

REPORT NO. DOT-TSC-OST-76-22

ENGINE PERFORMANCE TEST OF THE 1975 GM 140-CID

Energy Research and Development Administration
Bartlesville Energy Research Center
P.O. Box 1398
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INTERIM REPORT

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NOTICE

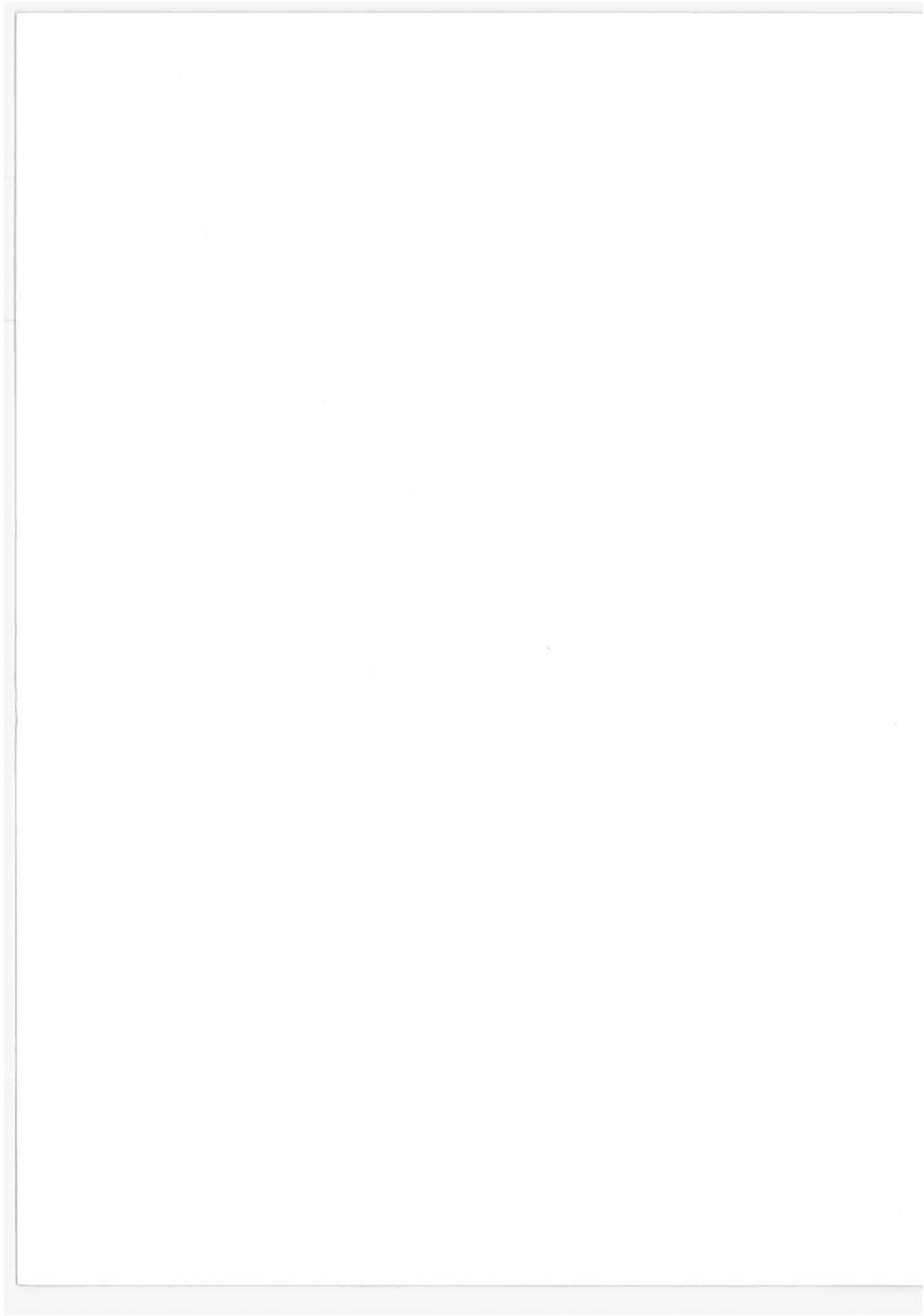
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16. Abstract An engine test of the 1975 GM 140 cubic-inch-displacement, 4-cylinder engine has been performed to determine its steady-state fuel consumption and emissions (HC, CO, and NO _x) maps. The data acquired are summarized in this report.					
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PREFACE

This report, prepared by the U.S. Energy Research and Development Administration, Bartlesville Energy Research Center for the U.S. Department of Transportation, Transportation Systems Center, Power and Propulsion Branch, Cambridge MA, presents results of an automobile engine test. This represents one of a series of 1975 engines tested.

Mr. Ralph G. Colello is the technical monitor on this project.

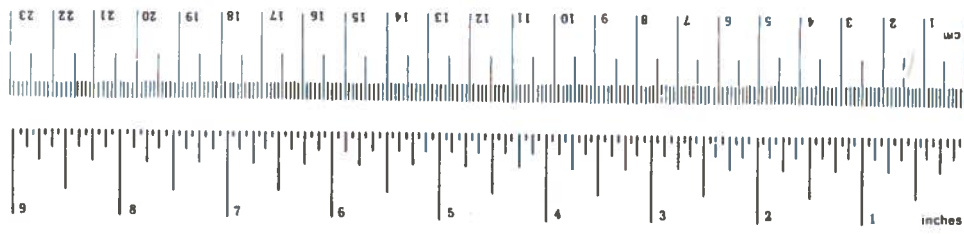
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.5	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

When You Know	Multiply by	To Find	Symbol
LENGTH			
millimeters	0.04	inches	in
centimeters	0.4	inches	in
meters	3.3	feet	ft
meters	1.1	yards	yd
kilometers	0.6	miles	mi
AREA			
square centimeters	0.16	square inches	in ²
square meters	1.2	square yards	yd ²
square kilometers	0.4	square miles	mi ²
hectares (10,000 m ²)	2.5	acres	
MASS (weight)			
grams	0.035	ounces	oz
kilograms	2.2	pounds	lb
tonnes (1000 kg)	1.1	short tons	
VOLUME			
milliliters	0.03	fluid ounces	fl oz
liters	2.1	pints	pt
liters	1.06	quarts	qt
liters	0.26	gallons	gal
cubic meters	35	cubic feet	ft ³
cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)			
Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



1. INTRODUCTION

This report presents the data acquired from tests of a Chevrolet 4-cylinder, 140-CID engine. This engine is used in the Chevrolet Vega and Monza and Pontiac Astre automobiles. The test results are sufficient to establish the steady-state maps for fuel consumption and emissions (carbon monoxide, hydrocarbon, oxides of nitrogen) over the entire operating range of the engine. This engine is one of a series of engines tested or to be tested.

The objective of this program is to obtain automotive engine performance data for estimating emissions and fuel economy in varied service and duty. The intent of this work is to provide basic engine-characteristic data required as input for engineering calculations involving ground transportation.

2. ENGINE TEST REPORT

The manufacturer's specifications for the Chevrolet 140-CID engine are given in table 1. A single batch of regular unleaded fuel was used throughout the test; fuel specifications are given in table 2. The engine was operated at various speeds and loads over a 45-hour break-in period; details of the break-in procedure are given in table 3. The total engine operating time was about 95 hours. The period of testing was August 23 through September 8, 1975.

The engine was mounted on a test stand and coupled to an eddy-current dynamometer. The engine was complete, except for fan (a cooling tower was used instead of a radiator). Emission control systems included exhaust-gas-recirculation (EGR), evaporative control charcoal canister, high energy ignition system, and a catalytic oxidation system. The exhaust system configuration was similar to that used in the Vega automobile. No alternator was included in the test setup. The engine was operated at the following steady-state modes:

Speeds: 1,000; 1,500; 2,000; 2,800; 3,600; 4,400 rpm

Loads: 0, 5, 10, 15, 25, 50, 75, 90, 100 pct of full load
(all repeated except for 4,400 rpm modes)

Idle: no load, load equivalent to transmission in drive
(both repeated)

Total number of test modes..... 56
Repeats..... 47
Total number of tests.....103

The following data were recorded:

Test number
Date
Barometric pressure, mm Hg
Dew point, °F
Inlet air temperatures, °F
Speed, rpm
Torque, lb-ft -- BLH strain gage load cell; Daytronics indicator
Fuel rate, lb/hr -- Fluidyne, positive displacement volumetric
flowmeter
Ignition timing, °BTC
Manifold vacuum, in. Hg
Throttle angle, degrees
CO, pct -- Beckman NDIR
CO₂, pct -- Beckman NDIR

O₂, pct -- Beckman polarographic detector
 HC, ppmC -- Custom-built heated flame ionization detector
 NO_x, ppm -- Thermo-Electron chemiluminescent detector
 Oil temperature, °F
 Oil pressure, psig
 Coolant temperature, °F
 Exhaust temperature, °F
 Exhaust pressure, in. H₂O

Exhaust composition, temperature, and pressure were determined before and after the catalyst. The computed data include absolute humidity (grains/lb dry air); power (bhp); air-fuel ratio; and emission rates of carbon monoxide (CO), unburned hydrocarbons (HC), and oxides of nitrogen (NO_x) in grams/hour. Exhaust emission rates were computed for two cases--with and without the catalyst. The following equations were applied in the computations:

$$W = \exp \left[12.02 \left(\frac{D - 1.4}{D + 212} \right) \right]$$

$$H = \frac{4348 W}{B - W}$$

$$P = \left(\frac{N \times T}{5252} \right) \left(\frac{736.6}{B - W} \right) \left(\frac{t + 460}{545} \right)^{0.5}$$

$$A/F = 4.895 \frac{(CO) + 2(CO_2) + 2(O_2) + \left(\frac{NO_x}{10^4} \right) + 3.148 (CO_2) \left(\frac{CO + CO_2}{CO + 3CO_2} \right)}{(CO) + (CO_2) + \left(\frac{HC}{10^4} \right) \left[1 + .03148(CO_2) \left(\frac{CO + CO_2}{CO + 3CO_2} \right) \right]}$$

The equation for A/F is based on:

1. Fuel = CH_{2.099}
2. Water-gas-shift equilibrium constant = $\frac{(CO) (H_2O)}{(CO_2) (H_2)} = 3$
3. HC was determined on a raw exhaust basis, all other species measured on a dry basis.
4. All NO_x is NO.

$$\text{Mass CO} = (\text{Exhaust flow rate}) \times (\text{CO}) \times \frac{\text{Mol. wt CO}}{\text{Mol. wt exhaust}}$$

x correction for water removal

$$\text{Mass CO} = 4.383 (F) (A/F + 1) (\text{CO}) \left[\frac{1}{1 + .03148(\text{CO}_2) \left(\frac{\text{CO} + \text{CO}_2}{\text{CO} + 3\text{CO}_2} \right)} \right]$$

$$\text{Mass HC} = 0.0002207 (F) (A/F + 1) (\text{HC})$$

$$\text{Mass NO}_x = 0.0007201 (F) (A/F + 1) (\text{NO}_x) \left[\frac{1}{1 + .03148(\text{CO}_2) \left(\frac{\text{CO} + \text{CO}_2}{\text{CO} + 3\text{CO}_2} \right)} \right] \times K_H$$

$$K_H = \frac{1}{1 - .0047 (H - 75)}$$

where A/F = air-fuel ratio

B = barometric pressure, mm Hg

CO = carbon monoxide concentration, vol pct

CO₂ = carbon dioxide concentration, vol pct

D = intake air dew point, °F

F = fuel rate, lb/hr

H = humidity, grains H₂O/lb dry air

HC = unburned hydrocarbon concentration, ppmC, vol

K_H = humidity correction factor

N = engine speed, rpm

NO = nitric oxide concentration, ppm, vol

NO_x = nitrogen oxides concentration, ppm, vol

O₂ = oxygen concentration, vol pct

P = corrected power, brake horsepower

T = torque, ft-lb

t = intake air temperature, °F

W = water vapor pressure, mm Hg

TABLE 1. - Manufacturer's engine specifications

Displacement:	140.0 cubic inches
Maximum horsepower:	87 hp at 4,400 rpm
Maximum torque:	122 lb-ft at 2,800 rpm
In-line 4 cylinders	
2 bbl carburetor	
Bore and stroke:	3.500 x 3.625 inches
Compression ratio:	8.00

TABLE 2. - Fuel specifications

Fuel No.....	7516
Research octane number.....	91.0
Motor octane number.....	83.5
Reid vapor pressure, psig.....	9.86
(by micro vapor pressure test)	
Distillation, °F:	
10 pct.....	125
50 pct.....	212
95 pct.....	390
100 pct.....	416
API gravity, °.....	66.1
FIA analysis, pct:	
Aromatics.....	11
Olefins.....	15
Paraffins.....	74
Sulfur, pct.....	0.0288
Lead, g/gallon.....	Trace

TABLE 3. - Engine break-in schedule

Simulated vehicle speed, mph	Engine speed, rpm	Manifold vacuum, in. Hg	Percent of time in mode
20	800	15	25
30	900	13.5	25
40	1,000	10.0	25
50	1,600	6.0	25

Total number of simulated miles prior to testing = 1,600.

3. DISCUSSION OF TEST RESULTS

The engine data (shown in figures 1 through 6) were highly repeatable except for air-fuel ratio (figure 2). The cause of this variation has not been determined but could presumably be due to minor leaks in the sampling system or in the determination of oxygen concentration. In the computation of A/F oxygen concentration has a strong influence on the calculated result for mixtures in the vicinity of stoichiometric.

Plots of engine performance versus engine speed at wide-open-throttle (WOT) are typical of spark ignition engines (figure 1). The brake specific fuel consumption (bsfc) data did not repeat accurately at low engine speeds (below 2,000 rpm). This discrepancy could be attributed to slight inaccuracies in fuel consumption; however, the bsfc trend is discernible.

The carburetion system maintained lean air-fuel mixtures over a wide range in speed and load with significant enrichment only at WOT modes (figure 2). The maintenance of lean operation is further demonstrated by the effect of operating mode on CO and HC emissions (figures 3 and 4). The catalyst was highly effective in promoting oxidation of CO and HC at conditions other than WOT where there was insufficient oxygen available for oxidation.

Emissions of NO_x are typical of spark-ignition engines which operate lean over most of their range with enrichment at WOT. The overall low level of NO_x emissions is due primarily to high EGR rates. The EGR valve used in these tests was designed for use in California production vehicles which have more stringent NO_x emission control. The catalyst caused minor reduction in NO_x emission at most engine modes. However, at engine modes where the air-fuel mixture was nearly stoichiometric ($A/F \approx 15$), the catalyst effected major reduction in NO_x emission rate.

4. CONCLUSION

Repeatability of engine performance data was satisfactory. Emissions were well controlled over most of the engine's operating range due to a combination of lean operation and effectiveness of the catalyst in promoting post-combustion oxidation of the pollutants.

GE 147-01D
7516

Test No.	1	2	3	4	5	6	7	8	9	10
Test Date	3/23/75	3/23/75	3/23/75	3/23/75	3/23/75	3/23/75	3/23/75	3/23/75	3/23/75	3/23/75
Test number	744.5	744.5	744.5	744.5	744.5	744.5	744.5	744.5	744.5	744.5
Parameter, test H. Humidity, grains/lb.	59	60	60	60	60	60	60	60	60	60
Temperature, °F	65	65	65	65	65	65	65	65	65	65
Engine speed, rpm	700	500	1000	1000	1000	1000	1000	1000	1000	1000
Torque, lb-ft.	0.0	9.0	100.0	90.0	50.0	25.0	15.0	10.0	10.0	5.0
Power, bhp*	0.0	1.0	18.8	16.3	9.4	4.7	2.2	1.0	1.0	0.5
Fuel rate, lb/hr.	2.2	2.2	11.0	7.4	5.6	4.5	3.7	3.7	3.7	3.0
Ignition timing, deg BTDC	10.0	10.0	17.0	16.0	15.0	11.0	11.0	11.0	11.0	11.0
Manifold vacuum, in Hg.	14.5	12.5	0.0	2.0	3.0	7.5	12.0	13.2	13.2	15.5
Throttle angle, deg.	0.0	0.0	74.0	25.5	13.0	7.5	4.0	3.5	3.5	2.0
Before Catalyst Concentrations, dry basis:										
CO, %	2150	1450	7.5000	2030	2010	1620	1620	2030	2030	2150
CO2, %	3.00	9.55	10.20	11.25	12.60	13.00	13.00	12.60	12.60	12.10
O2, %	3.25	7.00	2.21	1.10	2.15	2.70	2.70	2.35	2.35	3.65
HC, ppmC	12500	7406	536	1678	1386	5754	5754	6227	6227	4514
NOx, ppm	10	2	200	4100	1875	100	100	88	88	70
Air-fuel ratio	20.71	20.14	11.34	15.76	16.22	16.59	16.59	16.42	16.42	17.03
Emission rates, g/hr:										
CO	49.7	26.3	4069.3	13.2	26.2	50.1	50.1	70.5	70.5	45.0
HC	123.1	67.7	3.2	41.2	40.8	55.5	55.5	77.6	77.6	47.6
NOx**	0.9	0.0	17.5	513.5	123.5	4.3	4.3	5.2	5.2	2.5
Oil temperature, F	174	176	135	200	194	139	139	136	136	195
Oil pressure, psi	23	26	29	26	23	27	27	28	28	28
Coolant temperature, F	134	135	195	134	135	131	131	139	139	189
Exhaust temperature, F	756	733	958	1030	1010	1000	1000	960	968	936
Exhaust pressure, in H2O	4.0	4.0	3.0	7.0	7.0	5.0	5.0	4.0	4.0	4.0
After Catalyst Concentrations, dry basis:										
CO, %	.0021	.0025	7.5000	.0053	.0035	.0032	.0032	.0029	.0029	.0029
CO2, %	10.35	11.00	10.20	11.40	13.60	13.60	13.60	13.30	13.30	15.00
O2, %	5.35	5.75	2.20	.80	2.00	2.00	2.00	2.25	2.25	2.75
HC, ppmC	84	106	5045	73	74	114	114	160	160	142
NOx, ppm	25	30	238	4050	1500	125	125	90	90	35
Air-fuel ratio	20.28	20.03	11.76	15.86	16.41	16.36	16.36	16.57	16.57	16.38
Emission rates, g/hr:										
CO	.4	1.0	4011.7	2.6	1.5	1.0	1.0	.7	.7	.6
HC	.8	1.0	82.1	1.8	1.5	1.8	1.8	2.0	2.0	1.5
NOx**	.7	.9	17.7	516.2	103.6	6.1	6.1	3.5	3.5	2.8
Exhaust temperature, F	795	794	738	752	796	792	792	737	737	732
Exhaust pressure, in H2O	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine Fuel	11 3/23/75	12 3/23/75	13 3/23/75	14 3/23/75	15 3/23/75	16 3/23/75	17 8/23/75	18 3/23/75	19 8/23/75	20 3/23/75
Test Number	744.5	744.5	744.5	744.5	744.5	744.5	744.5	744.5	744.5	744.5
Test Date	69	69	69	69	69	69	69	69	69	69
Barometer, mm Hg	66	66	66	66	66	66	66	66	66	66
Humidity, grains/lb	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Temperature, F	0.0	100.0	90.0	75.0	50.0	25.0	15.0	10.0	5.0	0.0
Engine speed, rpm	0.0	28.2	25.4	21.2	14.1	7.1	3.5	2.8	1.4	0.0
Torque, lb-ft	2.9	17.3	12.5	10.6	8.9	7.4	6.1	5.9	5.1	4.8
Power, bhp	11.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Fuel rate, lb/hr	16.0	9.0	1.8	2.3	3.6	7.0	9.5	10.5	12.5	15.5
Ignition timing, deg BTC	2.0	74.0	35.5	30.0	24.0	15.0	9.0	7.5	6.0	4.5
Manifold vacuum, in Hg										
Throttle angle, deg										
Before Catalyst Concentrations, dry basis:										
CO, %	2.90	8.1700	1.4000	1.190	1.220	3.300	7.700	8.700	1.4000	3.0500
CO ₂ , %	11.25	9.95	13.45	12.30	12.40	11.70	12.70	12.85	12.70	12.40
O ₂ , %	5.00	2.25	1.15	2.35	3.55	4.25	2.40	2.15	1.80	1.00
HC, ppmC	19079	3304	1870	1426	1583	9844	8539	7415	7999	6324
NOx, ppm	30	163	1475	1162	340	145	72	59	45	50
Air-fuel ratio	17.50	11.52	14.90	16.45	17.43	16.83	15.32	15.22	14.63	13.65
Emission rates, g/hr:										
CO	55.0	6949.5	1058.6	83.9	77.5	168.9	296.4	319.6	428.3	820.7
HC	107.4	141.6	71.2	51.1	50.7	253.9	185.6	137.3	123.3	95.8
NOx**	1.0	22.0	177.9	131.8	34.5	11.8	4.4	3.5	2.4	2.1
Oil temperature, F	173	191	214	225	225	221	216	213	212	210
Oil pressure, psi	23	31	30	30	30	30	30	30	30	30
Coolant temperature, F	138	190	192	193	191	190	190	189	189	189
Exhaust temperature, F	959	1165	1292	1301	1294	1220	1152	1169	1145	1127
Exhaust pressure, in H ₂ O	4.0	19.0	17.0	15.0	13.0	11.0	9.0	8.0	7.0	7.0
After Catalyst Concentrations, dry basis:										
CO, %	0.015	8.3500	4.850	0.042	0.035	0.035	2.900	2.700	6.500	2.6200
CO ₂ , %	12.70	9.95	14.60	13.60	12.70	13.30	14.05	14.25	14.25	13.30
O ₂ , %	5.50	0.05	0.05	2.05	3.23	2.20	0.45	0.60	0.20	0.00
HC, ppmC	170	2588	40	40	28	80	75	65	150	1735
NOx, ppm	60	128	470	1175	280	175	45	43	25	18
Air-fuel ratio	17.60	11.44	14.76	16.44	17.42	16.54	15.10	15.20	14.76	13.66
Emission rates, g/hr:										
CO	5	7052.8	361.6	3.0	2.2	1.7	109.0	98.2	197.9	701.2
HC	1.8	110.1	1.5	1.4	0.9	2.0	1.4	1.2	2.3	23.4
NOx**	2.0	17.2	55.9	132.9	28.5	13.9	2.7	2.5	1.2	0.7
Exhaust temperature, F	699	890	1085	1130	1073	1098	1072	1050	1050	1020
Exhaust pressure, in H ₂ O	1.0	2.0	2.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0

* Corrected - SAE J616b

** Corrected for humidity.

Engine..... GM 140-CID
 Fuel..... 7516

	21	22	23	24	25	26	27	28	29	30
Test Number.....	8/29/75	8/29/75	8/29/75	8/24/75	8/24/75	8/24/75	8/24/75	8/24/75	8/24/75	8/29/75
Test Date.....	8/29/75	8/29/75	8/29/75	8/24/75	8/24/75	8/24/75	8/24/75	8/24/75	8/24/75	8/29/75
Barometer, mm Hg.....	742.6	742.6	742.6	739.2	739.2	739.2	739.2	739.2	739.2	742.6
Humidity, grains/lb.....	71	71	71	80	80	80	80	80	80	71
Temperature, F.....	68	68	67	69	69	68	68	68	68	68
Engine speed, rpm.....	2000	2000	2000	2000	2000	2000	2000	2000	2000	2900
Torque, lb-ft.....	103.0	92.0	77.0	55.0	28.0	16.5	11.0	5.5	0.0	105.0
Power, bhp.....	38.9	34.8	29.1	20.9	10.7	6.3	4.2	2.1	0.0	55.6
Fuel rate, lb/hr.....	22.4	17.4	14.2	11.0	8.3	7.0	6.4	5.0	5.7	29.4
Ignition timing, deg BTDC.....	15.5	16.0	15.0	15.0	22.0	26.0	24.0	21.0	18.5	20.0
Manifold vacuum, in Hg.....	1.0	1.6	2.8	3.6	9.2	11.5	13.0	13.4	14.6	0.0
Throttle angle, deg.....	76.0	45.8	35.0	27.5	13.5	8.5	7.0	5.5	4.0	76.0
Before Catalyst Concentrations, dry basis:										
CO, %.....	7.6500	2.0500	.2530	.1300	.2200	.5800	.3970	.5800	.8080	5.1000
CO2, %.....	9.95	13.30	13.95	12.55	11.25	10.70	11.70	11.10	12.10	11.30
O2, %.....	.06	.55	1.35	3.15	3.90	4.20	4.00	3.25	2.75	.15
HC, ppmC.....	3154	2220	1722	1189	7277	12337	11255	9524	10759	2599
NOx, ppm.....	260	1825	1600	350	220	125	100	67	50	1375
Air-fuel ratio.....	11.59	14.23	15.61	17.15	17.06	16.37	16.42	16.02	15.32	12.74
Emission rates, g/hr:										
CO.....	8219.3	2057.6	227.6	100.8	129.1	278.7	173.4	229.6	289.9	7811.4
HC.....	170.8	112.3	78.1	46.4	215.3	310.8	247.7	190.0	194.5	200.6
NOx**.....	45.1	295.9	232.4	45.6	21.7	10.1	7.3	4.5	3.0	340.2
Oil temperature, F.....	231	232	240	236	226	193	206	217	219	254
Oil pressure, psi.....	33	31	31	31	32	35	34	34	34	34
Coolant temperature, F.....	193	189	190	190	190	139	191	191	191	193
Exhaust temperature, F.....	1233	1340	1361	1340	1188	1134	1226	1177	1225	1330
Exhaust pressure, in H2O.....	30.0	24.0	21.0	20.0	15.0	8.0	8.0	7.0	7.0	66.0
After Catalyst Concentrations, dry basis:										
CO, %.....	8.0000	1.8000	.0051	.0041	.0032	.0021	.0071	.0013	.1030	5.3000
CO2, %.....	9.95	13.95	14.25	12.85	12.70	13.60	13.60	13.60	14.25	11.80
O2, %.....	.01	.01	1.20	2.70	2.85	2.00	1.95	1.35	.95	.01
HC, ppmC.....	2556	19	5	17	68	154	51	54	58	1765
NOx, ppm.....	165	863	1625	375	300	85	100	67	48	988
Air-fuel ratio.....	11.51	14.19	15.81	16.99	17.13	16.35	16.25	15.87	15.52	12.65
Emission rates, g/hr:										
CO.....	8529.3	1794.0	4.6	3.1	1.9	1.0	3.0	.7	36.3	8057.5
HC.....	137.3	9	.2	.7	2.0	3.6	1.1	.7	1.0	135.1
NOx**.....	28.4	138.8	238.6	48.3	29.4	6.7	7.2	4.3	2.9	242.5
Exhaust temperature, F.....	1087	1154	1210	1172	1170	922	1045	1112	1116	1268
Exhaust pressure, in H2O.....	13.0	12.0	10.0	10.0	6.0	1.0	1.0	1.0	1.0	36.0

* Corrected - SAE J816b
 ** Corrected for humidity.

GM 140-CID
7516

Engine.....	31	32	33	34	35	36	37	38	39	40
Fuel.....	8/24/75	8/24/75	9/ 9/75	9/ 6/75	8/29/75	8/26/75	8/26/75	8/26/75	8/26/75	8/26/75
Test Number.....	739.2	739.2	748.0	748.7	742.6	745.5	745.5	745.5	745.5	745.5
Test Date.....	80	80	77	70	71	71	71	71	71	71
Barometer, mm Hg.....	70	71	67	64	67	66	65	67	67	68
Humidity, grains/lb.....	2800	2800	2800	2800	2800	2800	2800	2800	3600	3600
Temperature, F.....	96.0	80.0	54.0	27.0	15.0	11.0	5.0	0.0	100.0	90.0
Engine speed, rpm.....	51.2	42.7	14.9	14.1	7.9	5.8	2.6	0.0	67.7	61.0
Torque, lb-ft.....	23.4	21.2	8.1	10.3	8.1	8.4	7.4	7.1	36.7	30.2
Power, bhp*.....	22.0	21.0	26.0	33.0	30.0	34.5	30.0	31.0	25.0	26.5
Fuel rate, lb/hr.....	1.0	1.8	8.5	13.5	14.0	15.6	16.0	16.5	1.0	1.8
Ignition timing, deg BTC.....	55.0	52.0	31.0	17.0	13.0	13.0	10.5	10.0	73.0	55.0
Manifold vacuum, in Hg.....										
Throttle angle, deg.....										
Before Catalyst										
Concentrations, dry basis:										
CO, %.....	8500	8330	4100	5630	5200	7200	7700	11000	45200	21700
CO2, %.....	13.30	12.70	14.05	14.05	13.60	13.00	13.00	13.30	11.95	13.15
O2, %.....	1.35	2.00	.60	.75	1.00	1.75	1.50	.95	.27	.70
HC, ppmC.....	1088	968	1553	2533	2006	2853	3140	2581	1730	1383
NOx, ppm.....	2800	1550	1225	420	163	132	90	73	1425	2500
Air-fuel ratio.....	15.44	15.91	15.03	14.93	15.17	15.51	15.28	14.80	13.08	14.36
Emission rates, g/hr:										
CO.....	1250.1	1148.7	373.3	351.8	261.7	385.2	356.1	471.3	8860.8	3821.7
HC.....	80.6	67.3	71.2	79.8	50.9	76.9	73.2	55.7	170.9	122.7
NOx**.....	692.1	399.3	185.4	42.0	13.2	11.4	6.7	5.0	450.6	710.2
Oil temperature, F.....	262	263	250	252	252	223	233	237	270	284
Oil pressure, psi.....	32	30	36	35	31	36	35	35	36	35
Coolant temperature, F.....	191	191	191	191	190	191	191	192	193	191
Exhaust temperature, F.....	1463	1485	1337	1230	1260	1262	1292	1317	1458	1489
Exhaust pressure, in H2O.....	69.0	67.0	17.0	8.0	9.0	6.0	4.0	3.5	94.0	83.0
After Catalyst										
Concentrations, dry basis:										
CO, %.....	5000	0046	0405	0600	1880	0126	1030	1950	45700	21500
CO2, %.....	14.25	13.60	14.43	14.60	14.43	14.25	14.05	14.05	12.10	13.45
O2, %.....	.65	1.60	.37	.67	.10	.90	.55	.50	.15	.17
HC, ppmC.....	23	23	242	115	3	86	46	34	1155	254
NOx, ppm.....	2000	1500	1025	250	90	120	75	48	1075	1950
Air-fuel ratio.....	15.20	16.13	15.17	15.35	14.91	15.54	15.26	15.18	13.04	14.14
Emission rates, g/hr:										
CO.....	719.8	6.4	37.2	38.4	92.6	6.7	47.3	85.4	8922.6	3720.9
HC.....	1.7	1.6	11.2	3.7	1	2.3	1.1	.8	113.7	22.2
NOx**.....	483.9	351.1	156.3	25.6	7.2	10.3	5.6	3.4	338.6	544.4
Exhaust temperature, F.....	1359	1399	964	1026	1171	977	1040	1059	1307	1410
Exhaust pressure, in H2O.....	32.0	31.0	5.7	3.7	2.0	3.0	1.0	.4	61.0	55.0

* Corrected - SAE J816b

** Corrected for humidity.

GH-140-CID
7516

Engine.....
Fuel.....

	41	42	43	44	45	46	47	48	49	50
Test Number.....	8/26/75	8/26/75	8/26/75	9/ 9/75	9/ 9/75	9/ 9/75	9/ 9/75	9/ 8/75	9/ 8/75	9/ 8/75
Test Date.....	745.5 71 68	745.5 71 68	745.5 71 67	748.0 77 67	748.0 77 68	748.0 77 68	748.0 77 68	746.0 71 68	746.0 71 71	746.0 71 70
Barometer, mm Hg.....	3600	3600	3600	3600	3600	3600	3600	4400	4400	4400
Humidity, grains/lb.....	75.0	50.0	23.0	15.0	10.0	5.0	0.0	95.0	85.0	71.0
Temperature, F.....	33.9	33.9	15.6	10.1	6.8	3.4	0.0	78.6	70.5	58.9
Engine speed, rpm.....	26.6	20.9	12.7	11.5	10.1	9.1	8.5	40.6	35.3	32.6
Torque, lb-ft.....	26.5	25.0	44.0	44.0	43.0	40.5	39.5	30.5	30.0	29.5
Power, bhp.....	2.5	4.7	12.7	15.0	15.8	16.4	17.0	1.0	2.4	3.9
Fuel rate, lb/hr.....	50.0	40.0	21.0	17.0	16.0	15.0	14.0	76.0	58.0	52.0
Ignition timing, deg BTC.....										
Manifold vacuum, in Hg.....										
Throttle angle, deg.....										
Before Catalyst Concentrations, dry basis:										
CO, %.....	1,2700	2450	1550	7250	4950	5200	5550	8,0000	1,2000	2,6700
CO ₂ , %.....	13.00	13.00	7.80	14.45	14.25	14.05	13.95	9.00	13.60	12.70
O ₂ , %.....	1.55	2.50	1.95	1.50	1.90	1.00	1.12	1.20	1.63	1.40
HC, ppmC.....	887	740	1218	1619	1381	1381	1553	14789	1381	1841
NOx, ppm.....	1600	850	750	470	325	195	143	625	3350	1800
Air-fuel ratio.....	15.75	16.59	16.99	14.79	15.17	15.23	15.27	10.66	14.77	13.89
Emission rates, g/hr:										
CO.....	2110.8	346.6	143.3	490.3	308.5	293.1	292.8	14571.1	2541.3	4933.8
HC.....	74.3	52.7	56.8	55.2	43.5	39.2	41.3	1357.5	147.4	171.5
NOx**.....	429.0	194.0	111.9	52.8	33.7	18.3	12.5	183.6	1144.2	536.4
Oil temperature, F.....	294	277	266	250	250	250	250	284	287	280
Oil pressure, psi.....	34	35	35	38	37	36	35	35	34	34
Coolant temperature, F.....	192	191	190	191	191	191	191	193	193	191
Exhaust temperature, F.....	1527	1508	1272	1262	1309	1331	1352	1460	1593	1563
Exhaust pressure, in H ₂ O.....	73.0	51.0	15.0	8.0	6.2	5.0	4.1	152.5	144.0	88.0
After Catalyst Concentrations, dry basis:										
CO, %.....	.0350	.0039	.0029	.4100	.0850	.1620	.0530	7.1700	1.0000	2.6200
CO ₂ , %.....	14.45	13.45	7.80	14.43	14.25	13.95	13.60	10.70	13.95	12.85
O ₂ , %.....	.75	2.15	1.70	1.53	1.30	1.55	1.97	1.2	1.23	1.14
HC, ppmC.....	18	15	32	566	161	195	1646	5767	865	1210
NOx, ppm.....	1100	900	750	280	275	140	131	80	3200	1675
Air-fuel ratio.....	15.46	16.52	17.10	15.11	15.77	15.91	16.13	11.72	14.65	13.81
Emission rates, g/hr:										
CO.....	58.2	5.5	2.7	283.4	55.1	95.5	29.6	14052.9	2097.0	4809.7
HC.....	1.5	1.1	1.5	19.7	5.3	5.8	46.4	569.6	91.4	111.9
NOx**.....	295.0	204.0	112.7	32.2	29.6	13.7	12.2	25.3	1082.2	495.9
Exhaust temperature, F.....	1488	1335	1184	1008	1026	1042	1040	1340	1370	1436
Exhaust pressure, in H ₂ O.....	47.0	29.0	4.0	4.4	3.4	2.5	1.9	76.0	58.0	46.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine.....
Fuel.....

	51 9/ 8/75	52 9/ 8/75	53 9/10/75	54 9/10/75	55 9/10/75	56 9/ 8/75	57 8/27/75	58 8/27/75	59 8/27/75	60 8/29/75
Test Number.....	746.0	746.0	740.5	740.5	740.5	746.0	749.9	749.9	749.9	742.6
Test Date.....	70 69	70 67	77 71	77 71	77 71	70 67	71 71	71 71	71 86	71 67
Barometer, mm Hg.....	4400	4400	4400	4400	4400	4400	700	600	1000	1000
Humidity, grains/lb.....	47.5	24.0	14.0	9.0	5.0	0.0	0.0	7.5	96.0	86.0
Temperature, F.....	39.3	19.8	11.7	4.2	4.2	0.0	0.0	.8	18.3	16.2
Torque, lb-ft.....	23.8	17.3	13.7	12.3	11.4	10.8	2.0	1.9	10.4	7.6
Power, bhp*.....	42.5	52.0	54.0	53.0	54.0	52.0	10.0	10.0	15.0	13.0
Fuel rate, lb/hr.....	8.5	13.3	14.7	15.7	16.5	17.1	15.0	13.0	0.0	2.0
Ignition timing, deg BTC.....	42.0	23.0	19.0	18.0	17.0	16.0	0.0	0.0	75.0	28.0
Manifold vacuum, in Hg.....										
Throttle angle, deg.....										
Before Catalyst Concentrations, dry basis:										
CO, %.....	1.1200	1.7500	1.2700	2.1000	2.6200	1.5700	.2000	.1500	6.8500	2.6200
CO ₂ , %.....	13.60	13.30	14.25	13.60	13.30	13.75	9.05	9.68	10.45	14.05
O ₂ , %.....	.37	.45	.35	.27	.30	.55	7.75	7.15	.42	.78
HC, ppmC.....	2128	3109	2606	3065	3586	2772	13705	11026	4941	3203
NO _x , ppm.....	2600	1400	1125	630	360	233	10	13	210	3200
Air-fuel ratio.....	14.54	14.19	14.39	13.94	13.69	14.34	20.02	19.74	11.97	14.14
Emission rates, g/hr:										
CO.....	1577.0	1751.7	1013.8	1458.9	1662.5	984.0	33.3	23.9	3527.8	1129.5
HC.....	151.0	156.8	104.8	107.3	114.7	87.5	114.8	88.4	128.2	69.6
NO _x **.....	587.0	224.7	148.9	72.5	37.9	23.4	.3	.3	17.4	222.8
Oil temperature, F.....	280	275	268	263	260	260	179	182	190	196
Oil pressure, psi.....	34	34	37	36	36	37	26	26	28	28
Coolant temperature, F.....	191	191	191	191	190	191	191	193	194	188
Exhaust temperature, F.....	1504	1381	1365	1327	1312	1369	766	737	1000	1031
Exhaust pressure, in H ₂ O.....	52.0	27.0	20.0	16.0	11.4	8.0	0.0	0.0	7.0	6.0
After Catalyst Concentrations, dry basis:										
CO, %.....	1.1200	1.5700	1.0000	1.5700	2.4700	1.6500	.0018	.0021	6.8500	.4700
CO ₂ , %.....	13.75	13.60	14.80	13.95	13.30	13.60	11.00	11.10	10.55	14.60
O ₂ , %.....	.20	.18	.10	.08	.25	.60	5.55	5.30	.20	.10
HC, ppmC.....	1267	2076	1220	2314	2890	2308	117	123	4514	145
NO _x , ppm.....	2650	1350	1075	480	270	175	27	30	220	2000
Air-fuel ratio.....	14.52	14.20	14.49	14.10	13.77	14.37	19.85	19.58	11.90	14.84
Emission rates, g/hr:										
CO.....	1572.6	1569.6	800.4	1102.5	1577.1	1037.4	.3	.3	3504.4	213.5
HC.....	89.7	104.6	49.2	81.9	93.0	73.1	1.0	1.0	116.4	3.3
NO _x **.....	596.6	216.4	142.6	55.9	28.6	17.6	.7	.8	18.1	146.8
Exhaust temperature, F.....	1349	1253	1121	1103	1056	1102	746	742	784	781
Exhaust pressure, in H ₂ O.....	24.0	10.0	7.0	5.4	2.7	4.0	0.0	0.0	2.5	.5

* Corrected - SAE J816b
** Corrected for humidity.

Engine..... GH 140-CID
 Fuel..... 7516

	61	62	63	64	65	66	67	68	69	70
Test Number.....	749.9	749.9	749.9	749.9	749.9	749.9	749.9	749.9	749.9	749.9
Test Date.....	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75
Barometer, mm Hg.....	71	71	71	71	71	71	71	71	71	71
Humidity, grains/lb.....	87	65	65	65	65	65	65	64	65	64
Temperature, F.....										
Engine speed, rpm.....	1000	1000	1000	1000	1000	1000	1000	1500	1500	1500
Torque, lb-ft.....	72.0	48.0	24.0	14.0	9.0	4.0	10.0	96.0	86.0	72.0
Power, bhp*.....	15.7	9.0	4.5	2.6	1.7	0.7	1.9	26.8	24.1	20.1
Fuel rate, lb/hr.....	7.0	5.6	4.4	3.7	2.9	2.6	2.5	17.7	12.4	10.7
Ignition timing, deg. BTC.....	15.0	13.0	11.0	11.0	9.5	10.0	9.0	10.0	9.0	9.5
Manifold vacuum, in Hg.....	2.5	5.6	9.8	12.6	17.0	17.4	17.8	1.0	2.0	2.8
Throttle angle, deg.....	24.5	14.5	9.0	7.0	5.0	2.7	2.5	76.0	34.5	29.5
Before Catalyst										
Concentrations, dry basis:										
CO, %.....	.0570	.2300	.9000	.6500	.2530	.1720	.1900	8.1700	1.2500	.1620
CO ₂ , %.....	13.30	13.75	13.60	13.45	13.30	12.40	12.25	9.30	13.30	13.60
O ₂ , %.....	2.30	1.50	1.25	1.65	2.25	3.50	3.75	3.35	3.85	1.35
HC, ppmC.....	3078	3867	5917	5728	4280	4129	4520	4624	3272	3031
NOx, ppm.....	2050	320	78	67	88	40	35	152	1500	1175
Air-fuel ratio.....	16.29	15.45	14.76	15.15	15.93	17.01	17.16	11.37	14.64	15.51
Emission rates, g/hr:										
CO.....	26.4	80.7	239.4	149.3	48.0	30.8	33.8	6867.2	927.9	109.4
HC.....	71.7	68.3	79.3	66.3	40.9	37.3	40.5	195.9	122.4	103.2
NOx**.....	152.6	18.1	3.3	2.5	2.7	1.2	1.0	20.6	173.3	127.8
Oil temperature, F.....	204	199	200	197	196	193	191	194	211	220
Oil pressure, psi.....	27	29	27	27	28	28	28	31	30	30
Coolant temperature, F.....	189	192	190	189	188	188	189	193	191	190
Exhaust temperature, F.....	1071	982	929	948	887	868	905	1175	1294	1311
Exhaust pressure, in H ₂ O.....	4.0	5.0	3.0	2.0	1.5	1.0	1.0	17.0	17.0	13.0
After Catalyst										
Concentrations, dry basis:										
CO, %.....	.0046	.0037	.4630	.0750	.0031	.0028	.0029	8.3500	.6050	.0071
CO ₂ , %.....	13.75	14.25	14.60	14.60	13.60	13.00	12.85	9.55	14.25	14.25
O ₂ , %.....	1.70	.80	.05	1.40	1.85	2.90	3.00	1.10	.05	.70
HC, ppmC.....	143	144	405	138	160	176	238	3465	.75	.40
NOx, ppm.....	1750	300	17	50	94	60	52	140	600	1062
Air-fuel ratio.....	16.18	15.47	14.72	15.15	16.24	17.09	17.18	11.32	14.70	15.44
Emission rates, g/hr:										
CO.....	2.1	1.3	122.0	17.1	.6	.5	.5	6967.9	448.5	4.7
HC.....	3.3	2.5	5.4	1.6	1.6	1.6	2.1	145.7	2.8	1.4
NOx**.....	129.0	16.9	.7	1.8	2.9	1.7	1.5	18.8	71.6	114.4
Exhaust temperature, F.....	880	835	798	774	757	691	648	921	1005	1131
Exhaust pressure, in H ₂ O.....	1.2	.2	0.0	0.0	0.0	0.0	0.0	6.0	9.0	6.0

* Corrected - SAE J8716b
 ** Corrected for humidity.

GH 140-CID
7516

Engine.....	71	72	73	74	75	76	77	78	79	80
Fuel.....	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75	8/27/75
Test Number.....	749.9	749.9	749.9	749.9	749.9	749.9	749.9	749.9	749.9	749.9
Test Date.....	71	71	71	71	71	71	71	71	71	71
	65	65	65	65	65	65	65	65	65	65
Barometer, mm Hg.....	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000
Humidity, grains/lb.....	48.0	24.0	14.0	9.0	4.0	1.0	100.0	90.0	75.0	50.0
Temperature, F.....	13.4	6.7	3.9	2.5	1.1	.3	37.3	33.6	28.0	18.7
Engine speed, rpm.....	9.0	7.3	6.3	5.9	5.4	5.2	22.7	16.0	13.5	11.2
Torque, lb-ft.....	9.0	9.0	10.0	10.0	9.0	9.0	16.0	15.0	15.5	15.5
Power, bhp.....	4.6	7.8	9.4	11.0	12.0	13.0	1.0	2.0	3.0	6.0
Fuel rate, lb/hr.....	23.0	16.0	12.2	10.5	9.0	8.2	76.0	42.0	35.0	24.9
Ignition timing, deg BDC.....										
Ignifold vacuum, in Hg.....										
Throttle angle, deg.....										
Before Catalyst										
Concentrations, dry basis:										
CO, %.....	.1250	.4300	.7250	9.600	1.1000	1.2000	7.2500	1.6500	3.100	.1800
CO ₂ , %.....	13.60	13.30	13.30	13.00	12.70	12.70	10.05	13.00	13.60	13.95
O ₂ , %.....	1.47	1.80	1.60	1.75	2.00	2.00	.25	1.30	1.45	1.25
HC, ppmC.....	2516	3999	5151	7087	3841	10273	3324	2123	2004	2008
NOx, ppm.....	350	120	69	58	52	47	300	1375	1162	390
Air-fuel ratio.....	15.64	15.56	15.15	14.94	14.86	14.67	11.80	14.87	15.62	15.50
Emission rates, g/hr:										
CO.....	71.7	199.1	283.7	244.8	363.0	377.7	8054.8	1602.8	266.7	126.7
HC.....	72.7	93.3	101.6	128.3	147.0	163.0	186.1	103.9	86.9	71.2
NOx**.....	35.2	8.9	4.5	5.4	2.8	2.4	53.7	215.0	160.9	44.2
Oil temperature, F.....	222	221	218	217	215	213	216	234	238	236
Oil pressure, psi.....	30	30	30	30	30	30	34	32	32	31
Coolant temperature, F.....	190	189	191	191	190	190	193	193	193	191
Exhaust temperature, F.....	1296	1242	1185	1171	1170	1174	1244	1331	1353	1326
Exhaust pressure, in H ₂ O.....	9.0	6.5	5.0	3.5	2.0	2.0	30.0	25.0	21.0	13.0
After Catalyst										
Concentrations, dry basis:										
CO, %.....	.0089	.1300	.1950	3.750	.4630	.5200	7.1700	.4100	.0058	.0064
CO ₂ , %.....	13.95	14.25	14.25	14.25	14.25	14.25	10.30	14.60	14.15	14.25
O ₂ , %.....	1.17	.85	.45	.20	.20	.10	.02	.10	1.00	.75
HC, ppmC.....	52	58	63	69	81	92	2527	29	44	40
NOx, ppm.....	350	80	50	34	30	25	188	465	1175	450
Air-fuel ratio.....	15.75	15.44	15.14	14.89	14.85	14.75	11.80	14.82	15.65	15.45
Emission rates, g/hr:										
CO.....	5.1	59.4	75.8	133.2	151.0	162.8	7944.8	394.2	5.0	4.5
HC.....	1.5	1.3	1.2	1.2	1.3	1.5	141.1	1.4	1.9	1.4
NOx**.....	35.4	5.9	3.1	1.9	1.6	1.3	33.5	72.0	162.6	50.7
Exhaust temperature, F.....	1076	1043	1045	1035	1047	1042	1097	1135	1271	1157
Exhaust pressure, in H ₂ O.....	3.0	2.0	.5	.1	0.0	0.0	15.0	11.0	10.0	5.0

** Corrected - SAL J816b
** Corrected for humidity.

GH 140-CID
-516

Engine.....
Fuel.....

	81 8/27/75	82 8/27/75	83 8/27/75	84 8/27/75	85 8/27/75	86 9/ 8/75	87 9/ 8/75	88 8/29/75	89 8/29/75	90 8/29/75
Test Number.....	749.9	749.9	749.9	749.9	749.9	746.0	746.0	742.6	742.6	742.6
Test Date.....	71 65	71 64	71 65	71 64	71 65	71 70	71 68	71 69	71 69	71 69
Barometer, mm Hg.....	2000	2003	2000	2000	2000	2800	2800	2800	2800	2800
Humidity, grains/lb.....	25.0	15.0	13.0	5.0	0.0	115.0	104.0	77.0	51.0	26.0
Temperature, F.....	9.2	5.6	3.7	1.9	0.0	60.7	54.8	40.8	27.0	13.8
Engine speed, rpm.....	7.8	7.0	6.8	6.2	5.7	31.3	26.5	20.3	15.5	10.4
Torque, lb-ft.....	23.0	23.0	21.0	19.0	17.0	19.5	19.5	20.0	20.0	34.0
Fuel rate, lb/hr.....	11.3	13.0	13.8	14.0	15.2	1.0	1.4	2.2	5.7	12.7
Ignition timing, deg BTDC.....	15.0	10.5	9.0	7.9	5.2	76.0	70.0	48.0	31.0	17.0
Throttle angle, deg.....										
Before Catalyst Concentrations, dry basis:										
CO, %.....	5800	5950	6500	11500	12200	60700	32200	8250	1620	6200
CO ₂ , %.....	13.60	13.75	13.50	12.85	12.70	11.00	12.40	13.00	13.60	13.95
O ₂ , %.....	1.40	1.65	1.15	1.50	1.75	3.33	1.60	1.67	1.65	.80
HC, ppmC.....	174	3997	4004	5942	7420	3195	2705	1570	904	2100
NOx, ppm.....	132	95	72	53	52	780	1975	1563	625	335
Air-fuel ratio.....	15.51	15.37	15.00	14.80	14.73	12.37	13.71	15.59	15.94	14.98
Emission rates, g/hr:										
CO.....	237.7	262.7	271.2	429.8	423.6	9652.3	4779.3	1067.2	162.7	393.9
HC.....	4.4	89.9	34.2	111.9	129.3	256.0	202.3	102.4	45.7	67.2
NOx**.....	12.2	6.6	4.8	3.5	2.9	200.0	472.8	326.6	101.4	34.4
Oil temperature, F.....	231	224	213	216	213	265	260	259	255	250
Oil pressure, psi.....	51	32	33	34	35	34	32	30	31	31
Coolant temperature, F.....	191	191	170	189	190	194	191	191	191	190
Exhaust temperature, F.....	1201	1214	1196	1225	1232	1395	1448	1455	1428	1221
Exhaust pressure, in H ₂ O.....	8.0	6.0	1.5	1.0	.5	63.0	54.0	41.0	27.0	12.5
After Catalyst Concentrations, dry basis:										
CO, %.....	1030	1620	3100	5200	5200	62000	33500	6032	6032	10000
CO ₂ , %.....	14.15	14.15	14.25	14.05	14.05	11.00	12.55	14.05	13.75	14.25
O ₂ , %.....	.65	.35	.20	.20	.15	.06	.13	.90	1.50	.05
HC, ppmC.....	57	57	63	69	86	2362	1528	29	46	87
NO _x , ppm.....	112	70	53	28	50	620	1800	1275	650	100
Air-fuel ratio.....	15.32	15.09	14.92	14.82	14.73	12.24	13.48	15.59	16.01	14.52
Emission rates, g/hr:										
CO.....	50.1	69.8	127.8	195.2	179.1	9754.3	4885.3	6.8	3.2	613.9
HC.....	1.4	1.2	1.3	1.3	1.5	187.2	112.3	1.9	2.3	2.7
NOx**.....	8.8	4.9	2.5	1.7	1.7	157.3	423.3	265.2	105.9	9.9
Exhaust temperature, F.....	1099	1047	997	997	1010	1262	1319	1372	1245	1130
Exhaust pressure, in H ₂ O.....	9.5	.4	.1	0.0	0.0	32.0	25.0	21.0	8.0	.8

* Corrected - SAE J816b
** Corrected for humidity.

Engine..... GH 140-CID
 Fuel..... 7516

Test Number.....	95 8/29/75	94 8/29/75	94 9/ 6/75	95 8/29/75	96 8/29/75	97 9/ 3/75	98 9/ 3/75	99 9/ 3/75	100 9/ 8/75	101 9/ 8/75	102 9/ 8/75	103 9/ 8/75
Barometer, mm Hg.....	742.6	742.6	748.7	742.6	742.6	745.0	745.0	745.0	746.0	746.0	746.0	746.0
Humidity, grains/lb.....	71	71	70	71	71	79	79	79	71	71	71	71
Temperature, F.....	67	67	64	70	69	70	71	70	67	67	67	67
Engine speed, rpm.....	2800	2800	2800	3600	3600	3600	3600	3600	3600	3600	3600	3600
Torque, lb-ft.....	15.0	10.0	0.0	57.0	87.0	73.0	73.0	73.0	16.0	11.0	5.0	0.0
Power, bhp.....	6.9	3.2	0.0	66.1	59.2	49.7	49.7	49.7	10.8	7.4	3.4	0.0
Fuel rate, lb/hr.....	3.1	8.7	7.3	36.4	30.2	26.8	21.5	21.5	11.5	10.6	9.5	8.8
Ignition timing, deg.BTDC.....	29.5	33.5	30.0	24.5	24.5	26.0	23.5	23.5	44.0	44.0	40.5	40.0
Manifold vacuum, in Hg.....	14.4	14.8	16.2	1.0	1.8	2.6	3.4	3.4	15.3	16.3	17.0	17.1
Throttle angle, deg.....	13.0	12.0	10.0	72.0	56.0	53.5	50.2	24.0	17.0	16.0	15.0	14.0
Before Catalyst Concentrations, dry basis:												
CO, %.....	7500	3080	6500	47000	21000	8080	1430	6650	15700	19000	17000	2700
CO ₂ , %.....	13.75	14.05	13.95	12.10	13.15	13.15	12.25	13.95	13.60	13.60	13.60	13.95
O ₂ , %.....	1.70	1.60	1.10	2.24	1.57	1.65	3.60	3.52	3.30	3.28	3.30	1.25
HC, ppm.....	1897	1902	2417	2023	1814	1301	1073	1842	2018	2166	2135	861
NOx, ppm.....	185	153	85	1438	2350	1725	860	880	400	250	145	145
Air-fuel ratio.....	14.97	14.78	15.12	13.00	14.27	15.63	17.58	14.86	14.25	14.09	14.18	15.57
Emission rates, g/hr:												
CO.....	411.1	420.6	290.7	9074.1	3685.5	1379.0	221.2	539.3	1049.5	1147.4	931.4	149.8
HC.....	52.4	49.9	54.5	196.8	160.5	103.3	83.7	75.3	68.0	65.9	59.0	24.1
NOx**.....	16.4	12.8	6.1	448.3	666.2	494.0	223.3	119.7	43.1	24.3	12.8	13.0
Oil temperature, F.....	237	242	235	274	285	268	275	268	250	250	250	250
Coolant temperature, F.....	35	35	34	32	32	32	34	34	35	35	35	35
Exhaust temperature, F.....	191	191	190	193	191	191	190	190	192	191	190	191
Exhaust pressure, in H ₂ O.....	7.0	6.0	5.0	98.0	83.0	75.0	61.0	22.0	7.0	4.8	3.2	2.5
After Catalyst Concentrations, dry basis:												
CO, %.....	3100	4100	1030	48700	20700	9125	9095	3100	15700	15700	17000	9145
CO ₂ , %.....	14.60	14.60	14.25	11.95	13.60	14.05	12.55	14.43	13.00	13.00	12.70	13.45
O ₂ , %.....	.05	.01	.85	1.07	.11	1.20	3.50	3.50	1.85	1.92	1.57	2.00
HC, ppm.....	4	5	98	1444	405	26	27	51	1147	1262	1374	40
NOx, ppm.....	53	38	45	1050	1875	1700	950	350	370	208	123	128
Air-fuel ratio.....	14.81	14.75	15.45	12.86	14.12	15.81	17.69	14.86	14.67	14.92	15.06	16.38
Emission rates, g/hr:												
CO.....	168.4	212.6	47.0	9315.3	3584.9	21.5	14.8	250.9	1084.5	1007.8	993.7	8.5
HC.....	1.1	1.1	2.3	139.2	35.3	2.3	2.1	2.1	40.9	40.9	40.5	1.2
NOx**.....	4.6	3.2	3.3	324.4	524.5	490.6	247.6	47.5	41.2	21.5	11.5	12.0
Exhaust temperature, F.....	1034	1039	1035	1310	1393	1424	1343	1194	1072	1024	1009	1024
Exhaust pressure, in H ₂ O.....	2.0	.5	1.9	62.0	45.5	43.0	36.0	4.7	.2	0.0	0.0	0.0

** Corrected - SAE J816
 ** Corrected for humidity.

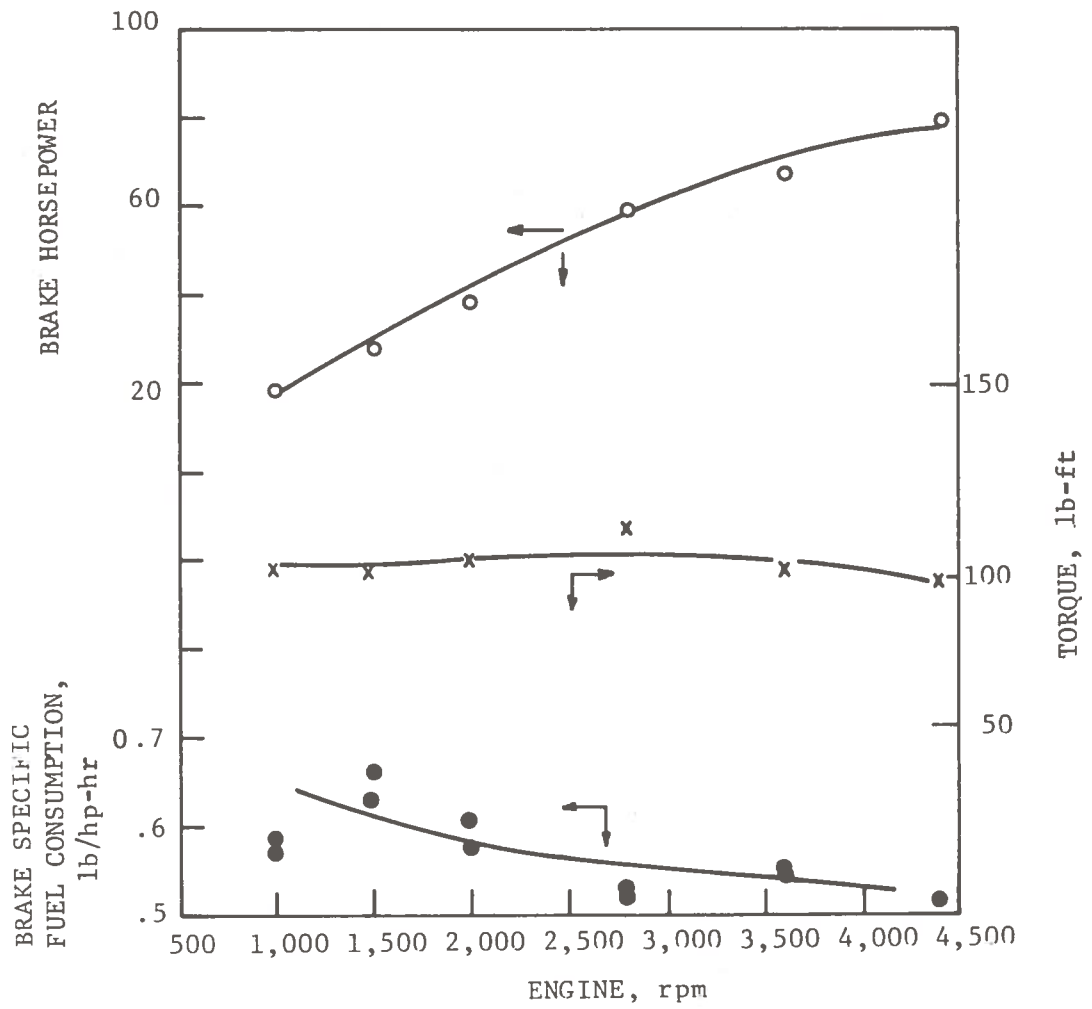


FIGURE 1. - Brake Specific Fuel Consumption, Torque and Brake Horsepower versus Engine rpm at Wide-Open-Throttle--GM 140-CID, 2V Engine.

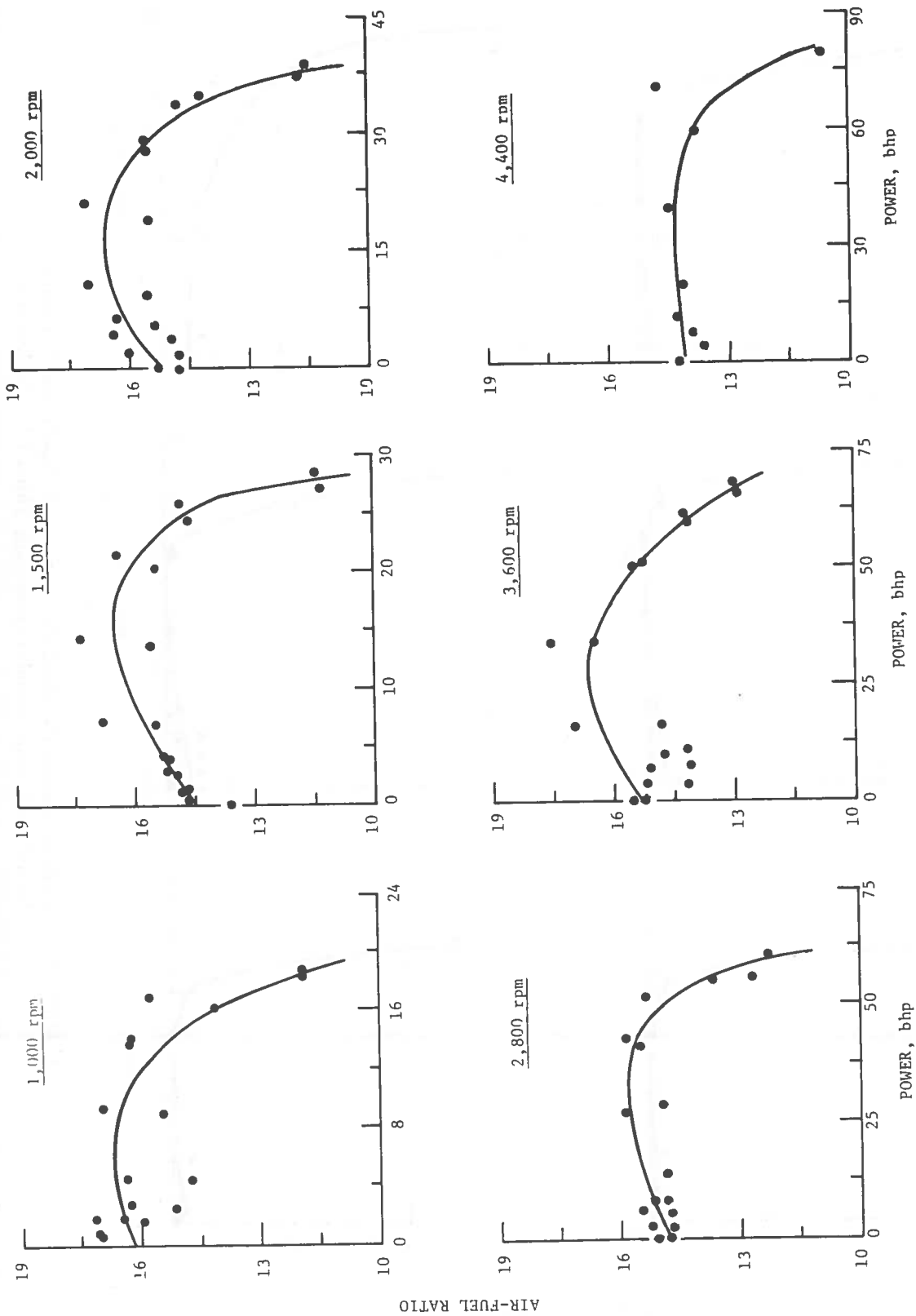


FIGURE 2. - Air-Fuel Ratio versus Power at Various Speed and Load Conditions--GM 140-CID, 2V Engine.

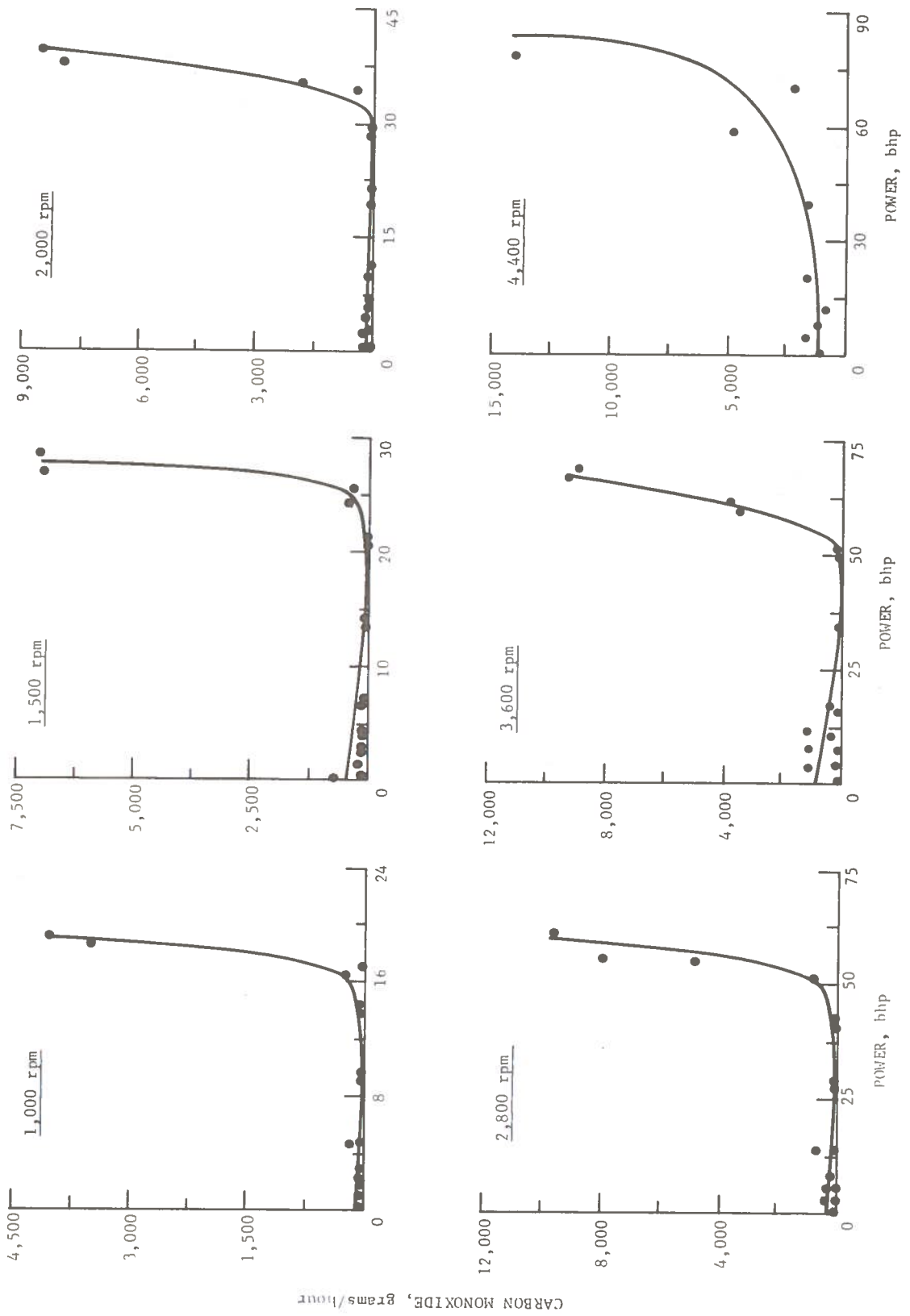


FIGURE 3. - Carbon Monoxide Emissions versus Power at Various Speed and Load Conditions--GM 140-CID, 2V Engine.

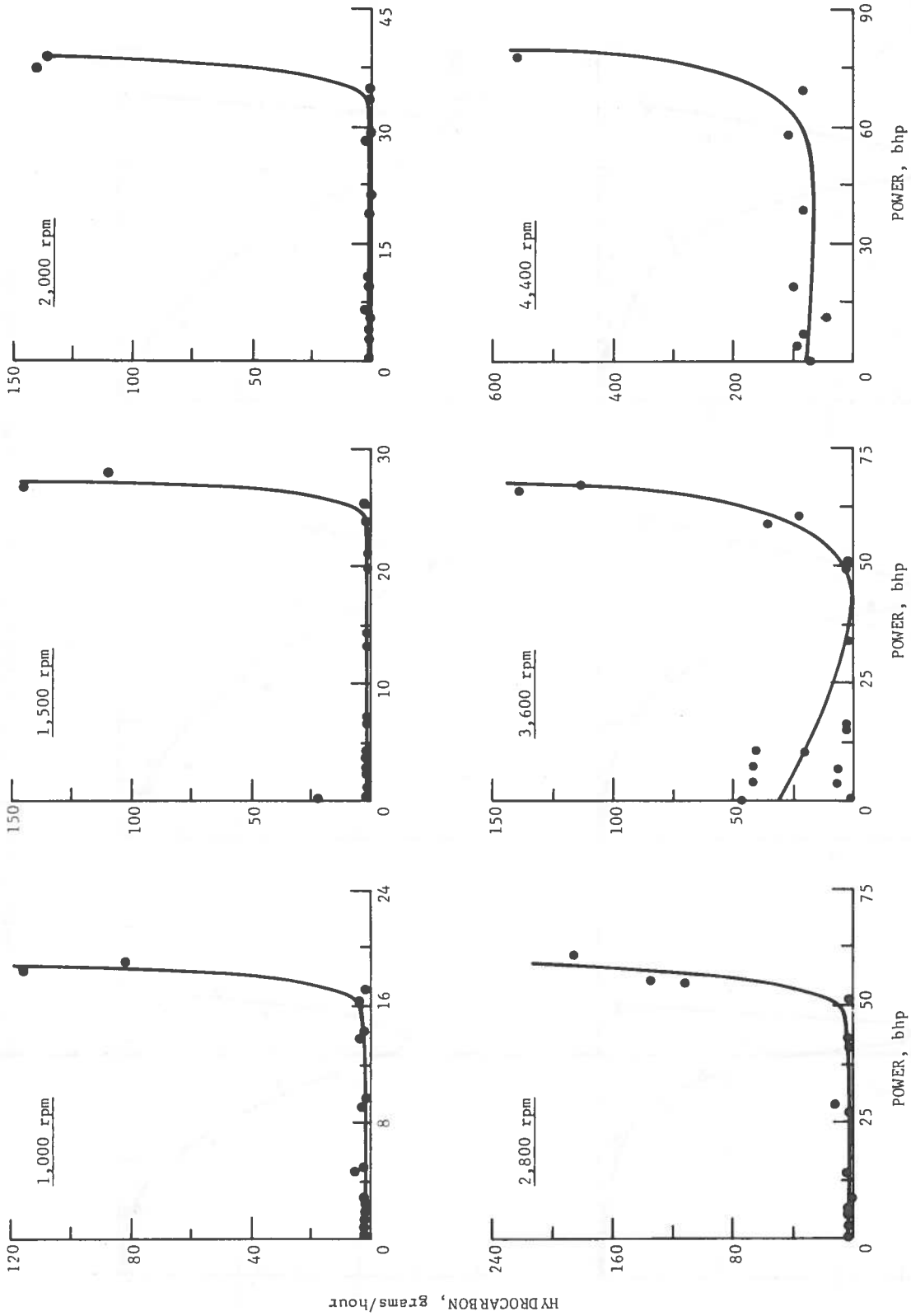


FIGURE 4. - Hydrocarbon Emissions versus Power at Various Speed and Load Conditions--GM 140-CID, 2V Engine.

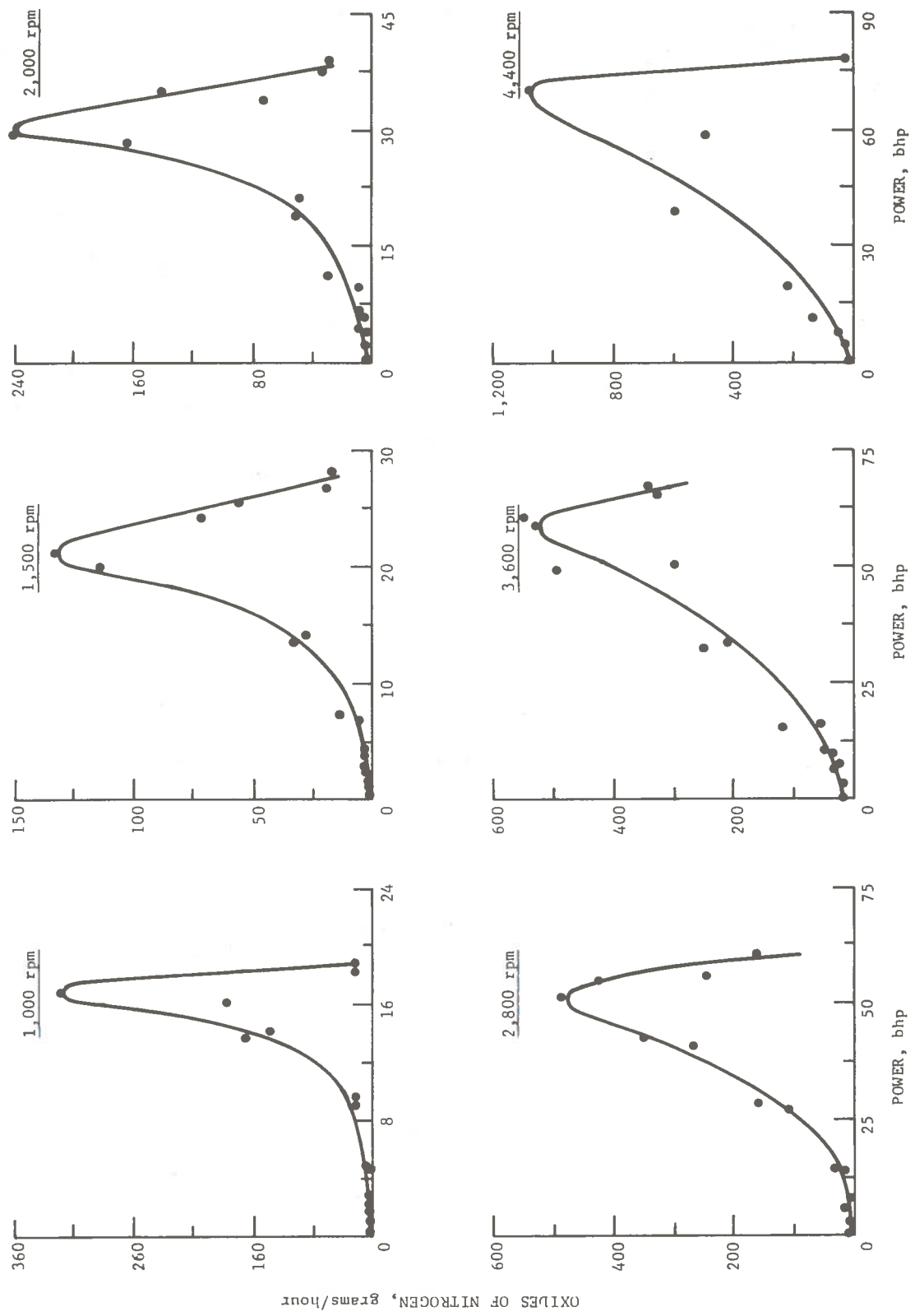


FIGURE 5. - Oxides of Nitrogen Emissions versus Power at Various Speed and Load Conditions--GM 140-CID, 2V Engine.

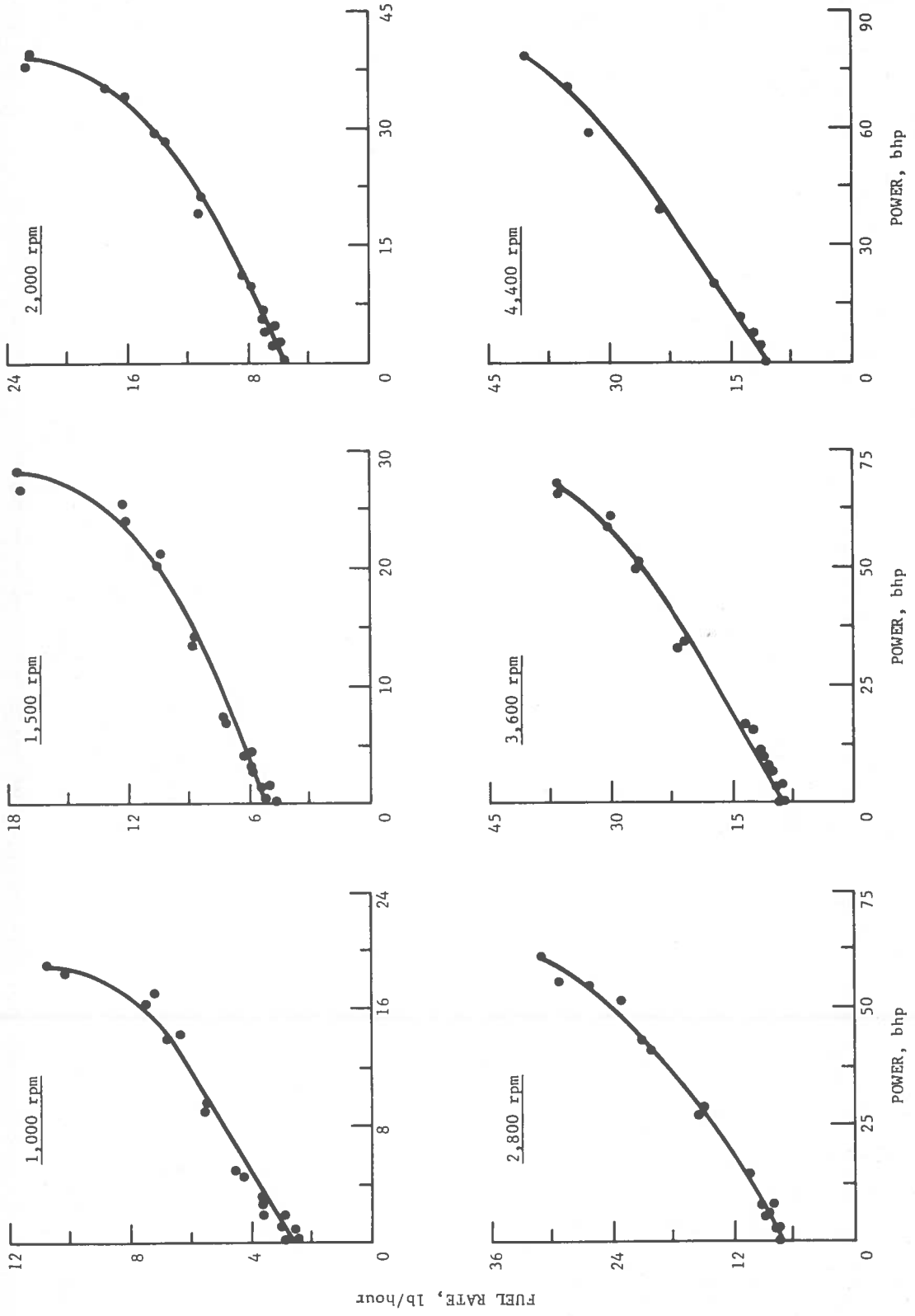


FIGURE 6. - Fuel Rate versus Power at Various Speed and Load Conditions--GM 140-CID, 2V Engine.

