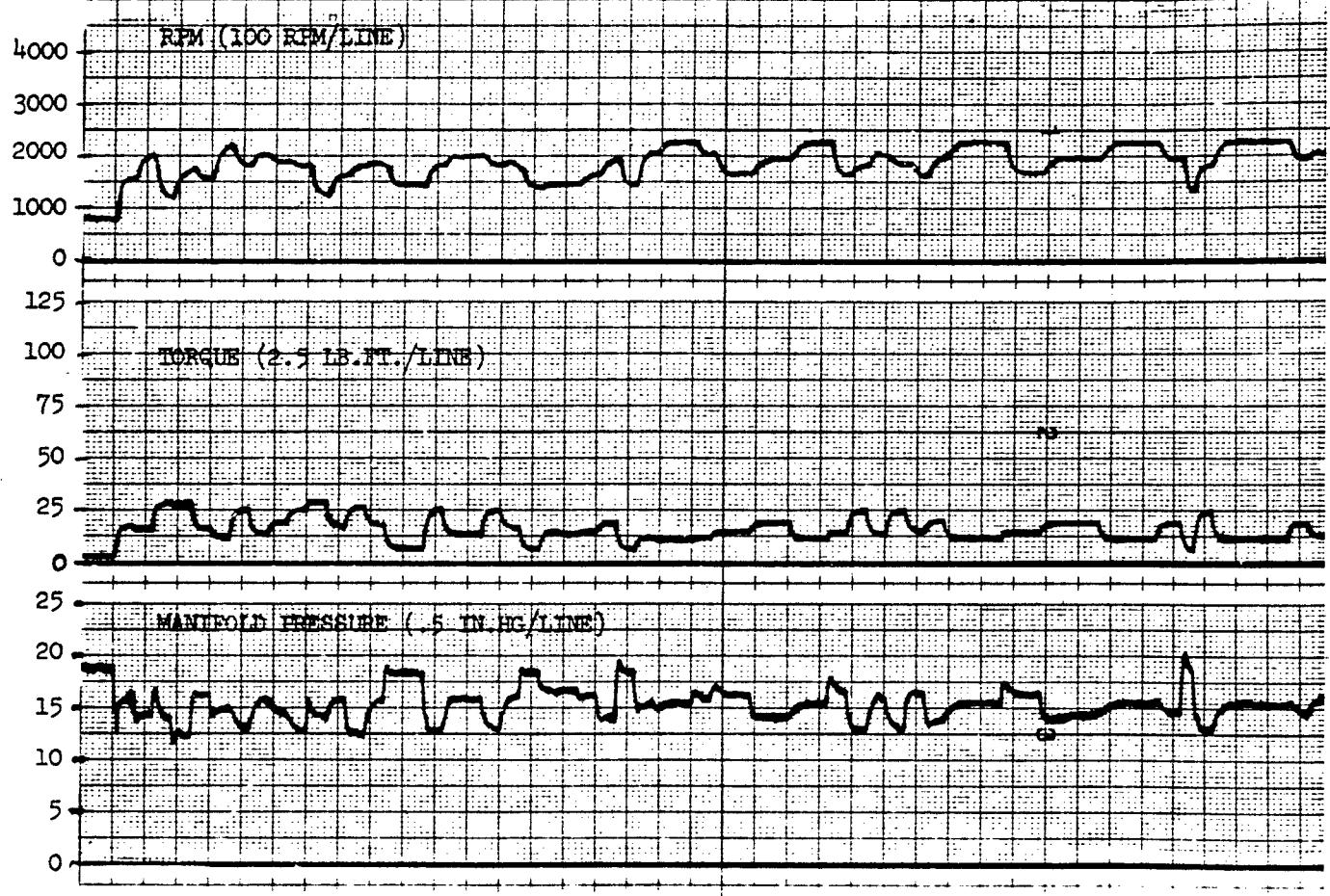
DATA REDUCTION WORKSHEET
COURSE HIGHWAY

ENGINE SPEED (RPM)	PROP.SHAFT TORQUE (FT.LB.)	VEHICLE GEAR	GEAR RATIO	ENGINE TORQUE (FT.LB.)
2700	75	4TH	1.0	75.00
2750	70	4TH	1.0	70.00
2700	75	4TH	1.0	75.00
2700	90	4TH	1.0	90.00
2700	80	4TH	1.0	80.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	80	4TH	1.0	80.00
2700	80	4TH	1.0	80.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
2700	75	4TH	1.0	75.00
1500	75	2ND	3.179	23.59
1000	190	2ND	3.179	59.76
1750	150	3RD	1.674	89.61
3000	140	3RD	1.674	83.63

figure 5-4. Highway Data Reduction Worksheet (Sheet 2 of 2)

LEVEL CROSS COUNTRY
(20 MM/SEC.)

BRUSH INSTRUMENTS DIVISION, GOULD INC. CLEV



L CROSS COUNTRY

D MM/SEC.)

ON, GOULD INC.

CLEVELAND, OHIO

PRINTED IN U.S.A.

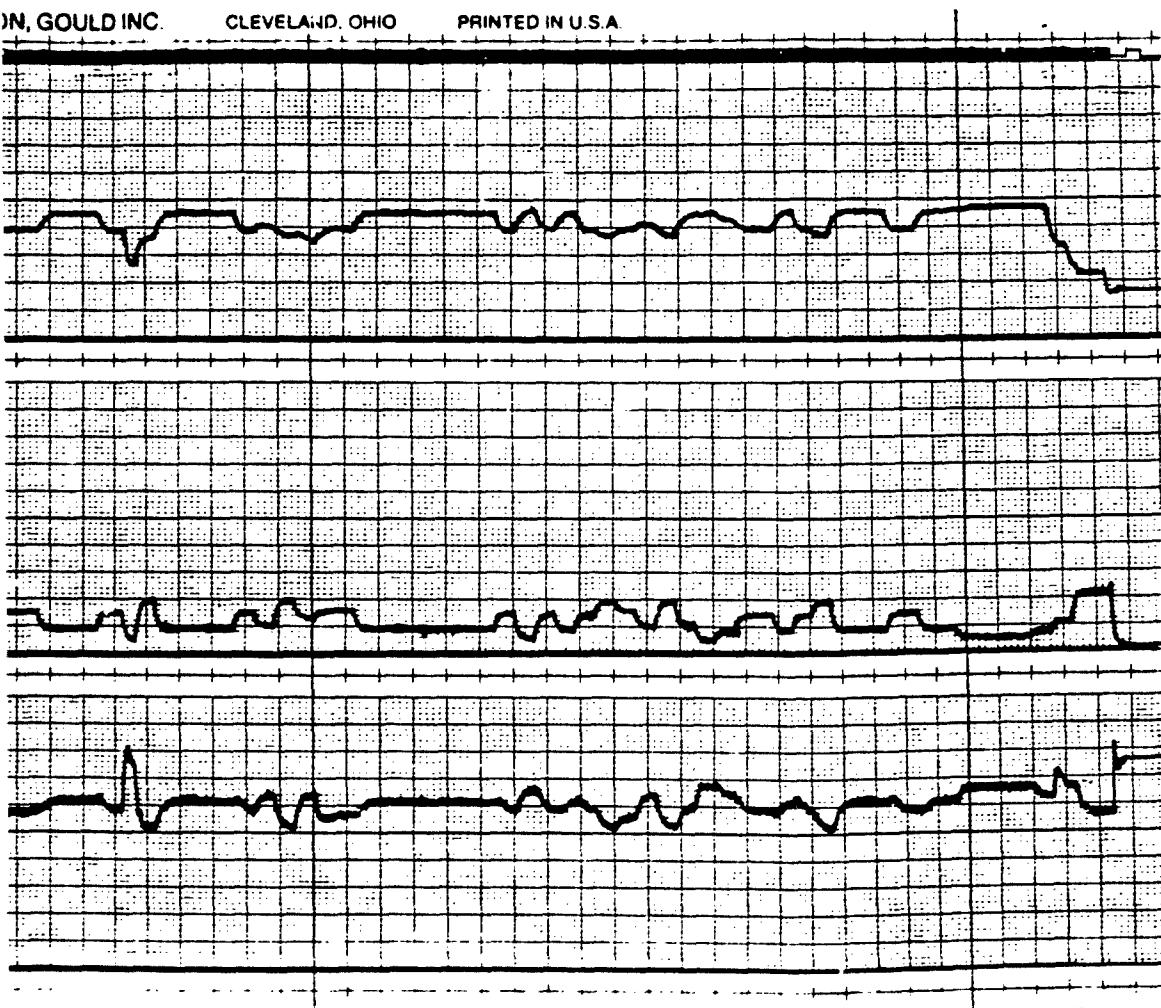
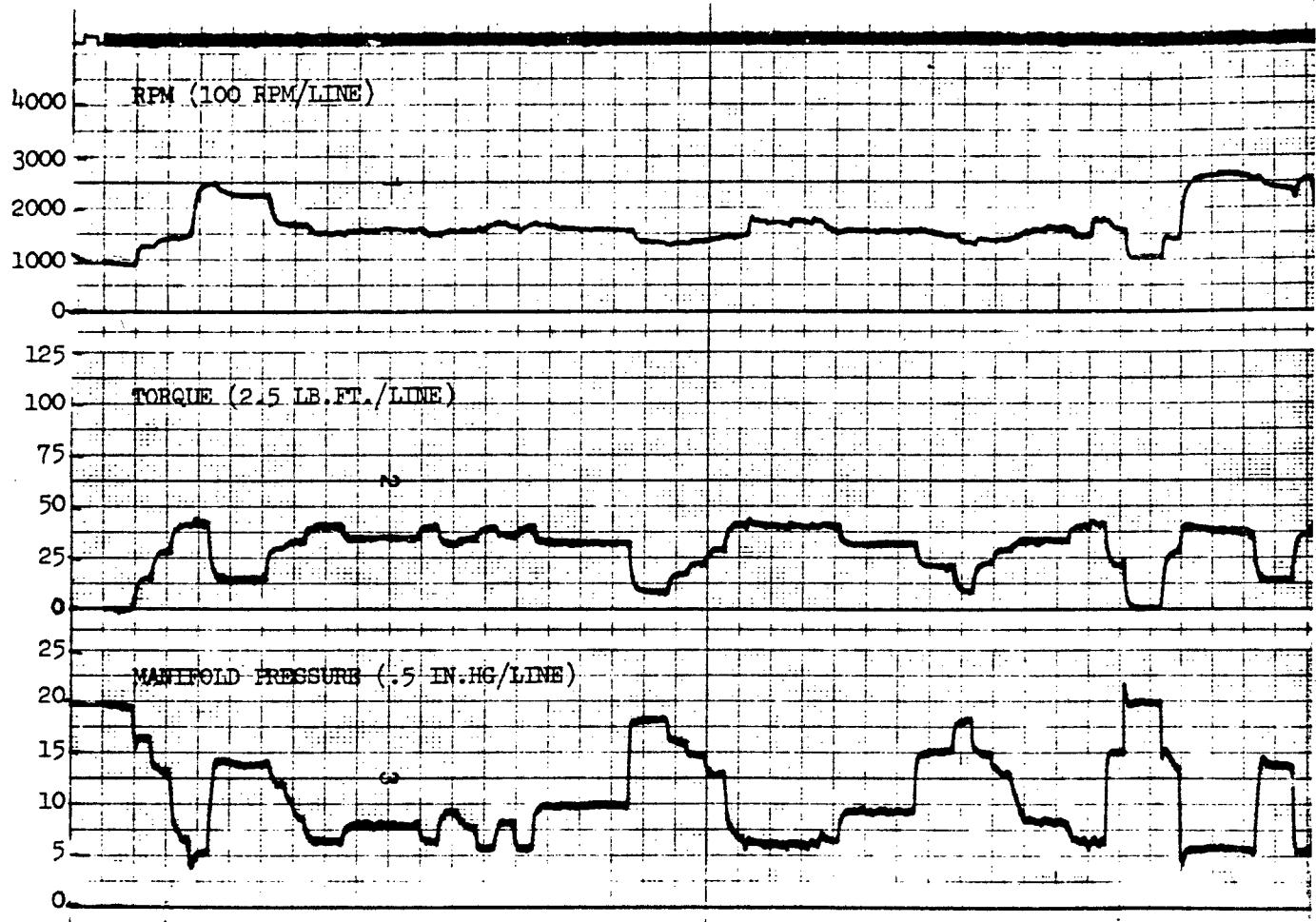


figure 6-1. Typical Continuous Strip Recording - Level Cross Country

SECONDARY ROADS
(20 MM/SEC.)



ONDARY ROADS
MM/SEC.)

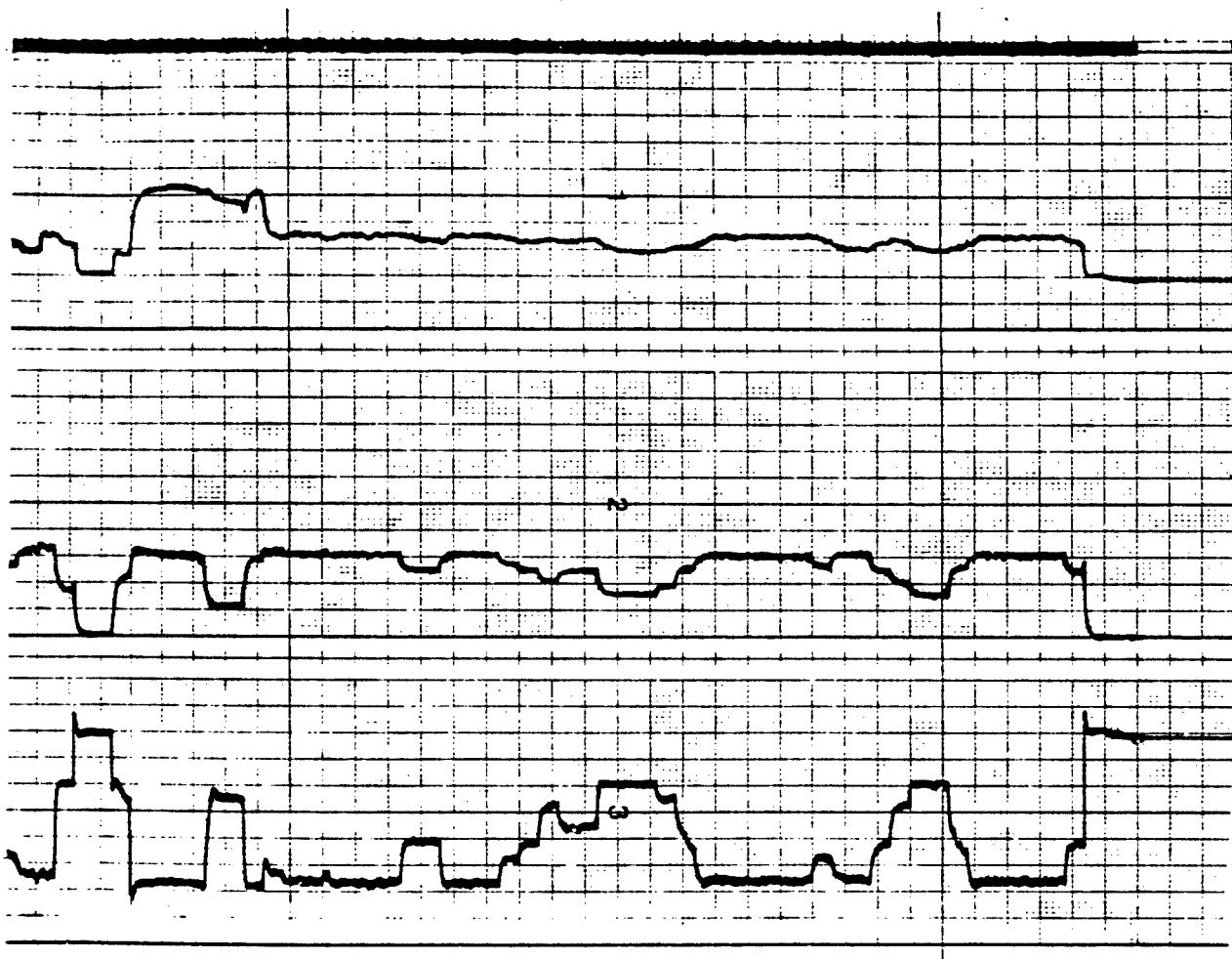
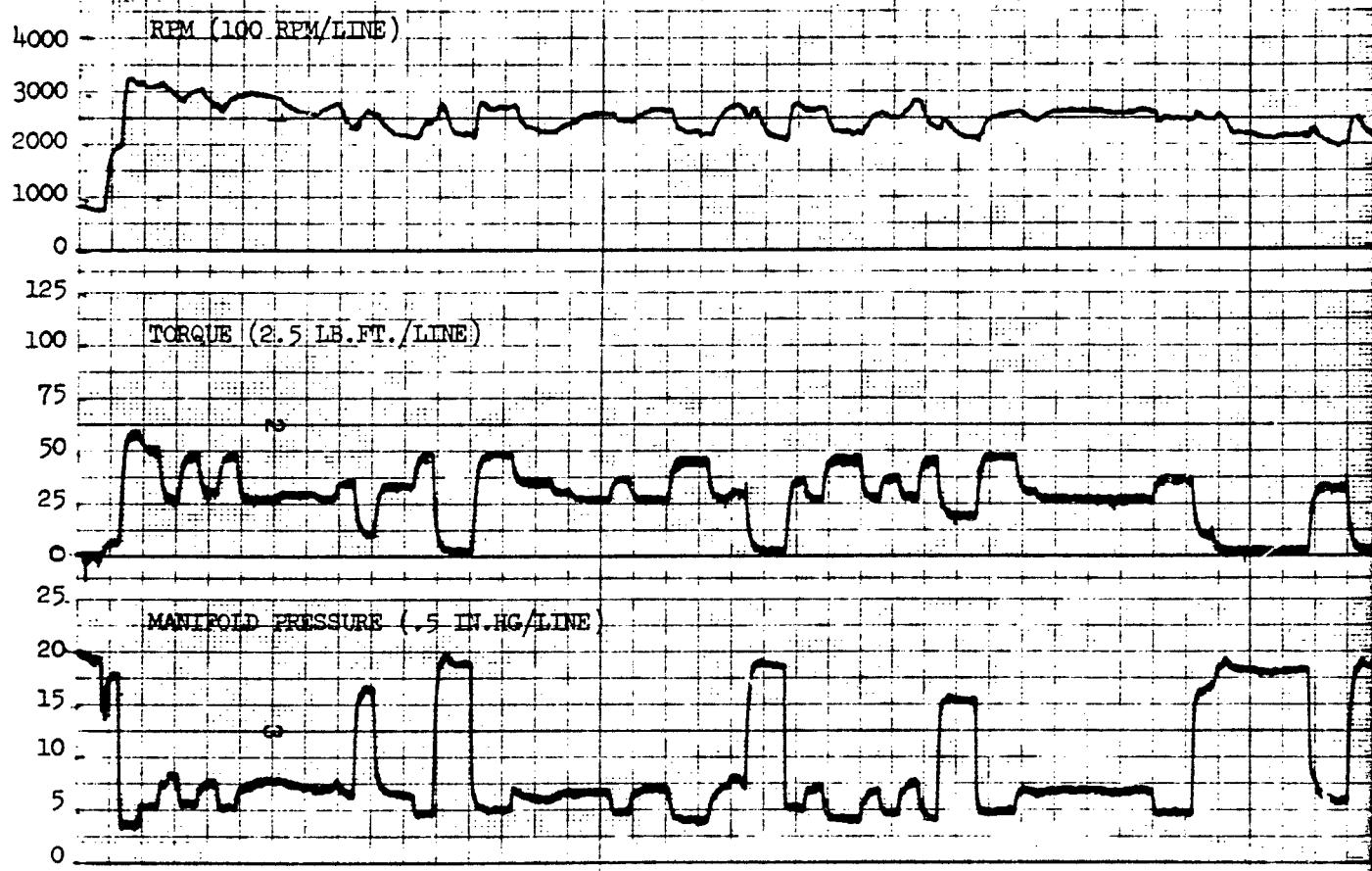


figure 6-2. Typical Continuous Strip Recording - Secondary Roads

HILLY CROSS COUNTRY
(20 MM/SEC.)

INSTRUMENTS DIVISION, GOULD INC CLEVELAND, OHIO PRIN. U.S.A.



BY

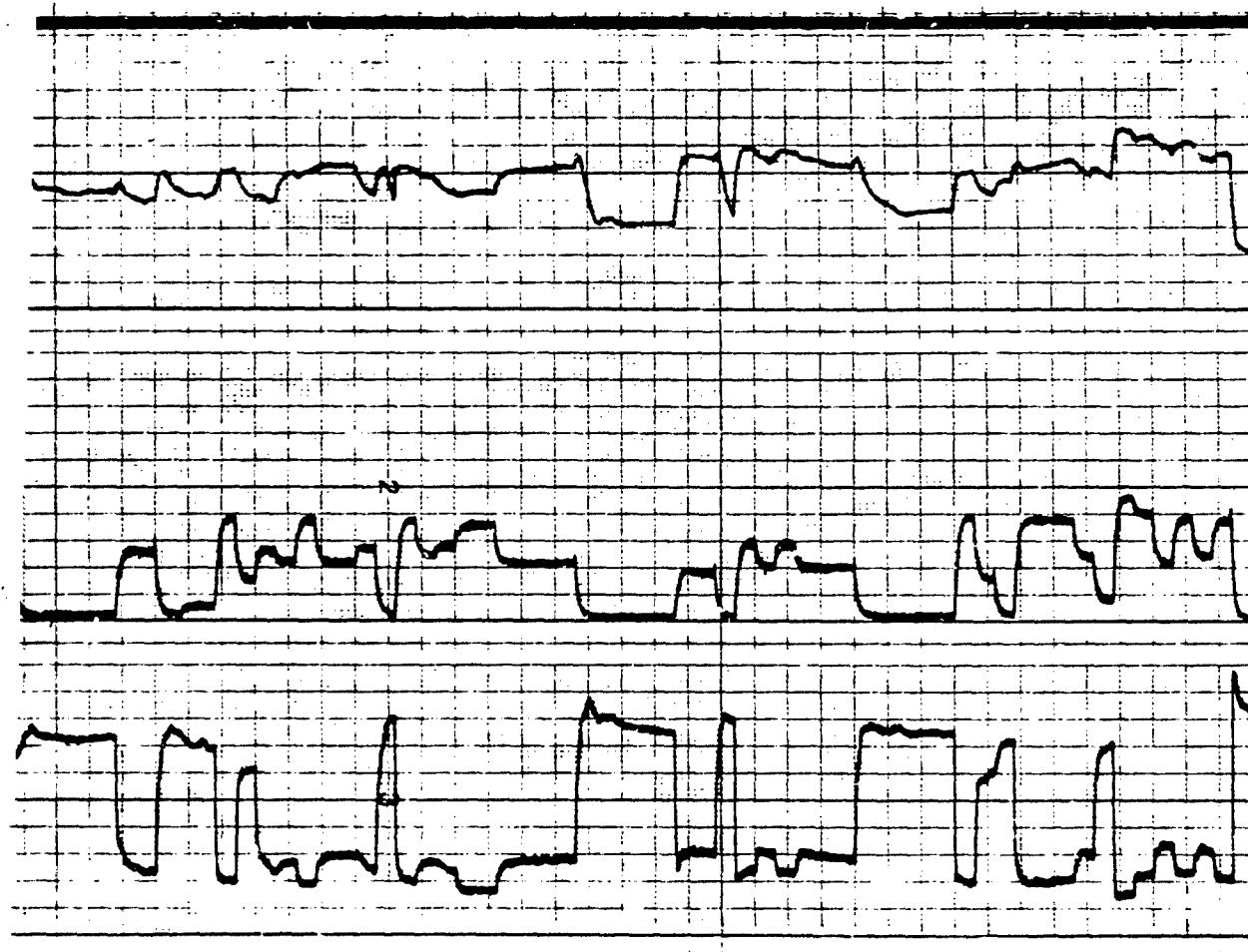


figure 6-3. Typical Continuous Strip Recording - Hilly Cross Country

HIGHWAY

(20 MM/SEC.)

BRUSH INSTRUMENTS DIVISION GOULD INC CLEVELAND

4000 RPM (100 KPM/LINE)

3000

2000

1000

0

125

100

75

50

25

0

TORQUE (2.5 LB.FT./LINE)

25

20

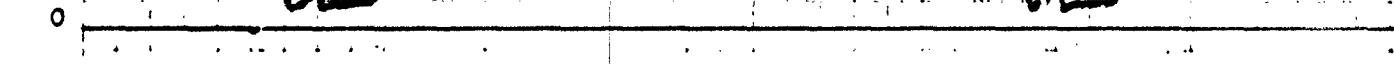
15

10

5

0

MANIFOLD PRESSURE (.5 IN.HG/LINE)



HIGHWAY
(20 MM/SEC.)

OML INC CLEVELAND, OHIO PRINTED IN U.S.A.

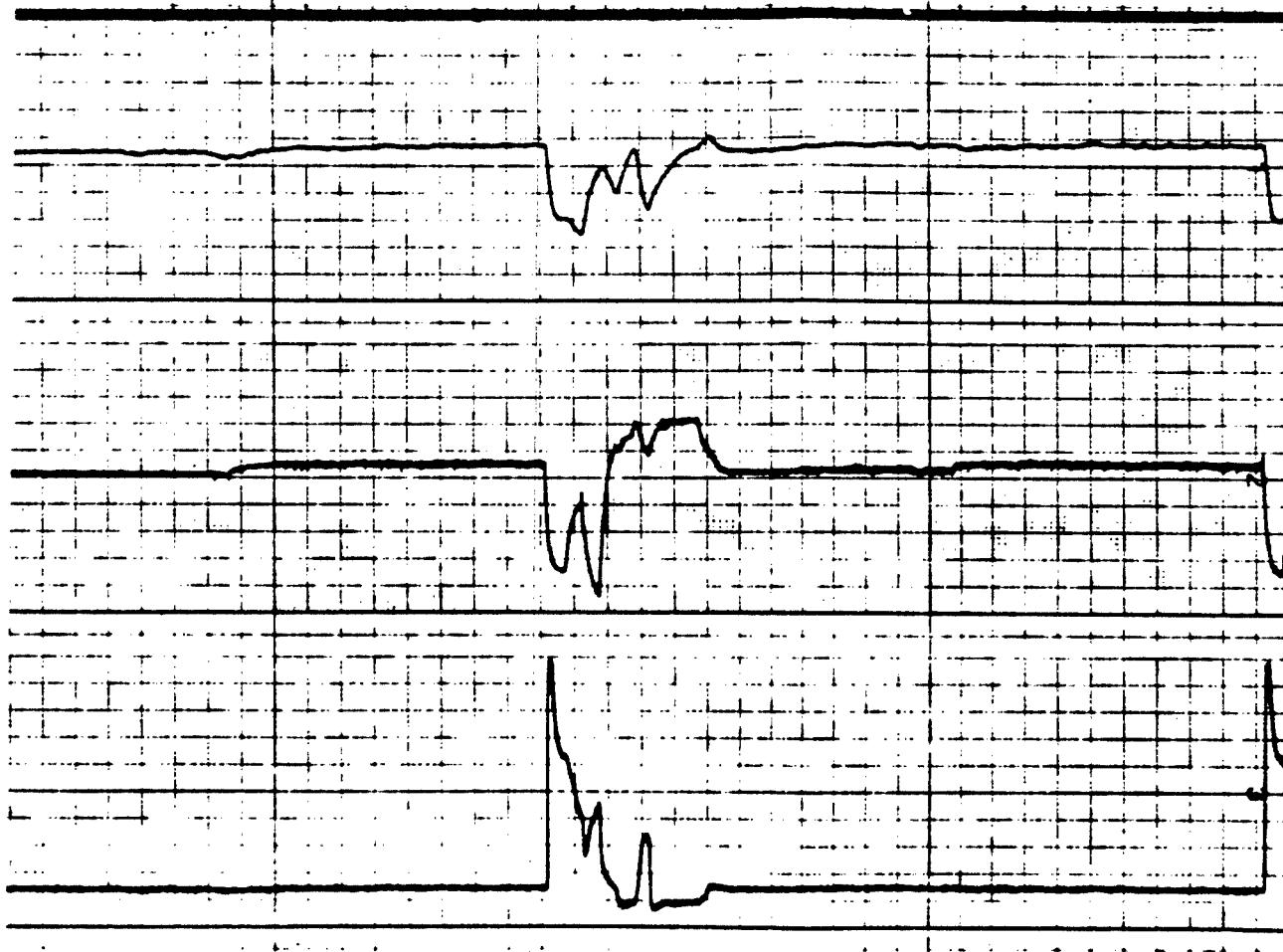


figure 6-4. Typical Continuous Strip Recording - Highway

COURSE:
INTERMEDIATE

L-141 ENGINE TEST DATA

GALLONS OF FUEL USED

figure 7-1. L-141 Engine Test Data

OPERATION DATA SUMMARY

<u>TERRAIN</u>	<u>MILEAGE</u>	<u>GALLONS FUEL CONSUMED</u>	<u>TIME (HOURS)</u>	<u>AVG.SPEED (MPH)</u>	<u>AVG.MPG.</u>
LEVEL CROSS COUNTRY	1,096	132.6	93.0	11.78	8.26
SECONDARY ROADS	1,274	103.9	78.0	16.33	12.25
HILLY CROSS COUNTRY	692	85.5	40.0	17.28	8.09
HIGHWAY	1,775	125.2	39.0	45.52	14.17
INTERMIDDED	5,163	486.6	298.3	17.31	10.61
SUMMARY	10,000	933.8	548.3	18.23	10.7

figure 8-1. Operation Data Summary



40 MARIETTA ST. N.W. 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 822-7388

355 KING ST. WEST
TORONTO 135, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL. GAS

SAMPLE DATA	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE. SIUM	MO		SILI. CON		TIN		VISC	SLUDGE	PA.
	PISTONS REARINGS		RINGS		CYLINDER BRAINS CRANK SH CAM SHA	GASKETS SPRING DISHES, BRASS		RINGS		DIRY (THUR. ALT. INTAKE)		BRASS		SAF		PA.
Date Sampled Sample # Lab/unit # Miles/hr. Since last Oil change	8-14-74 417655 56805 5.0 5.0	2 N	1 N	2 N	2 N	10 N	420 N	2 N		7 N		1 N		26 N	+2 N	
ALL WEAR METAL LEVELS WITHIN EXPECTED LIMITS. OVERALL ENGINE AND OIL CONDITION APPEAR SATISFACTORY.																
Date Sampled Sample # Lab/unit # Miles/hr. Since last Oil change	8-16-74 417656 56739 10 5	2 N	1 N	2 N	2 N	10 N	300 N	5 N		7 N		2 N		26 N	+2 N	
ESSENTIALLY LITTLE CHANGE IN WEAR TREND. ENGINE AND OIL CONDITION CONTINUE TO APPEAR SATISFACTORY.																
Date Sampled Sample # Lab/unit # hrs. Since last Oil change	8-16-74 417657 56934 15 10	2 N	1 N	4 N	3 N	10 N	1000 N	4 N		7 N		2 N		25 N	+3 N	
WEAR TREND STABILIZED. OVERALL ENGINE AND OIL CONDITION APPEARS SATISFACTORY.																
Date Sampled Sample # Lab/unit # Miles/hr. Since last Oil change	8-16-74 417658 56938 20 15	3 N	1 N	2 N	4 N	11 N	1000 N	4 N		7 N		3 N		24 N	+2 N	
WEAR TREND REMAINS STABLE. OVERALL ENGINE AND OIL CONDITION APPEARS SATISFACTORY.																
Date Sampled Sample # Lab/unit # hrs. Since last Oil change	8-17-74 417659 56932 25 20	2 N	1 N	2 N	4 N	10 N	1000 N	3 N		6 N		3 N		25 N	+3 N	
WEAR TREND REMAINS STABLE. OVERALL ENGINE AND OIL CONDITION APPEARS SATISFACTORY.																
Date Sampled Sample # Lab/unit # Miles/hr. Since last Oil change	8-19-74 417660 56924 30 25	2 N	1 N	3 N	4 N	10 N	1000 N	2 N		6 N		2 N		26 N	+3 N	
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.																
Normal A - Abnormal S - Severe																
K.D. LEWIS - MAIL DROP A-23 MICHIGAN DIVISION - LTV AEROSPACE P.O. BOX 909 WARREN, MICHIGAN 48090																
OIL MAKE & TYPE _____ HISTORY & REMARKS _____ 313-539-0300 extn: 596, 531																

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 1 of 17)



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7365

355 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1866

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL GA

SAMPLE DATA	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE SIUM	MO	SILI. CON	TIN	VISC.	SLUDGE	%
	Wear Bearings		RINGS	Wear Gears	Lubricant Friction Loss	Wear Shafts	Wear Bearings	Wear Shafts	Dilute Fusible Alloy Instant		Wear Bearings	Wear Shafts	
Date Sampled 8-19-74	2	1	1	3	10	1000	3			7	2	23	N +3
Sample # 417661	N	N	N	N	N	N	N		N	N		N	N
Lab/unit # 71079	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Miles/hr.	35												
Since last Oil change	30												
Date Sampled 8-20-74	2	1	2	3	12	1000	3			10	2	22	N +3
Sample # 417662	N	N	N	N	N	N	N		N	N		N	N
Lab/unit # 71052	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Miles/hr.	40												
Since last Oil change	35												
Date Sampled 8-20-74	2	1	3	4	12	1000	4			10	2	23	N +3
Sample # 417663	N	N	N	N	N	N	N		N	N		N	N
Lab/unit # 71073	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Miles/hr.	45												
Since last Oil change	40												
Date Sampled 8-20-74	3	1	3	3	13	1000	4			10	2	23	N +3
Sample # 417664	N	N	N	N	N	N	N		N	N		N	N
Lab/unit # 71076	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Miles/hr.	50												
Since last Oil change	45												
Date Sampled 8-21-74	3	1	2	4	12	1000	3			10	2	23	N +3
Sample # 417665	N	N	"	N	N	N	N		N	N		N	N
Lab/unit # 71059	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Miles/hr.	55												
Since last Oil change	50												
Date Sampled 8-21-74	2	1	2	4	10	1000	3			8	3	24	N +3
Sample # 417666	N	N	N	N	N	N	N		N	N		N	N
Lab/unit # 71136	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Miles/hr.	60												
Since last Oil change	55												
N - Normal A - Abnormal S - Severe		ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE SIUM	MO	SILI. CON	TIN	VISC.	SLUDGE

K.D. LEWIS - MAIL DROP A-23
MICHIGAN DIVISION - LTV AEROSPACE
P.O. BOX 909
WARREN, MICHIGAN 48090

OIL MAKE & TYPE _____

HISTORY & REMARKS LEVEL CROSS-COUNTRY

(313) 539-0300 extn: 596, 531

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 2 of 17)



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7385

388 KING ST. WEST
TORONTO 136, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL. GA

SAMPLE DATA	ALUM. INUM.	BOR. ON	CHRO. MIUM.	COP. PER	IRON	LEAD	MAGNE- SIUM	MO		SILI. CON		TIN		VISC	SLUDGE	OIL LEVEL
	PISTONS BEARINGS	RINGS	WHEELS	CYLINDER RINGS CRANE SH CAM SH	GASOLINE ADDITIVE DIESEL BEARINGS	RINGS		DIRT (THRU' AIR INTAKE)		BRASS		SAE		MM PP PP		
Date Sampled 8-21-74	3	1	2	4	10	1000	3			8		4		23	N	+3
Sample # 417667	N	N	N	N	N	N	N			N		N			N	
Lab/unit # 71131	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.															
Miles/hr. 65																
Since last oil change 60																
Date Sampled 8-22-74	2	1	2	5	11	1000	3			7		3		23	N	+4
Sample # 417668	N	N	N	N	N	N	N			N		N			N	
Lab/unit # 71138	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.															
Miles/hr. 70																
Since last oil change 65																
Date Sampled 8-22-74	2	1	3	4	10	1000	3			6		3		24	N	+4
Sample # 417669	N	N	N	N	N	N	N			N		N			N	
Lab/unit # 71155	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.															
Miles/hr. 75																
Since last oil change 70																
Date Sampled 8-22-74	3	1	2	5	11	1000	3			8		3		24	N	+4
Sample # 417670	N	N	N	N	N	N	N			N		N			N	
Lab/unit # 71140	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.															
Miles/hr. 80																
Since last oil change 75																
Date Sampled 8-22-74	2	1	3	4	10	1000	3			8		3		24	N	+5
Sample # 417671	N	N	N	N	N	N	N			N		N			N	
Lab/unit # 71137	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.															
Miles/hr. 85																
Since last oil change 80																
Date Sampled 8-23-74	2	1	6	4	10	1000	4			3		3		23	N	+4
Sample # 417672	N	N	N	N	N	N	N			N		N			N	
Lab/unit # 71299	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.															
Miles/hr. 90																
Since last oil change 85																
1 — Normal A — Abnormal S — Severe	ALUM. INUM.	BOR. ON	CHRO. MIUM.	COP. PER	IRON	LEAD	MAGNE- SIUM	MO		SILI. CON		TIN		VISC	SLUDGE	MM PP PP

K.D. LEWIS - MAIL DROP A-23
MICHIGAN DIVISION - LTV AEROSPACE
P.O. BOX 909
WARREN, MICHIGAN 48090

OIL MAKE & TYPE

HISTORY & REMARKS LEVEL CROSS-COUNTRY

(313) 539-0300 extn: 596, 531

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 3 of 17)



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 822-7388

355 KING ST. WEST
TORONTO 135, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL. GAS

SAMPLE DATA	ALUM. INUM	COR. ON	CHRO. MUM	COP. PER	IRON	LEAD	MAGNE SIUM	MO		SILI. CON		TIN	VISC	SLUDGE	SL.
	TESTED WITH OIL	PINS	PIPS	IRON PARTS	LEAD PARTS	MAGNE SIUM PARTS	MO PARTS	PINS	PINS	PINT TESTING TIME INTERVAL	TEST	TEST	TEST	TEST	TEST
Date 8-23-74 Sample # 417673 Fleet/unit # 71301 Miles/hrs. 95 Since last oil change 90	P	L	5	4	10	1000	3			4		3	23	N	+5
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.

Date 8-23-74 Sample # 417674 Fleet/unit # 71297 Miles/hrs. 100 Since last oil change 95	2	1	4	5	10	1000	3			4		3	23	N	+5
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.

Date Sample# Fleet/unit# Miles/hrs. Since last Oil Change															
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

SECONDARY ROADS

Date 8-26-74 Sample # 417675 Fleet/unit # 71637 Miles/hrs. 105 Since last oil change 95	2	1	?	3	10	1000	2			4		2	26	N	+1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

WEAR TREND STABLE. ALL CONDITIONS APPEAR SATISFACTORY.

Date 8-27-74 Sample # 417676 Fleet/unit # 71636 Miles/hrs. 110 Since last oil change 10	3	1	2	5	10	1000	3			4		2	25	N	+1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.

Date 8-27-74 Sample # 417677 Fleet/unit # 71634 Miles/hrs. 115 Since last oil change 15	3	1	2	4	10	1000	3			5		3	26	N	+2
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.

TEST A Abnormal TEST B Normal	ALUM INUM	BOR C4	CHRO. MUM	COP. PER	IRON	LEAD	MAGNE SIUM	MO		SILI. CON		TIN	VISC	SLUDGE	SL.

G.O. NAME - NATL. DRIV. A-23
MANUFACTURER - IBM AEROSPACE

OIL MAKE & TYPE - LEVEL CROSS-COUNTRY
TESTER'S REMARKS

(013) 532-0200 with: 506, 531

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 4 of 17)

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40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7385

388 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1866

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL. G

SAMPLE DATA	ALUM. INUM	BOR- ON	CHRO- MIUM	COP- PER	IRON	LEAD	MAGNE- SIUM	MO	SILI- CON	TIN	VISC	SLUDGE	Wear
	PERCENT ABNORMAL	PERCENT SEVERE	PERCENT SEVERE	PERCENT SEVERE	PERCENT SEVERE								
Date Sampled 8-27-74 Sample # 417678 Unit/Unit # 71642 Miles/Hrs. Since last Oil change 120 20	1 N	1 N	2 N	2 N	10 N	1000 N	4 N		2 N	1 N	25 N	N	+2 N
Date Sampled 8-27-74 Sample # 417679 Unit/Unit # 71644 Miles/Hrs. Since last Oil change 125 25	1 N	1 N	4 N	2 N	10 N	1000 N	2 N		1 N	1 N	26 N	N	+2 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date Sampled 8-28-74 Sample # 417680 Unit/Unit # 71640 Miles/Hrs. Since last Oil change 130 30	2 N	1 N	2 N	3 N	10 N	1000 N	3 N		2 N	2 N	26 N	N	+2 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date Sampled 8-28-74 Sample # 417681 Unit/Unit # 71641 Miles/Hrs. Since last Oil change 135 35	2 N	1 N	3 N	4 N	10 N	1000 N	3 N		2 N	2 N	26 N	N	+2 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date Sampled 8-28-74 Sample # 417682 Unit/Unit # 71635 Miles/Hrs. Since last Oil change 140 40	3 N	1 N	3 N	4 N	10 N	1000 N	3 N		4 N	3 N	25 N	N	+2 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date Sampled 8-29-74 Sample # 417683 Unit/Unit # 71645 Miles/Hrs. Since last Oil change 145 45	1 N	1 N	3 N	3 N	10 N	1000 N	2 N		2 N	2 N	26 N	N	+3 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													

Normal A - Abnormal S - Severe	ALUM. INUM	BOR- ON	CHRO- MIUM	COP- PER	IRON	LEAD	MAGNE- SIUM	MO	SILI- CON	TIN	VISC	SLUDGE	Wear
-----------------------------------	---------------	------------	---------------	-------------	------	------	----------------	----	--------------	-----	------	--------	------

K.D. LEWIS - MAIL DROP A-23
MICHIGAN DIVISION - LTV AEROSPACE
P.O. BOX 909
WARREN, MICHIGAN 48090

OIL MAKE & TYPE _____
HISTORY & REMARKS _____ secondary roads
(313) 539 0300 extn: 506, 531

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 5 of 17)

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**WEAR
CHECK International**

40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7388

388 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

Date	1	1	2	3	10	1000	2		2	1	25	N	+3
Date	8-20-74	1	1	2	3	10	1000	2		2	1	25	N +3
Sample #	417684	N	N	N	N	N	N	N	N	N	N	N	N
Lab/unit #	71643												
Miles/hr.	150												
Since last													
Oil change	50												
Date	8-29-74	1	1	4	5	10	1000	2		1	2	26	N +3
Sample #	417685	N	N	N	N	N	N	N	N	N	N	N	N
Lab/unit #	71639												
Miles/hr.	155												
Since last													
Oil change	55												
Date	8-30-74	3	1	5	6	10	1000	3		4	3	25	N +3
Sample #	417686	N	N	N	N	N	N	N	N	N	N	N	N
Lab/unit #	71633												
Miles/hr.	160												
Since last													
Oil change	60												
Date	8-30-74	3	1	7	4	10	1000	3		1	3	26	N +3
Sample #	417687	N	N	N	N	N	N	N	N	N	N	N	N
Lab/unit #	71638												
Miles/hr.	165												
Since last													
Oil change	65												
Date													
Sample #													
Lab/unit #													
Miles/hr.													
Since last													
Oil change													

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 6 of 17)

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40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 582-7366

385 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/CACOLINE/NATL. G.

	ALUM. INUM	BOR- ON	CHRO- MIUM	COP- PER	IRON	LEAD	MAGNE- SIUM	MO		SILI- CON		TIN		VISC	SLUDGE	PPM
8-31-74 417690 69247 180 80	5	1	6	6	10	1000	3			5		4		24	N	+5
	N	N	N	N	N	N	N	N		N		N		SAC		N
9-3-74 417691 69248 185 5	4	1	3	3	10	1000	3			6		3		24	N	+2
	N	N	N	N	N	N	N	N		N		N				N
9-4-74 417692 69245 100 10	2	1	3	3	10	1000	3			4		2		24	N	+2
	N	N	N	N	N	N	N	N		N		N				N
9-5-74 417693 69047 195 15	4	1	6	2	10	1000	4			2		2		24	N	+3
	N	N	N	N	N	N	N	N		N		N				N
9-5-74 417694 69048 200 20	3	1	3	2	10	1000	3			2		1		23	N	+3
	N	N	N	N	N	N	N	N		N		N				N
9-6-74 417695 69049 205 25	3	1	4	5	10	1000	3			4		3		24	N	+6
	N	N	N	N	N	N	N	N		N		N				N

K.D. LEWIS - MAIL DROP A-23
MICHIGAN DIVISION LTV AEROSPACE CORP.
P.O. BOX 202
ANN ARBOR, MICHIGAN 48090

OIL MAKE & TYPE _____
HISTORY & REMARKS Secondary roads
(313) 539 0300 extn: 506, 501

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 7 of 17)

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40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 822-7368

388 KING ST. WEST
TORONTO 135, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON SW.19, ENGLAND
(01-947-0281)

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL GA

SAMPLE DATA	ALUM. INUM.	BOR. ON	CHRO. MIUM.	COP. PER	IRON	LEAD	MAGNE. SIUM	MO	SILI. CON	TIN	VISC	SLUDGE	PFL SULPH	
	PISTONS BEARINGS		RINGS		CYLINDER BUSHES CRANK SHAFT SHAFTS	GASOLINE ADDITIVE	DIESEL BEARINGS	RINGS	SHRT ITNU. AND INTAKE		SAE			
Date Sampled 9-6-74	4	1	4	4	11	1000	3		2	2	24	N	+4	
Sample # 417696	N	N	N	N	N	N	N		N	N			N	
Lod/unit # 69046														
Miles/hr.	210	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Since last Oil change 30														
Date Sampled 9-9-74	3	1	4	5	10	1000	1		2	4	25	N	+4	
Sample # 417697	N	N	N	N	N		N		N	N			N	
.ab/unit # 69442														
Miles/hr.	215	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Since last Oil change 35														
Date Sampled 9-9-74	2	1	4	4	10	1000	3		1	2	24	N	+3	
Sample # 417698	N	N	N	N	N	N	N		N	N			N	
.ab/unit # 69418														
Miles/hr.	220	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Since last Oil change 40														
Date Sampled														
Sample #														
.ab/unit #														
Miles/hr.														
Since last Oil change														
-HIGHWAY-														
Date Sampled 9-10-74	5	1	3	5	10	1000	3		4	3	23	N	+3	
Sample # 417699	N	N	N	N	N	N	N		N	N			N	
.ab/unit # 69242														
Miles/hr.	225	WEAR TREND STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Since last Oil change 5														
Date Sampled 9-11-74	4	1	3	6	10	1000	3		4	3	23	N	+2	
Sample # 417700	N	N	N	N	N	N	N		N	N			N	
.ab/unit # 69243														
Miles/hr.	230	WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.												
Since last Oil change 10														
— Normal A — Abnormal S — Severe		ALUM. INUM.	BOR. ON	CHRO. MIUM.	COP. PER	IRON	LEAD	MAGNE. SIUM	MO	SILI. CON	TIN	VISC	SLUDGE	PFL SULPH
K.D. LEWIS - MAIL DROP A-23 MICHIGAN DIVISION LTV AEROSPACE CORP. P.O. BOX 909 WARREN, MICHIGAN 48090		OIL MAKE & TYPE _____												
		HISTORY & REMARKS _____												
		(313) 539 0300 extn: 596, 531												

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 8 of 17)



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 822-7368

365 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.10, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL. GA

SAMPLE DATA	ALUM. INUM.	BOR. ON	CHRO. MIUM.	COP. PER	IRON	LEAD	MAGNE- SIUM	MO	SILI- CON	TIN	VISC	SLUDGE	PPM SULFUR
	PISTONS BEARINGS		RINGS	BRASS	CYLINDER RINGS SCREWS CUP BR.	COOLING ADDITIVE D-1000 OIL/BAL.		RINGS	BRASS (TIN) AIR INTAKE)		SAE		PPM SULFUR
Date Sampled 9-12-74 Sample # 417701 Lab/unit # 69316 Miles/hrs. 235 Since last 15 Oil change	2 N	1 N	4 N	5 N	10 N	1000 N	3 N		3 N	2 N	24	N	+3 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date Sampled 9-12-74 Sample # 417702 Lab/unit # 69244 Miles/hrs. 240 Since last 20 Oil change	4 N	1 N	3 N	7 N	11 N	1000 N	4 N		6 N	2 N	24	N	+2 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY. (NOTE ALTHOUGH STABLE, COPPER IS RUNNING SLIGHTLY HIGHER AT THIS LOAD RANGE)													
Date Sampled 9-13-74 Sample # 417703 Lab/unit # 69441 Miles/hrs. 245 Since last 25 Oil change	5 N	1 N	9 N	5 N	10 N	1000 N	2 N		1 N	4 N	25	N	+5 N
NOTE CHROMIUM LEVEL (RINGS) INCREASED SHARPLY DURING THIS 5 HOUR PERIOD. ALL OTHER WEAR METAL LEVELS REMAINED STABLE.													
Date Sampled 9-16-74 Sample # 417704 Lab/unit # 69417 Miles/hrs. 250 Since last 30 Oil change	3 N	1 N	3 N	8 N	10 N	1000 N	3 N		2 N	3 N	24	N	+2 N
CHROMIUM LEVEL SUBSIDED. ALL OTHER WEAR METAL LEVELS REMAIN STABIL.													
Date Sampled 9-16-74 Sample # 417705 Lab/unit # 69419 Miles/hrs. 255 Since last 35 Oil change	4 N	1 N	5 N	9 N	10 N	1000 N	1 N		2 N	4 N	23	N	+2 N
WEAR TREND STABILIZED. COPPER CONTINUES TO RUN SLIGHTLY HIGHER THAN ON PREVIOUS LOAD SETTINGS.													
Date Sampled Sample # Lab/unit # Miles/hrs. Since last Oil change													
FIRST RUN INTERMIXED													
n — Normal a — Abnormal s — Severe													
4700584 K.D.LEWIS - MAIL DROP A-23 MICHIGAN DIVISION LTV AEROSPACE CORP. P.O. BOX 909 WARREN, MICHIGAN 48090							OIL MAKE & TYPE _____ HISTORY & REMARKS _____ HIGHWAY (313) 539-0300 extn: 596, 531						

Figure 9-1. Spectrometric Oil Analysis Reports (Sheet 9 of 17)

**WEAR
CHECK** International

40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 822-7268

266 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1900

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0881

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL G

SAMPLE DATA	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE. SIUM	MO		SILI. CON		TIN		VISC	SLUDGE	OIL TYPE
	PISTONS BEARINGS		RINGS	—	STEEL COPPER IRON IRON IRON	IRON IRON IRON IRON IRON	IRON IRON IRON IRON IRON	RINGS		IRON IRON IRON IRON IRON	—	—	BAR		—	
Date Sampled 9-19-74 Sample # 417706 Lab/unit # 69670 Miles/hr. 261 Since last Oil change 6.0	2 N	1 N	3 N	3 N	10 N	1000 N	4 N			3 N		2 N		24 N	N	+5 N
WEAR TREND STABLE. ALL CONDITIONS APPEAR SATISFACTORY																
Date 9-19-74 Sampled 417707 Sample # 69672 Lab/unit # 267 Miles/hr. 12 Since last Oil change	3 N	1 N	3 N	4 N	10 N	1000 N	2 N			4 N		2 N		24 N	N	+5 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR STAIISFACTORY.																
Date 9-20-74 Sampled 417708 Sample # 69671 Lab/unit # 273 Miles/hr. 18 Since last Oil change	3 N	1 N	3 N	5 N	10 N	1000 N	2 N			2 N		2 N		24 N	N	+6 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.																
Date 9-21-74 Sampled 417709 Sample # 69783 Lab/unit # 281 Miles/hr. 24 Since last Oil change	2 N	1 N	3 N	4 N	10 N	1000 N	4 N			4 N		2 N		24 N	N	+8 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.																
Date 9-21-74 Sampled 417710 Sample # 69782 Lab/unit # 287 Miles/hr. 30 Since last Oil change	4 N	1 N	4 N	5 N	10 N	1000 N	6 N			6 N		2 N		23 N	N	+7 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.																
Date 9-23-74 Sampled 417711 Sample # 69939 Lab/unit # 291 Miles/hr. 36 Since last Oil change	2 N	1 N	2 N	6 N	10 N	1000 N	3 N			4 N		2 N		26 N	N	+4 N
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.																
A — Normal B — Abnormal S — Severe	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE. SIUM	MO		SILI. CON		TIN		VISC	SLUDGE	OIL TYPE

K.D. LEWIS - MAIL DROP A-23
MICHIGAN DIVISION LTV AEROSPACE CORP.
P.O. BOX 909
WARREN, MICHIGAN 48090

OIL MAKE & TYPE _____
HISTORY & REMARKS _____
(313) 539-0300

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 10 of 17)



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7388

385 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1968

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL GA

SAMPLE DATA	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGN. SIUM	MO	SILI. CON	TIN	VISC	SLUDGE	W.H. %
	PISTONS BEARINGS		RINGS		CYLINDER RINGS CRANK SH.	GASKET COMPO. DIESEL OPERATION		RINGS		DIRT (THRU' AIR INTAKE)		SAE	
Date Sampled 9-24-74 Sample # 417712 Lab/unit # 69940 Miles/hrs. 297 Since last Oil change 42	5	1	6	7	11	1000	5		7	2	26	N	+4
N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	
MINOR INCREASES IN RING & PISTON WEAR RATES NOTED, BUT STILL WELL WITHIN LIMITS. COPPER LEVEL INCREASING GRADUALLY. ALL OTHER WEAR METAL LEVELS STABLE.													
Date Sampled 9-25-74 Sample # 417713 Lab/unit # 69941 Miles/hrs. 303 Since last Oil change 48	5	1	6	9	10	1000	3		6	3	26	N	+4
N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	
RING & PISTON WEAR RATES UNCHANGED. COPPER LEVEL STILL SLIGHTLY HIGHER THAN PREVIOUS. ALL OTHER WEAR METAL LEVELS STABLE.													
Date Sampled 9-25-74 Sample # 417714 Lab/unit # 69942 Miles/hrs. 309 Since last Oil change 54	3	1	4	7	10	1000	5		7	2	26	N	+4
N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	
RING & PISTON WEAR RATES DECREASING, AS IS COPPER LEVEL. ALL OTHER WEAR METAL LEVELS STABLE.													
Date Sampled 9-26-74 Sample # 417715 Lab/unit # 69943 Miles/hrs. 315 Since last Oil change 60	2	1	6	7	10	1000	3		2	2	25	N	+4
N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	
RING WEAR RATES FLUCTUATING. ALL OTHER WEAR METAL LEVELS STABLE.													
Date Sampled 9-27-74 Sample # 417716 Lab/unit # 69944 Miles/hrs. 321 Since last Oil change 66	2	1	3	6	10	1000	3		2	3	25	N	+5
N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	
WEAR TREND STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date Sampled 9-30-74 Sample # 417717 Lab/unit # 59299 Miles/hrs. 327 Since last Oil change 72	3	1	6	9	10	1000	4		4	3	23	N	+1
N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	N N N N N N	
RING WEAR RATES CONTINUE TO FLUCTUATE SLIGHTLY. COPPER LEVEL BEGINNING TO INCREASE. ALL OTHER WEAR METAL LEVELS STABLE.													
1 - Normal A - Abnormal 3 - Severe	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGN. SIUM	MO	SILI. CON	TIN	VISC	SLUDGE	W.H. %
K.D. LEWIS - MAIL DROP A-23 MICHIGAN DIVISION LTV AEROSPACE CORP. P.O. BOX 909 WARREN, MICHIGAN 48090													
18	OIL MAKE & TYPE	INTERMIXED											
14	HISTORY & REMARKS												
12	(313) 539-0300												

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 11 of 17)

~~WEAR CHECK~~ International

40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7368

388 KING ST. WEST
TORONTO 138, ONTARIO
(416) 368-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0261

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL GA

SAMPLE DATA	ALUM	VISC	CHEM	MAGN	COP	IRON	LEAD	MAGNE SIUM	MO		SILI- CON		TIN		VISC	SLUDGE	FEED
3-30-74 417718 59300 333 78	2 N	1 N	5 N	9 N	10 N	1000 N	5 N			4 N		2 N	23	N	+2 N		
10-2-74 417719 52448 339 84	3 N	1 N	5 N	7 N	10 N	1000 N	2 N			2 N		2 N	25	N	+7 N		
10-2-74 417720 59536 345 90	2 N	1 N	6 N	10 N	12 N	1000 N	5 N			1 N		2 N	24	N	+6 N		
10-3-74 417721 59537 351 96	2 N	1 N	6 N	10 N	10 N	1000 N	2 N			1 N		4 N	24	N	+6 N		
10-4-74 417722 59538 357 102	4 N	1 N	10 N	11 N	10 N	1000 N	2 N			4 N		4 N	23	N	+5 N		
10-5-74 417723 59539 363 102	2 N	1 N	6 N	10 N	10 N	1000 N	2 N			1 N		4 N	24	N	+6 N		

K.D. LEWIS MAIL DROP A-23
MICHIGAN DIVISION LTV AEROSPACE CORP.
P.O. BOX 200
ANN ARBOR, MICHIGAN 48106

OIL MAKE & TYPE: INTERMIXED
HISTORY & REMARKS: (313) 522-0300

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 12 of 17)

BEST AVAILABLE CGT



**40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30323
(404) 822-7385**

**388 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1966**

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL. G.

K.D. LEWIS - MAIL DRCP A-23
MICHIGAN DIVISION LTV AEROSPACE CORP.
P.O. BOX 909
WARREN, MICHIGAN 48090

SIL MARS & TYP. INTERMIXED

HISTORY & REMARKS

(313) 539-0300 Extn: 596, 531

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 13 of 17)



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7368

385 KING ST. WEST
TORONTO 138, ONTARIO
(416) 968-1960

28 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL G

SAMPLE DATA	ALUM. INUM	COR. CN	CHRO. MICA	COP. PER	IRON	LEAD	MAGNE SIUM	MO	SILI. CON		TIN		VISC	SLUDGE	ECYC
	CHROMIUM	MANGANESE	COPPER	IRON	LEAD	MAGNESIUM	MO	SILICON	IRON THRU SILICON		TIN	SAE	SLUDGE	ECYC	
Date Sampled Sample # Lab/unit # Miles/hrs. Since last Oil change	10-9-74 417730 59761 405 149	3	1	9	11	11	1000	3		2	3	23	N	+7	
NEAR TREND STABLE. ALL CONDITIONS APPEAR SATISFACTORY.															
Date Sampled Sample # Lab/unit # Miles/hrs. Since last Oil change	10-10-74 417731 59762 411 155	2	1	5	8	10	1000	3		2	2	24	N	+7	
SLIGHT REDUCTION IN RING WEAR RATES NOTED. OTHERWISE STABLE.															
Date Sampled Sample # Lab/unit # Miles/hrs. Since last Oil change	10-10-74 417732 59763 417 161	5	1	12	10	10	1000	2		3	4	23	N	+5	
RING WEAR RATES FLUCTUATING & NEARING TOP END OF NORMAL RANGE. OTHERWISE STABLE.															
Date Sampled Sample # Lab/unit # Miles/hrs. Since last Oil change	10-11-74 417733 59764 423 167	6	1	15	12	11	1000	4		4	4	24	N	+7	
RING WEAR RATES FURTHER INCREASED & NOW AT TOP END OF NORMAL RANGE. OTHERWISE STABLE. (NOTE TENDENCY FOR COPPER & ALUMINUM TO INCREASE WITH CHROMIUM)															
Date Sampled Sample # Lab/unit # Miles/hrs. Since last Oil change	10-74 417734 52111 429 173	5	1	8	14	18	1000	4		7	3	25	N	+7	
COPPER LEVEL (BEARINGS, BUSHINGS, GUIDES) BEGINNING TO INCREASE. IRON LEVEL (CYLINDERS, C.SHAFT) INCREASING. RING WEAR RATES DECREASED. ALL OTHER WEAR METAL LEVELS STABLE.															
Date Sampled Sample # Lab/unit # Miles/hrs. Since last Oil change	10-74 417735 52113 435 179	4	1	9	15	15	1000	4		6	3	24	N	+9	
CONDITION ESSENTIALLY SAME AS AT 429 HOURS, WITH ONLY SLIGHT REDUCTION IN IRON CONTENT NOTED.															
A = Normal S = Abnormal G = Severe															
K.D. LEWIS - MAIL DROP A-23								OIL MAKE & TYPE: INTERMITTED							
MICHIGAN DIVISION LTV AEROSPACE CORP.								HISTORY & REMARKS							
P.O. BOX 909								(313) 539-0300 Extn: 506, 531							

Figure 9-1. Spectrometric Oil Analysis Reports (Sheet 14 of 17)

BEST AVAILABLE COPY



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7388

388 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL G

SAMPLE DATA	ALUMINUM	BORON	CHROMIUM	COPPER	IRON	LEAD	MAGNESIUM	MOLY	SILICON	TIN	VISCOSITY	SLUDGE	WATER
Date Sampled 10-15-74 Sample # 417736 Lab/unit # 52112 Miles/hr. 441 Since last 185 Oil change	6	1	9	14	21	1000	5		9	3	24	N	+8
N N N N N N									N	N			
IRON LEVEL FLUCTUATING & NOW DEMONSTRATING RATE OF WEAR TWICE TH NOTED AT 423 HOURS. (STILL WITHIN NORMAL LIMITS) OTHERWISE, STA													
Date Sampled 10-74 Sample # 417737 Lab/unit # 52115 Miles/hr. 447 Since last 191 Oil change	2	1	5	10	11	1000	3		2	3	23	N	+9
N N N N N N									N	N			
FLUCTUATION CONTINUES. GENERAL REDUCTION IN ENGINE WEAR RATES ACROSS THE BOARD.													
Date Sampled 10-74 Sample # 417738 Lab/unit # 52114 Miles/hr. 453 Since last 197 Oil change	4	1	7	13	15	1000	4		6	3	24	N	+8
N N N N N N									N	N			
COPPER & IRON CONTENTS BEGINNING TO INCREASE AGAIN. OTHERWISE STABLE.													
Date Sampled 10-16-74 Sample # 417739 Lab/unit # 52187 Miles/hr. 459 Since last 203 Oil change	7	1	10	15	20	1000	5		7	3	25	N	+9
N N N N N N									N	N			
FURTHER INCREASES IN COPPER & IRON CONTENT NOTED. RING WEAR RATE DEMONSTRATING MINOR INCREASE. OTHERWISE STABLE.													
Date Sampled UNK Sample # 417740 Lab/unit # 52293 Miles/hr. 465 Since last 209 Oil change	6	1	13	15	17	1000	3		5	3	25	N	+6
N N N N N N									N	N			
MINOR INCREASE IN RING WEAR RATES NOTED. COPPER LEVEL STABLE. IRON LEVEL BEGINNING TO DECREASE.													
Date Sampled 10-17-74 Sample # 417741 Lab/unit # 52188 Miles/hr. 471 Since last 215 Oil change	7	1	10	12	11	1000	4		5	3	26	N	+7
N N N N N N									N	N			
FLUCTUATION CONTINUES. RING WEAR RATES DROPPING. COPPER LEVEL BEGINNING TO DECREASE. FURTHER REDUCTION IN IRON LEVEL (CYLS).													
Normal A --- Abnormal S --- Severe	ALUMINUM	BORON	CHROMIUM	COPPER	IRON	LEAD	MAGNESIUM	MOLY	SILICON	TIN	VISCOSITY	SLUDGE	WATER
K.D. LEWIS - MAIL DROP A-23 MICHIGAN DIVISION LTV AEROSPACE CORP. P.O. BOX 909 WARREN, MICHIGAN 48090													
OIL MAKE & TYPE INTERMITTED													
HISTORY & REMARKS													
(313) 539-0300 Extr. 596, 531													

figure 9-1. Spectrometric Oil Analysis Reports (Sheet 15 of 17)

BEST AVAILABLE COPY



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7368

388 KING ST. WEST
TORONTO 135, ONTARIO
(416) 392-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-947-0281

MAKE: WHITE

MODEL: M 151 FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL G.

SAMPLE DATA	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE. SIUM	MO		SILI. CON		TIN		VISC	SLUDGE	SPL. RETONE
	PISTONS BEARING		RINGS	—	CYLINDER BORE GAGE ON COP. ON	GASKET RING GAGE ON COP. ON	—	RINGS		DIRT (THRU' AIR- INTAKE)		—	SAC	—	—	
Date 10-74 Sampled 417742 Sample # 52189 Lab/unit # Miles/hrs. 477 Since last 221 Oil change	7	1	12	12	16	1000	4			7		3		26	N	+7
N N N N N N N N N N N N N N N N																
Date 10-74 Sampled 417743 Sample # 52329 Lab/unit # Miles/hrs. 483 Since last 227 Oil change	4	1	8	13	15	1000	3			4		3		25	N	+6
N N N N N N N N N N N N N N N N																
Date 10-74 Sampled 417744 Sample # 52330 Lab/unit # Miles/hrs. 489 Since last 233 Oil change	8	1	15	15	15	1000	3			6		3		24	N	+6
N N N N N N N N N N N N N N N N																
Date 10-18-74 Sampled 417745 Sample # 52331 Lab/unit # Miles/hrs. 495 Since last 239 Oil change	5	1	10	15	18	1000	4			6		3		24	N	+6
N N N N N N N N N N N N N N N N																
Date 10-19-74 Sampled 417746 Sample # 52332 Lab/unit # Miles/hrs. 501 Since last 245 Oil change	8	1	20	14	14	1000	3			9		4		24	N	+7
N N A N N N N N N N N N N N N N																
SHARP INCREASE IN RING WEAR RATES NOTED, WHICH ARE NOW HIGHER THAN NORMAL. PISTON WEAR RATES CONTINUE TO FLUCTUATE MILDLY. OTHERWISE STABLE.																
Date 10-19-74 Sampled 417747 Sample # 52333 Lab/unit # Miles/hrs. 507 Since last 251 Oil change	3	1	12	15	17	1000	4			4		2		24	N	+7
N N N N N N N N N N N N N N N N																
RING WEAR RATES SUBSIDED. SLIGHT REDUCTION IN PISTON WEAR RATES. OTHERWISE STABLE.																
n — Normal A — Abnormal S — Severe	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE. SIUM	MO		SILI. CON		TIN		VISC	SLUDGE	PPM.
4700584	MR. K.D. LEWIS - MAIL DROP A-23 MICHIGAN DIVISION LTV AEROSPACE CORP P.O. BOX 909 WARREN, MICHIGAN 48090															
	OIL MAKE & TYPE <u>INTERMIXED</u> HISTORY & REMARKS _____ (313) 539-0300 EXT 596, 531															

Figure 6-1. Spectrometric Oil Analysis Reports (Sheet 16 of 17)



40 MARIETTA ST. N.W., 14TH FLOOR
ATLANTA, GEORGIA 30303
(404) 522-7366

388 KING ST. WEST
TORONTO 138, ONTARIO
(416) 362-1966

24 WORPLE ROAD
LONDON S.W.19, ENGLAND
01-847-0281

WEAR-CHECK REPORT

MAKE: WHITE

MODEL: M 151

FLEET/UNIT #: 4700584

DIESEL/GASOLINE/NATL G

SAMPLE DATA	ALUM. INUM	BOR. ON	CHRO. MIUM	COP. PER	IRON	LEAD	MAGNE. SIUM	MO	SILI. CON	TIN	VISC	SLUDGE	PER. CENT
	PISTONS BEARINGS		RINGS		CYLINDER RINGS CUPPING CARBON	GASKETS SCREWS PISTON PINNAGE		RINGS	DIRTY THRU AIR INTAKES		SAE		PER. CENT
Date 10-20-74 Sampled Sample # 417748 Lab/unit # 52334 Miles/hr. 514 Since last 259 Oil change	6	1	14	11	10	1000	2		4	4	24	N	+7
N N N N N N N N N N N N N N													
WEAR TREND FAIRLY STABLE, WITH ONLY SLIGHT REDUCTION IN COPPER NOTED.													
Date 10-20-74 Sampled Sample # 417749 Lab/unit # 52335 Miles/hr. 520 Since last 256 Oil change	6	1	13	15	11	1000	3		5	4	25	N	+8
N N N N N N N N N N N N N N													
WEAR TREND STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date 10-21-74 Sampled Sample # 417750 Lab/unit # 52435 Miles/hr. 526 Since last 271 Oil change	5	1	13	12	15	1000	4		5	4	22	N	+8
N N N N N N N N N N N N N N													
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date 10-21-74 Sampled Sample # 417751 Lab/unit # 52436 Miles/hr. 533 Since last 277 Oil change	5	1	14	12	15	1000	4		4	3	23	N	+9
N N N N N N N N N N N N N N													
WEAR TREND REMAINS STABLE. ALL CONDITIONS APPEAR SATISFACTORY.													
Date 10-22-74 Sampled Sample # 417752 Lab/unit # 52477 Miles/hr. 539 Since last 284 Oil change	6	1	16	16	17	1000	4		6	4	24	N	+7
N N A A N N N N N N N N N N													
COPPER & CHROMIUM (RINGS) LEVELS INCREASED & NOW SLIGHTLY ABOVE NORMAL. OTHERWISE STABLE.													
Date 10-22-74 Sampled Sample # 417753 Lab/unit # 52475 Miles/hr. 544 Since last 289 Oil change	4	1	12	16	17	1000	4		2	3	24	N	+7
N N N A N N N N N N N N N N													
DECREASE IN RING WEAR RATES NOTED. OTHERWISE UNCHANGED.													
N -- Normal A -- Abnormal S -- Severe													
MR. K.D. LEWIS - MAIL DROP A-23 MICHIGAN DIVISION LTV AEROSPACE CORP P.O. BOX 909 WARREN, MICHIGAN 48090													
OIL MAKE & TYPE. INTERMIXED													
HISTORY & REMARKS _____													
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figure 9-1. Spectrometric Oil Analysis Reports (Sheet 17 of 17)

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ABSTRACT (Continue on reverse side if necessary and identify by block number) Field data was acquired on the L-141 engine over selected courses at APG. A laboratory simulation test was developed from the data and a 10,000 mile equivalent endurance test was conducted. Purpose was to establish a base from which a short, severe test procedure could be developed. A total of 548 test hours was required to accumulate the 10,000 mileage equivalent. Performance tests were made each 100 hours and oil sample analyses were made approximately every six hours of test time. No engine mechanical failures were experienced during the test. Engine wear was not considered excessive. It was concluded that a short severe test could be developed.		

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