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HS-803 330

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES
IN THE UNITED STATES

First Series - Report No. 20
1975 Chevrolet 350 CID (5.7 Liters)
With Dresser Variable-Area Venturi System

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MAY 1978

INTERIM REPORT

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16. Abstract Experimental data were obtained in dynamometer tests of a 1975 Chevrolet 350 CID engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.					
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PREFACE

This report, prepared by the U.S. Department of Energy, Bartlesville Energy Research Center, for the U.S. Department of Transportation, Transportation Systems Center, Energy Technology Branch, Cambridge MA, presents results of experimental work to obtain information on performance characteristics of an engine used in automobiles sold in the U.S. The engine used in this work is one of a series of 23 engines to be tested in the current program. This is the twentieth of the reports to be published covering work with those engines.

This project is funded by the National Highway Traffic Safety Administration, Office of Research and Development, Office of Passenger Vehicle Research, Technology Assessment Division.

Ralph G. Colello and James A. Kidd, Jr., of the U.S. Department of Transportation, Transportation Systems Center, are the technical monitors.

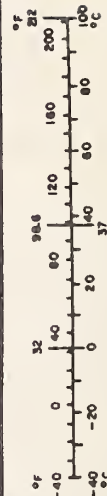
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

When You Know	Symbol	To Find	Symbol
LENGTH			
inches	in	centimeters	cm
feet	ft	centimeters	cm
yards	yd	meters	m
miles	mi	kilometers	km
AREA			
square inches	in ²	square centimeters	cm ²
square feet	ft ²	square meters	m ²
square yards	yd ²	square meters	m ²
square miles	mi ²	square kilometers	km ²
acres		hectares	ha
MASS (weight)			
ounces	oz	grams	g
pounds	lb	kilograms	kg
short tons (2000 lb)		tonnes	t
VOLUME			
teaspoons	ts	milliliters	ml
tablespoons	ts	milliliters	ml
fluid ounces	fl oz	milliliters	ml
cups	c	liters	l
pints	p	liters	l
quarts	qt	liters	l
gallons	gal	liters	l
cubic feet	ft ³	cubic meters	m ³
cubic yards	yd ³	cubic meters	m ³
TEMPERATURE (exact)			
Fahrenheit temperature	°F	Celsius temperature	°C
5/9 (after subtracting 32)			

Approximate Conversions from Metric Measures

When You Know	Symbol	To Find	Symbol
LENGTH			
millimeters	mm	inches	in
centimeters	cm	inches	in
meters	m	feet	ft
kilometers	km	miles	mi
AREA			
square centimeters	cm ²	square inches	in ²
square meters	m ²	square yards	yd ²
square kilometers	km ²	square miles	mi ²
hectares (10,000 m ²)	ha	acres	
MASS (weight)			
grams	g	ounces	oz
kilograms	kg	pounds	lb
tonnes (1000 kg)	t	short tons	
VOLUME			
milliliters	ml	fluid ounces	fl oz
liters	l	pints	p
liters	l	quarts	qt
liters	l	gallons	gal
cubic meters	m ³	cubic feet	ft ³
cubic meters	m ³	cubic yards	yd ³
TEMPERATURE (exact)			
Celsius temperature	°C	Fahrenheit temperature	°F
9/5 (then add 32)			



1. INTRODUCTION

Data acquired from steady-state tests of a 1975 Chevrolet 350 CID (cubic-inch-displacement) engine equipped with a special fuel metering system are presented in this report. A prototype variable-area venturi carburetor manufactured by Dresser Industries was used in place of the standard carburetor system. The test results are sufficient to establish maps of fuel consumption and emissions of carbon monoxide, unburned hydrocarbons, and oxides of nitrogen over the operating range of the modified engine.

2. ENGINE TEST REPORT

General specifications for the engine and fuel system utilized in these tests may be found in table 1. A single batch of regular grade unleaded gasoline was used throughout the test program. An analysis of the fuel appears in table 2.

Prior to testing, the standard carburetor of a test-stand-mounted mean-tolerance Chevrolet 350 CID V8 engine (which has been used in previous experimental studies) was removed and replaced with a prototype variable area venturi system manufactured by Dresser Industries. This device is designed to reduce the cylinder-to-cylinder variation in air/fuel mixture typical of multicylinder engines. With a uniform mixture being delivered to each cylinder, an engine should be able to operate at leaner air/fuel ratios than an engine equipped with a conventional carburetor system.

The standard Chevrolet exhaust-gas-recirculation (EGR) system was utilized for NO_x control. Exhaust-gas-recirculation was completely cut off at engine idle, and at other speeds was controlled by a manifold vacuum signal applied to the EGR valve diaphragm.

Steady-state tests of the engine were made at the speed and load conditions indicated in table 3. The Dresser device was adjusted and/or repositioned on the intake manifold to provide uniform cylinder-to-cylinder mixture distribution at an air-fuel ratio of approximately 18:1. Exhaust gas samples were obtained both before and after treatment by a catalytic converter.

The following data were recorded at each test point:

Test number
Date
Barometric pressure, mm Hg
Dewpoint, °F
Inlet air temperature, °F
Speed, rpm
Torque, lb-ft -- BLH strain gage load cell; Daytronics indicator
Fuel rate, lb/hr -- Fluidyne positive displacement fuel flowmeter
Ignition timing, °BTC
Manifold vacuum, in. Hg
Venturi opening, pct
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. H_2O
 Intake manifold temperature, °F.

The following equations were used in calculating power, air/fuel ratio, absolute humidity, and mass emission rates of carbon monoxide (CO), unburned hydrocarbons (HC), and oxides of nitrogen (NO_x):

1. Partial pressure of water vapor in intake air (millimeters of mercury):

$$P = \exp \left[18.717 - \frac{7308.1}{393 + D} \right] ,$$

where D = dewpoint, °F.

2. Absolute humidity (grains moisture per pound dry air):

$$H = \frac{4347.8(P)}{B - P} ,$$

where B = barometric pressure, mm Hg.

3. Humidity correction factor (dimensionless):

$$K_H = \frac{1}{1 - 0.0047(H - 75)} .$$

Note: This factor is used to correct the NO_x mass emission rate to a standard humidity of 75 grains moisture per pound dry air.

4. Stoichiometric air/fuel ratio (dimensionless):

$$\text{AF}_s = \frac{69(2 + \frac{x}{2} - y)}{\text{MW}_{\text{fuel}}} ,$$

where x = hydrogen-carbon atomic ratio of fuel,
 y = oxygen-carbon atomic ratio of fuel,
 MW_{fuel} = fuel molecular weight per carbon atom,
 $= 12.01115 + 1.00797x + 15.9994y$.

5. Hydrogen concentration in raw exhaust (percent):

$$H_2 = \frac{x(CO)(CO + CO_2)}{2(CO + 3CO_2)},$$

where CO = carbon monoxide concentration (percent)
CO₂ = carbon dioxide concentration (percent)

Note: This equation assumes a water-gas shift equilibrium constant

$$\frac{(CO)(H_2O)}{(CO_2)(H_2)} = 3.$$

6. Correction factor for emission concentrations from wet basis to dry basis (dimensionless):

$$C_w = 1 + \frac{(\frac{x}{2})(CO + CO_2) - H_2}{100}.$$

Note: In these tests only HC is measured on a wet basis.
All other species are measured on a dry basis.

7. Air/Fuel ratio (dimensionless):

$$AF = \frac{AF_s}{2 + \frac{x}{2} - y} \left[\frac{(1 + \frac{x}{2} - y)(CO) + (2 + \frac{x}{2} - y)(CO_2) + 2(O_2) + \frac{NO_x}{10^4} - H_2}{CO + CO_2 + C_w \left(\frac{HC}{10^4} \right)} \right],$$

where O₂ = oxygen concentration (percent),
NO_x = oxides of nitrogen (ppm),
HC = unburned hydrocarbon concentration (ppmC).

8. Exhaust flow (pounds per hour):

$$M_{EX} = M_F(1 + AF),$$

where M_F = fuel flow rate (pounds per hour).

9. Carbon monoxide mass emission rate (grams per hour):

$$M_{CO} = \frac{M_{EX}}{C_w} \left(\frac{CO}{100} \right) \left(\frac{MW_{CO}}{MW_{EX}} \right) 453.59237,$$

where MW_{CO} = molecular weight of CO (=28.01115),
MW_{EX} = molecular weight of exhaust gas (=28.967).

10. Unburned hydrocarbon mass emission rate (grams per hour):

$$M_{HC} = M_{EX} \left(\frac{HC}{10^6} \right) \left(\frac{MW_{HC}}{MW_{EX}} \right) 453.59237,$$

where MW_{HC} = molecular weight per carbon atom of HC,
 $= 12.01115 + 1.00797x + 15.9994y$.

11. Oxides of nitrogen mass emission rate (grams per hour):

$$M_{NO_x} = \frac{M_{EX}}{C_w} \left(\frac{NO_x}{10^6} \right) \left(\frac{MW_{NO_x}}{MW_{EX}} \right) (K_H) 453.59237,$$

where MW_{NO_x} = molecular weight of NO_2 (=46.0028).

12. Power (brake horsepower corrected to a standard barometric pressure of 736.6 mm Hg and a standard temperature of 85° F):

$$HP = \frac{N(T)}{5252.113} \left(\frac{736.6}{B - P} \right) \sqrt{\frac{t + 460}{545}},$$

where N = engine speed (revolutions per minute),
 T = brake torque (foot-pounds),
 t = air temperature (°F).

3. DISCUSSION OF TEST RESULTS

The prototype fuel metering system used on this engine did enable operation at leaner air/fuel ratios than the standard carburetor system. Due to the small venturi area, maximum power was limited to less than 40 pct of that available with the standard carburetor system. Since the engine was operated at air/fuel ratios leaner than stoichiometric for all test conditions, the catalytic converter was very effective in controlling carbon monoxide and unburned hydrocarbons. See figures 1-5.

The repeatability of emission rates, fuel consumption, and engine performance was satisfactory for the purposes of these tests.

4. CONCLUSIONS

The purpose of the experimental work reported here is to establish data for this engine. Those data are presented in the tables accompanying this report.

TABLE 1. MANUFACTURER'S ENGINE SPECIFICATIONS

Displacement.....	350 cu. in.
Maximum horsepower.....	145 hp at 3,800 rpm
Maximum torque.....	250 lb-ft at 2,200 rpm
Bore and stroke.....	4.00 in. x 3.48 in.
Compression ratio.....	8.5

TABLE 2. FUEL SPECIFICATIONS

Fuel No.....	7516
Research octane No.....	91.0
Motor octane No.....	83.5
Reid vapor pressure, psig..... (by micro vapor pressure test)	9.86
Distillation, °F:	
10 pct.....	125
50 pct.....	212
95 pct.....	390
100 pct.....	416
Specific gravity, °.....	0.7161
API gravity, °.....	66.1
FIA analysis, pct:	
Aromatics.....	11
Olefins.....	15
Paraffins.....	74
Sulfur, pct.....	0.0288
Lead, g/gal.....	Trace

TABLE 3. TEST-NUMBER CROSS-REFERENCE INDEX

Pct Full Load	Engine Speed, rpm									
	650	800	1,000	1,300	1,500	1,900	2,200	2,800	3,300	3,800
0	157	153	12	20	28 82 104	110	44	54 94	62 98	70 102
10			11	19	27 81 103	85 109	43	51 53 93	61 97	69 101
25	158		10 72	18 76	26	34 84 108	42 87 88	50 52 92	60 152	68 100
40	159	154	9 150	17 75	25 79	33 83 107	41	49 91	59 95	67 99
60	160	155	8	16	24	32	40	48	58	66
75			7	15	23	31	39	47	57	65
90	4		6	14	22	30	38	46	56	64
100	2	156	5	13	21	29	37	45	55	63

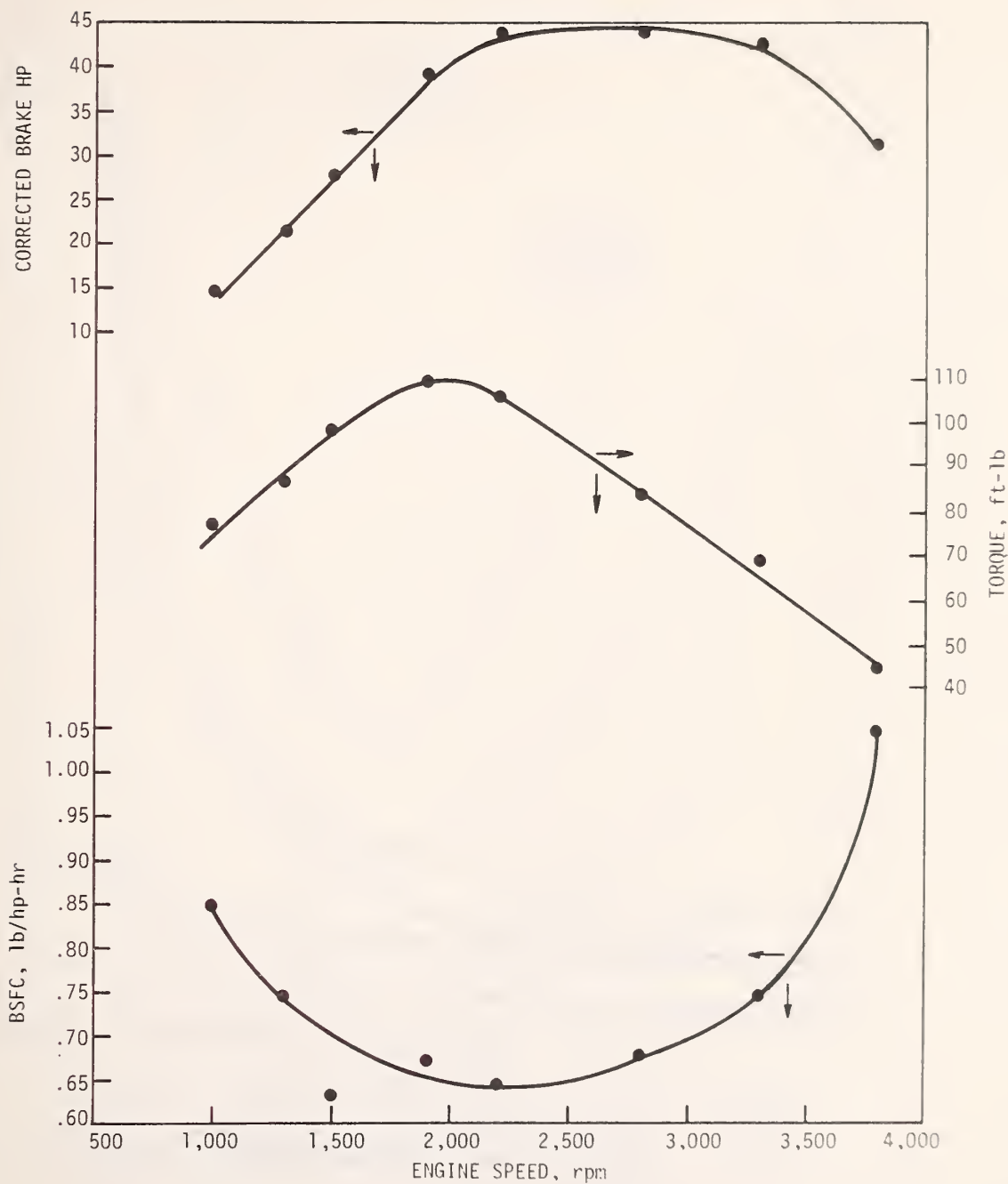


FIGURE 1. Brake Specific Fuel Consumption, Torque, and Brake Horsepower versus Engine rpm at Wide-Open-Throttle--Chevrolet 350-CID Dresser Engine.

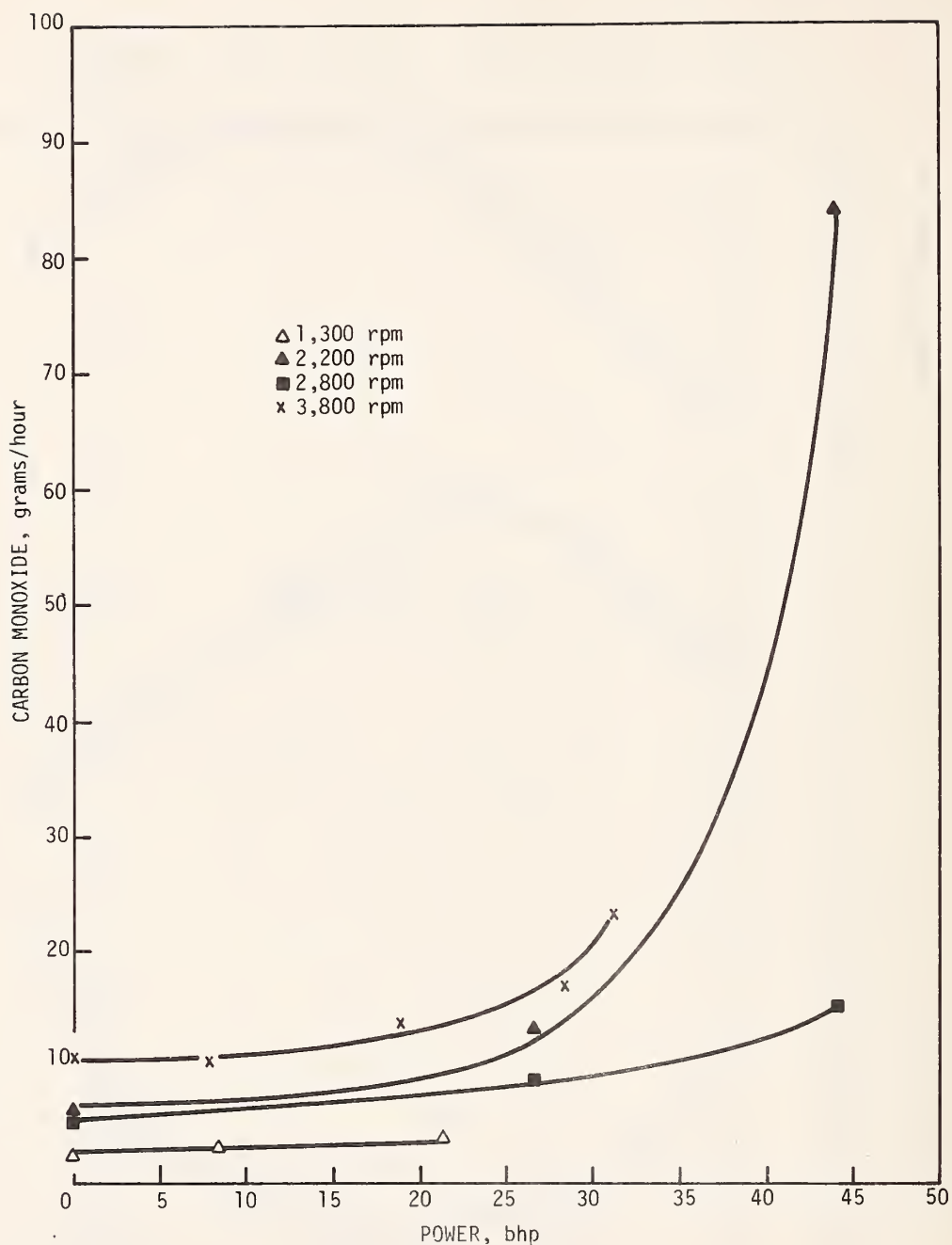


FIGURE 2. Carbon Monoxide Emissions versus Power at Various Speed and Load Conditions--350-CID Chevrolet Dresser Engine.

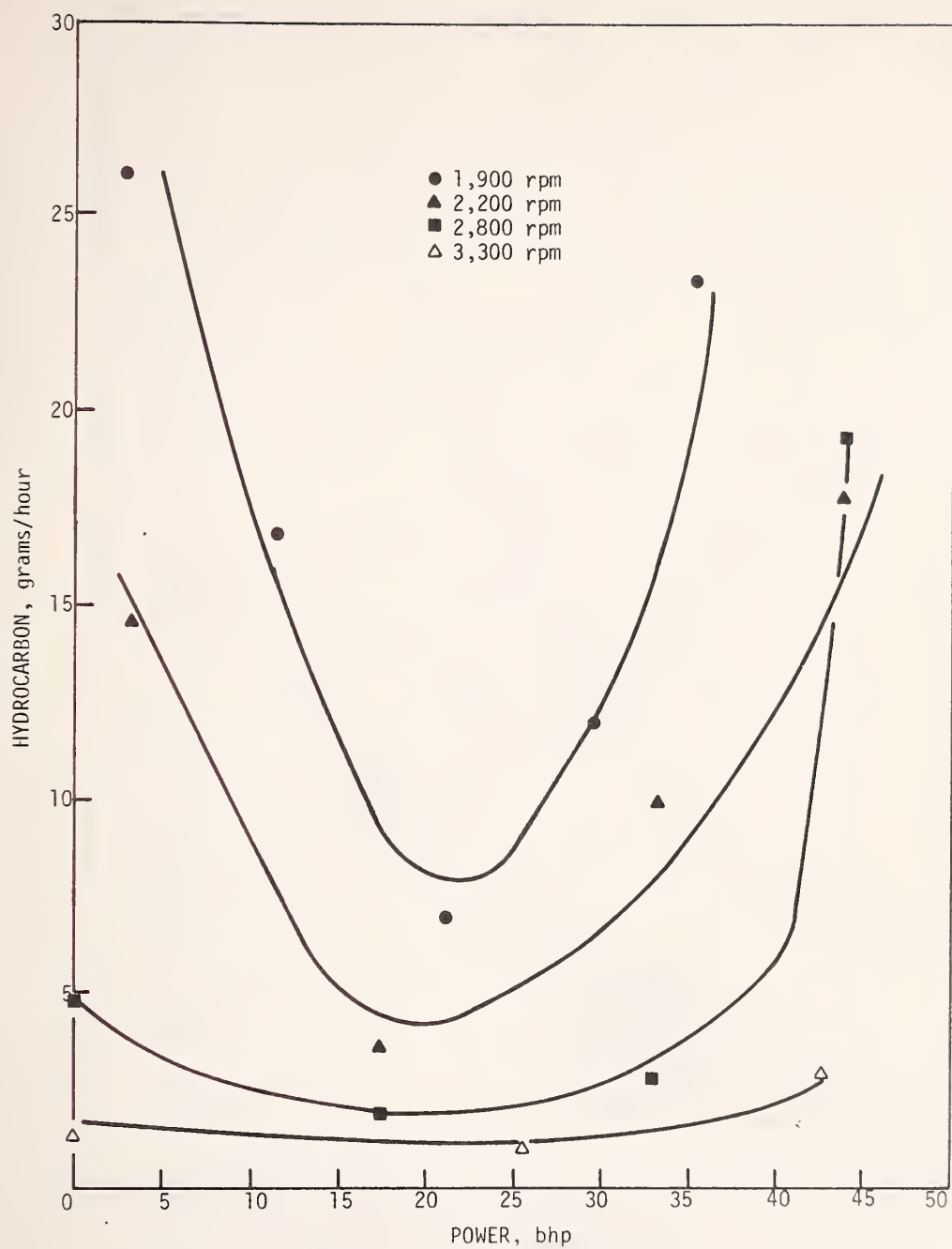


FIGURE 3. Hydrocarbon Emissions versus Power at Various Speed and Load Conditions--350-CID Chevrolet Dresser Engine.

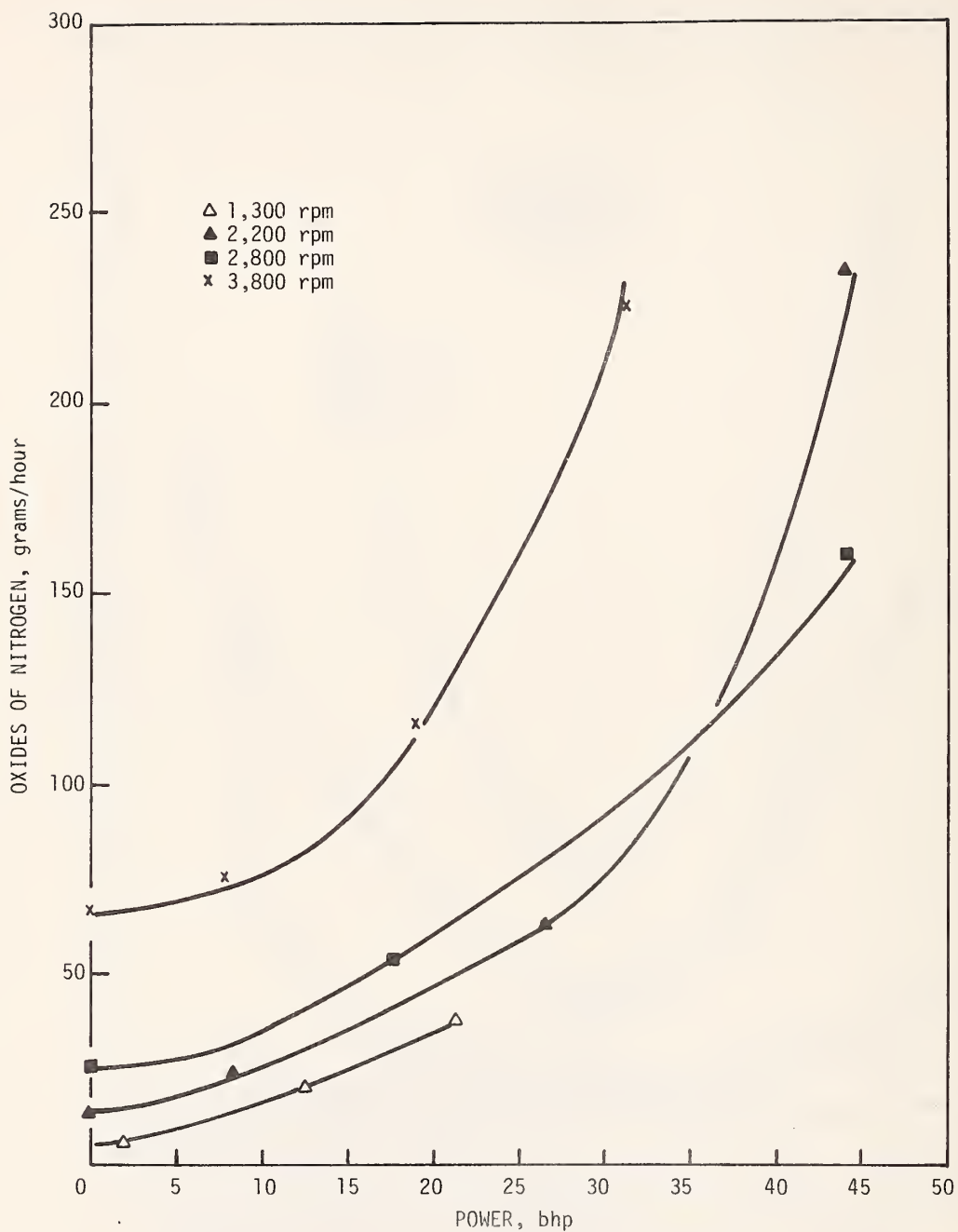


FIGURE 4. Oxides of Nitrogen Emissions versus Power at Various Speed and Load Conditions--350-CID Chevrolet Dresser Engine.

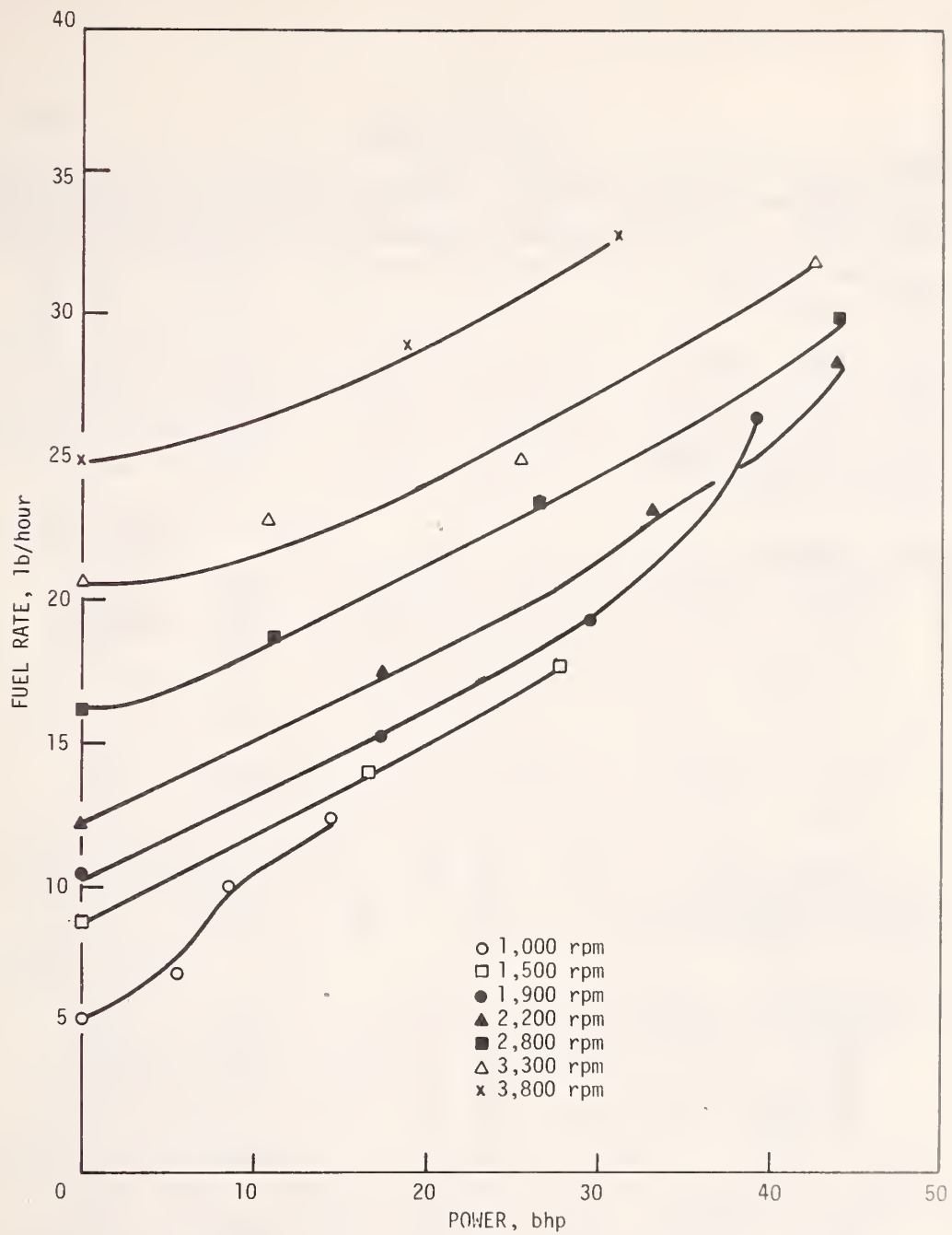


FIGURE 5. Fuel Rate versus Power at Various Speed and Load Conditions--350-CID Chevrolet Dresser Engine.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	2	4	5	6	7
Test Date.....	1/20/76	1/20/76	1/15/76	1/15/76	1/15/76
Barometer, mm Hg.....	758.0	758.0	742.4	742.4	742.4
Humidity, grains/lb.....	60	60	63	63	63
Temperature, F.....	64	98	80	79	79
Engine speed, rpm.....	650	650	1000	1000	1000
Torque, lb-ft.....	28.0	25.0	76.0	67.0	57.0
Power, bhp*.....	3.3	3.1	14.5	12.8	10.9
Fuel rate, lb/hr.....	4.4	4.1	12.3	11.7	10.9
Ignition timing, deg BTC....	24.0	24.0	15.0	15.0	17.5
Manifold vacuum, in Hg.....	17.0	17.0	7.0	6.4	8.5
Throttle angle, deg.....	0.0	0.0	100.0	96.4	92.9
Intake man. temp., F.....	130	129	0	0	0
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1100	.1250	.1700	.1880	.2000
CO2, %.....	12.10	11.95	11.95	11.55	11.40
O2, %.....	3.60	3.75	3.90	4.35	4.70
HC, ppmC.....	2707	3041	2535	3368	4484
NOx, ppm.....	50	45	119	70	50
Air-fuel ratio.....	17.37	17.46	17.62	17.94	18.08
Emission rates, g/hr:					
CO.....	34.3	37.0	151.9	161.9	163.1
HC.....	42.6	45.3	114.2	146.1	184.3
NOx**.....	2.4	2.0	16.5	9.4	6.3
Oil temperature, F.....	181	184	200	203	200
Oil pressure, psi.....	30	30	32	32	33
Coolant temperature, F.....	170	170	180	175	170
Exhaust temperature, F.....	585	595	980	995	995
Exhaust pressure, in H2O....	1.0	1.0	15.0	15.0	12.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0032	.0060	.0048	.0044	.0046
CO2, %.....	12.40	12.25	12.25	11.95	11.80
O2, %.....	3.40	3.45	3.65	4.00	4.15
HC, ppmC.....	452	508	508	394	506
NOx, ppm.....	72	65	163	106	80
Air-fuel ratio.....	17.55	17.61	17.77	18.15	18.29
Emission rates, g/hr:					
CO.....	1.0	1.8	4.3	3.8	3.8
HC.....	7.2	7.6	23.0	17.2	21.0
NOx**.....	3.5	3.0	22.8	14.3	10.2
Exhaust temperature, F.....	602	566	1000	990	995
Exhaust pressure, in H2O....	0.0	0.0	2.0	2.0	2.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 550-Dresser
 Fuel..... 7516

Test Number.....	8	9	10	11	12
Test Date.....	1/15/76	1/31/76	1/31/76	1/31/76	1/31/76
Barometer, mm Hg.....	742.4	743.6	743.6	743.6	743.6
Humidity, grains/lb.....	63	46	46	46	46
Temperature, F.....	79	76	72	75	79
Engine speed, rpm.....	1000	1000	1000	1000	1000
Torque, lb-ft.....	45.0	30.0	19.0	7.5	0.0
Power, bhp*.....	8.6	5.7	3.6	1.4	0.0
Fuel rate, lb/hr.....	10.0	6.9	6.3	5.7	5.5
Ignition timing, deg BTC....	21.5	23.0	22.0	22.0	23.0
Manifold vacuum, in Hg.....	10.4	16.8	18.0	18.8	18.9
Throttle angle, deg.....	78.6	50.0	42.9	42.9	35.7
Intake man. temp., F.....	0	114	112	119	121
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.2150	.1200	.1295	.1550	.1750
CO2, %.....	11.40	11.95	12.10	11.95	11.40
O2, %.....	4.50	3.90	3.65	3.87	4.65
HC, ppmC.....	5606	1183	1128	1295	3699
NOx, ppm.....	43	68	54	35	25
Air-fuel ratio.....	17.74	17.85	17.62	17.78	18.18
Emission rates, g/hr:					
CO.....	156.7	61.0	59.1	65.0	69.9
HC.....	205.8	30.3	25.9	27.4	74.5
NOx**.....	4.9	5.0	3.6	2.1	1.4
Oil temperature, F.....	196	198	201	195	194
Oil pressure, psi.....	35	35	35	36	35
Coolant temperature, F.....	170	180	170	170	170
Exhaust temperature, F.....	980	780	763	749	672
Exhaust pressure, in H2O....	10.0	5.0	5.0	4.0	4.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0044	.0044	.0044	.0044	.0050
CO2, %.....	12.10	12.10	12.25	12.25	11.95
O2, %.....	3.90	3.70	3.45	3.63	4.05
HC, ppmC.....	676	158	164	198	506
NOx, ppm.....	70	109	89	63	51
Air-fuel ratio.....	17.98	17.90	17.66	17.80	18.17
Emission rates, g/hr:					
CO.....	3.2	2.2	2.0	1.8	2.0
HC.....	25.0	4.0	3.8	4.2	10.2
NOx**.....	8.0	8.0	5.9	3.8	2.9
Exhaust temperature, F.....	990	751	688	666	726
Exhaust pressure, in H2O....	2.0	.5	0.0	0.0	0.0

* Corrected - SAE J816b
 ** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	13	14	15	16	17
Test Date.....	1/19/76	1/19/76	1/19/76	1/19/76	1/31/76
Barometer, mm Hg.....	753.5	753.5	753.5	753.5	743.6
Humidity, grains/lb.....	61	61	61	61	46
Temperature, F.....	110	112	109	95	90
Engine speed, rpm.....	1300	1300	1300	1300	1300
Torque, lb-ft.....	85.0	76.5	64.0	51.0	34.0
Power, bhp*.....	21.3	19.2	16.0	12.6	8.5
Fuel rate, lb/hr.....	15.8	14.7	13.6	12.5	8.8
Ignition timing, deg BTC....	19.0	22.0	25.0	27.5	27.0
Manifold vacuum, in Hg.....	8.8	9.6	10.2	124.0	17.0
Throttle angle, deg.....	100.0	94.7	84.2	73.7	52.6
Intake man. temp., F.....	131	132	142	141	123
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1450	.1500	.1620	.1880	.1270
CO2, %.....	12.40	12.25	12.10	11.95	12.10
O2, %.....	4.00	4.00	3.90	4.00	3.80
HC, ppmC.....	679	791	1128	1408	936
NOx, ppm.....	220	150	130	100	140
Air-fuel ratio.....	17.89	17.90	17.80	17.85	17.77
Emission rates, g/hr:					
CO.....	167.3	162.0	160.4	172.0	81.3
HC.....	39.5	43.0	56.3	64.9	30.2
NOx**.....	39.1	24.9	19.8	14.1	13.0
Oil temperature, F.....	222	222	220	216	205
Oil pressure, psi.....	35	35	35	35	37
Coolant temperature, F.....	175	180	180	180	170
Exhaust temperature, F.....	1122	1096	1076	1055	863
Exhaust pressure, in H2O....	20.0	18.0	15.0	13.0	7.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0035	.0035	.0032	.0035	.0055
CO2, %.....	12.55	12.40	12.40	12.25	12.40
O2, %.....	3.60	3.60	3.65	3.75	3.65
HC, ppmC.....	85	96	170	226	144
NOx, ppm.....	220	200	180	150	183
Air-fuel ratio.....	17.73	17.76	17.79	17.90	17.79
Emission rates, g/hr:					
CO.....	4.0	3.8	3.2	3.2	3.5
HC.....	4.9	5.2	8.4	10.4	4.6
NOx**.....	38.7	33.0	27.4	21.1	16.9
Exhaust temperature, F.....	1057	1035	1019	1014	764
Exhaust pressure, in H2O....	9.0	8.0	6.0	4.0	1.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	18	19	20	21	22
Test Date.....	1/31/76	1/31/76	1/31/76	1/20/76	1/20/76
Barometer, mm Hg.....	743.6	743.6	743.6	754.0	754.0
Humidity, grains/lb.....	46	46	46	54	54
Temperature, F.....	90	90	80	117	116
Engine speed, rpm.....	1300	1300	1300	1500	1500
Torque, lb-ft.....	21.0	8.5	0.0	96.0	86.0
Power, bhp*.....	5.2	2.1	0.0	27.9	25.0
Fuel rate, lb/hr.....	7.9	6.9	6.5	17.6	16.5
Ignition timing, deg BTC....	26.0	26.0	26.0	24.0	25.0
Manifold vacuum, in Hg.....	18.0	19.0	19.6	8.8	9.2
Throttle angle, deg.....	47.4	42.1	36.8	100.0	95.5
Intake man. temp., F.....	126	131	128	139	145
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1350	.1440	.1460	.1300	.1450
CO2, %.....	12.10	11.95	12.10	11.80	11.80
O2, %.....	3.80	3.95	3.85	3.85	4.10
HC, ppmC.....	891	901	959	731	675
NOx, ppm.....	82	48	42	250	190
Air-fuel ratio.....	17.77	17.92	17.79	17.92	18.11
Emission rates, g/hr:					
CO.....	77.7	73.5	69.7	168.5	178.3
HC.....	25.9	23.2	23.1	47.8	41.8
NOx**.....	6.8	3.5	2.9	48.5	35.0
Oil temperature, F.....	204	210	212	226	226
Oil pressure, psi.....	37	37	37	33	35
Coolant temperature, F.....	170	170	170	180	185
Exhaust temperature, F.....	867	845	828	1127	1115
Exhaust pressure, in H2O....	7.0	6.0	5.0	22.0	21.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0053	.0053	.0050	.0044	.0044
CO2, %.....	12.25	12.10	12.10	12.10	11.95
O2, %.....	3.65	3.75	3.87	3.65	3.85
HC, ppmC.....	122	141	169	141	96
NOx, ppm.....	120	80	67	300	250
Air-fuel ratio.....	17.83	17.94	18.05	17.87	18.07
Emission rates, g/hr:					
CO.....	3.1	2.7	2.4	5.7	5.4
HC.....	3.5	3.6	4.1	9.2	5.9
NOx**.....	10.0	5.9	4.7	58.0	45.9
Exhaust temperature, F.....	782	743	734	1058	1051
Exhaust pressure, in H2O....	1.0	.5	0.0	11.0	10.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	23	24	25	26	27
Test Date.....	1/20/76	1/20/76	1/20/76	1/21/76	1/30/76
Barometer, mm Hg.....	754.0	754.0	754.0	752.7	743.2
Humidity, grains/lb.....	54	54	54	56	46
Temperature, F.....	118	105	102	98	91
Engine speed, rpm.....	1500	1500	1500	1500	1500
Torque, lb-ft.....	72.0	58.0	38.0	24.0	10.0
Power, bhp*.....	20.9	16.7	10.9	6.9	2.9
Fuel rate, lb/hr.....	15.3	13.9	12.1	11.1	9.6
Ignition timing, deg BTC....	30.0	30.0	30.0	29.0	30.0
Manifold vacuum, in Hg.....	11.3	12.0	13.6	14.2	16.2
Throttle angle, deg.....	81.8	77.3	68.2	63.6	50.0
Intake man. temp., F.....	151	136	137	143	223
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1550	.1720	.2080	.2530	.2300
CO2, %.....	11.80	11.80	11.55	11.00	12.25
O2, %.....	3.90	4.40	4.70	5.50	4.03
HC, ppmC.....	703	1069	1684	4469	2543
NOx, ppm.....	200	100	73	45	28
Air-fuel ratio.....	17.94	18.27	18.46	18.82	17.61
Emission rates, g/hr:					
CO.....	174.9	179.8	191.8	218.4	159.8
HC.....	40.0	56.3	78.2	194.4	89.1
NOx**.....	33.8	15.6	10.1	5.9	2.8
Oil temperature, F.....	227	204	216	216	202
Oil pressure, psi.....	36	33	33	34	38
Coolant temperature, F.....	180	180	180	185	170
Exhaust temperature, F.....	1035	1076	1071	1052	1012
Exhaust pressure, in H2O....	19.0	16.0	13.0	12.0	9.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0044	.0053	.0065	.0087	.0093
CO2, %.....	12.10	12.10	11.80	11.55	12.55
O2, %.....	3.65	4.15	4.40	4.75	3.65
HC, ppmC.....	101	135	197	392	396
NOx, ppm.....	250	150	100	70	55
Air-fuel ratio.....	17.87	18.27	18.55	18.89	17.72
Emission rates, g/hr:					
CO.....	4.9	5.5	6.0	7.5	6.5
HC.....	5.7	7.1	9.2	17.1	13.9
NOx**.....	42.0	23.4	13.8	9.1	5.6
Exhaust temperature, F.....	1089	980	1022	1045	786
Exhaust pressure, in H2O....	9.0	6.0	5.0	4.0	2.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	28	29	30	31	32
Test Date.....	1/30/76	1/23/76	1/23/76	1/23/76	1/23/76
Barometer, mm Hg.....	743.2	744.1	744.1	744.1	744.1
Humidity, grains/lb.....	46	58	58	49	49
Temperature, F.....	90	105	104	115	116
Engine speed, rpm.....	1500	1900	1900	1900	1900
Torque, lb-ft.....	0.0	76.0	68.0	57.0	46.0
Power, bhp.....	0.0	28.1	25.1	21.2	17.1
Fuel rate, lb/hr.....	8.7	19.7	17.7	16.2	15.2
Ignition timing, deg BTC....	29.0	32.0	32.0	33.0	33.0
Manifold vacuum, in Hg.....	17.0	9.3	10.2	11.8	12.2
Throttle angle, deg.....	40.9	100.0	92.0	84.0	80.0
Intake man. temp., F.....	206	126	126	128	139
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.2450	.1950	.2000	.1880	.2000
CO2, %.....	12.40	11.80	11.70	11.80	11.40
O2, %.....	3.70	4.25	4.50	4.25	4.75
HC, ppmC.....	3961	956	1124	1125	4484
NOx, ppm.....	26	400	300	225	150
Air-fuel ratio.....	17.13	18.16	18.36	18.13	18.13
Emission rates, g/hr:					
CO.....	150.1	286.1	267.2	227.3	227.6
HC.....	122.3	70.7	75.7	68.6	257.2
NOx**.....	2.3	89.4	61.0	39.8	25.0
Oil temperature, F.....	202	221	227	228	226
Oil pressure, psi.....	38	35	33	35	35
Coolant temperature, F.....	175	180	180	180	180
Exhaust temperature, F.....	653	1195	1160	1036	1108
Exhaust pressure, in H2O....	8.0	34.0	28.0	23.0	21.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0097	.0065	.0064	.0050	.0065
CO2, %.....	12.85	12.25	11.95	12.10	11.95
O2, %.....	3.27	4.00	4.25	4.00	4.00
HC, ppmC.....	511	113	141	113	281
NOx, ppm.....	51	450	350	275	200
Air-fuel ratio.....	17.35	18.12	18.40	18.16	18.17
Emission rates, g/hr:					
CO.....	6.0	9.5	8.6	6.0	7.4
HC.....	15.9	8.3	9.5	6.9	16.1
NOx**.....	4.6	100.0	71.3	48.7	33.3
Exhaust temperature, F.....	957	1142	1101	1077	1085
Exhaust pressure, in H2O....	2.0	16.0	12.0	10.0	9.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	33	34	37	38	39
Test Date.....	1/23/76	1/23/76	2/ 7/76	2/ 7/76	2/ 7/76
Barometer, mm Hg.....	744.1	744.1	747.8	747.8	747.8
Humidity, grains/lb.....	49	49	41	41	41
Temperature, F.....	125	118	82	90	83
Engine speed, rpm.....	1900	1900	2200	2200	2200
Torque, lb-ft.....	31.0	19.0	106.0	95.0	80.0
Power, bhp*.....	11.6	7.1	44.0	39.7	33.3
Fuel rate, lb/hr.....	13.5	12.4	28.3	25.2	23.1
Ignition timing, deg BTC....	33.0	33.0	26.0	31.0	35.0
Manifold vacuum, in Hg.....	14.6	15.6	6.7	9.3	11.3
Throttle angle, deg.....	68.0	60.0	100.0	90.0	80.0
Intake man. temp., F.....	134	135	119	135	132
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.2100	.2370	.5200	.3750	.2530
CO2, %.....	11.70	11.25	12.25	11.95	11.55
O2, %.....	4.50	4.75	3.70	4.10	4.45
HC, ppmC.....	5621	6718	1132	902	786
NOx, ppm.....	140	90	850	580	475
Air-fuel ratio.....	17.68	17.80	17.37	17.88	18.37
Emission rates, g/hr:					
CO.....	207.0	215.4	1047.8	693.2	441.9
HC.....	279.2	307.8	115.0	84.1	69.2
NOx**.....	20.2	12.0	242.5	151.8	117.5
Oil temperature, F.....	222	220	230	231	230
Oil pressure, psi.....	35	35	35	36	37
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1082	1058	1000	965	981
Exhaust pressure, in H2O....	15.0	14.0	73.0	60.0	52.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0071	.0075	.0405	.0156	.0156
CO2, %.....	12.25	12.40	12.40	12.40	11.95
O2, %.....	3.60	3.45	3.75	3.67	4.15
HC, ppmC.....	451	565	170	85	113
NOx, ppm.....	170	140	800	635	490
Air-fuel ratio.....	17.74	17.57	17.87	17.83	18.32
Emission rates, g/hr:					
CO.....	7.0	6.7	83.9	28.7	27.1
HC.....	22.4	25.3	17.7	7.9	9.9
NOx**.....	24.5	18.2	234.7	165.4	120.5
Exhaust temperature, F.....	1101	1107	977	908	890
Exhaust pressure, in H2O....	6.0	5.0	33.0	24.0	20.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	40	41	42	43	44
Test Date.....	2/ 7/76	2/ 7/76	2/ 7/76	1/24/76	1/24/76
Barometer, mm Hg.....	747.9	747.8	747.8	748.6	748.5
Humidity, grains/lb.....	41	41	41	46	45
Temperature, F.....	82	84	88	96	97
Engine speed, rpm.....	2200	2200	2200	2200	2200
Torque, lb-ft.....	64.0	42.0	27.0	8.0	0.0
Power, bhp*.....	26.6	17.5	11.3	3.4	0.0
Fuel rate, lb/hr.....	19.7	17.4	15.6	12.4	12.2
Ignition timing, deg BTC....	37.0	36.0	36.0	36.0	36.0
Manifold vacuum, in Hg.....	13.3	15.8	16.0	17.4	17.6
Throttle angle, deg.....	68.6	60.0	54.3	51.7	51.7
Intake man. temp., F.....	136	139	144	141	144
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1950	.1750	.1900	.2230	.2250
CO2, %.....	11.55	11.95	11.80	12.25	12.25
O2, %.....	4.15	3.87	4.20	4.10	4.15
HC, ppmC.....	449	349	450	3164	3390
NOx, ppm.....	290	170	106	86	78
Air-fuel ratio.....	18.22	17.91	18.19	17.59	17.59
Emission rates, g/hr:					
CO.....	288.4	223.8	221.0	199.8	197.4
HC.....	33.5	22.5	26.4	142.8	149.9
NOx**.....	60.7	30.8	17.5	11.1	9.9
Oil temperature, F.....	228	230	220	225	227
Oil pressure, psi.....	37	40	40	38	38
Coolant temperature, F.....	180	175	170	180	180
Exhaust temperature, F.....	987	1123	1128	1116	1115
Exhaust pressure, in H2O....	38.0	26.0	26.0	14.0	14.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0089	.0058	.0056	.0075	.0075
CO2, %.....	11.80	12.25	12.10	12.70	12.70
O2, %.....	4.20	3.57	3.92	3.65	3.55
HC, ppmC.....	101	56	68	283	397
NOx, ppm.....	300	221	144	113	136
Air-fuel ratio.....	18.40	17.78	18.09	17.70	17.69
Emission rates, g/hr:					
CO.....	13.3	7.4	6.5	6.7	6.6
HC.....	7.6	3.6	3.9	12.8	17.5
NOx**.....	63.3	39.7	23.5	14.7	15.5
Exhaust temperature, F.....	857	875	876	1050	1050
Exhaust pressure, in H2O....	12.0	8.0	6.0	5.0	5.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	45	46	47	48	49
Test Date.....	1/26/76	1/26/76	1/27/76	1/27/76	1/27/76
Barometer, mm Hg.....	753.6	753.6	751.1	751.1	751.1
Humidity, grains/lb.....	41	41	46	46	46
Temperature, F.....	95	97	89	92	95
Engine speed, rpm.....	2800	2800	2800	2800	2800
Torque, lb-ft.....	83.0	75.0	62.0	50.0	33.0
Power, bhp*.....	44.1	39.9	32.9	26.6	17.6
Fuel rate, lb/hr.....	29.8	27.3	25.4	23.4	20.8
Ignition timing, deg BTC....	36.0	38.0	39.0	39.0	38.0
Manifold vacuum, in Hg.....	10.0	11.2	13.0	14.0	15.6
Throttle angle, deg.....	100.0	89.7	82.1	76.9	66.7
Intake man. temp., F.....	108	108	110	110	110
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1250	.1300	.1230	.1280	.1300
CO2, %.....	11.95	11.95	12.10	12.10	12.10
O2, %.....	4.25	4.35	4.20	4.40	4.25
HC, ppmC.....	451	169	141	158	147
NOx, ppm.....	540	450	400	275	210
Air-fuel ratio.....	18.26	18.38	18.22	18.37	18.25
Emission rates, g/hr:					
CO.....	278.9	267.1	233.0	225.2	201.8
HC.....	50.7	17.5	13.5	14.0	11.5
NOx**.....	170.9	131.2	109.5	69.9	47.1
Oil temperature, F.....	255	254	246	247	246
Oil pressure, psi.....	38	38	35	35	36
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1369	1320	1270	1275	1262
Exhaust pressure, in H2O....	80.0	67.0	57.0	50.0	40.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0067	.0064	.0053	.0050	.0044
CO2, %.....	11.95	11.95	12.25	12.25	12.25
O2, %.....	4.35	4.40	4.10	4.30	4.20
HC, ppmC.....	169	56	28	32	25
NOx, ppm.....	500	450	420	310	240
Air-fuel ratio.....	18.48	18.54	18.21	18.37	18.29
Emission rates, g/hr:					
CO.....	15.1	13.3	10.0	8.8	6.8
HC.....	19.2	5.9	2.7	2.8	1.9
NOx**.....	160.2	132.4	114.8	78.8	53.9
Exhaust temperature, F.....	1035	1017	1197	1186	1176
Exhaust pressure, in H2O....	40.0	32.0	27.0	22.0	17.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	50	51	52	53	54
Test Date.....	1/27/76	1/27/76	1/27/76	1/27/76	1/27/76
Barometer, mm Hg.....	751.1	751.1	751.1	751.1	751.1
Humidity, grains/lb.....	46	42	42	42	42
Temperature, F.....	96	90	94	96	96
Engine speed, rpm.....	2800	2800	2800	2800	2800
Torque, lb-ft.....	21.0	33.0	21.0	8.0	0.0
Power, bhp*.....	11.2	17.5	11.2	4.3	0.0
Fuel rate, lb/hr.....	18.8	21.0	19.0	16.6	16.4
Ignition timing, deg BTC....	39.0	39.0	39.0	39.0	39.0
Manifold vacuum, in Hg.....	16.6	15.7	16.4	17.9	18.0
Throttle angle, deg.....	61.5	64.1	61.5	51.3	48.7
Intake man. temp., F.....	115	110	115	120	125
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1430	.1350	.1520	.1520	.1600
CO2, %.....	12.25	12.10	11.95	12.10	12.10
O2, %.....	4.20	4.15	4.25	4.00	4.00
HC, ppmC.....	169	180	225	564	564
NOx, ppm.....	165	210	160	130	130
Air-fuel ratio.....	18.15	18.16	18.26	17.97	17.96
Emission rates, g/hr:					
CO.....	199.4	211.3	215.8	186.0	193.2
HC.....	11.9	14.2	16.1	34.8	34.3
NOx**.....	33.2	46.8	32.4	22.7	22.4
Oil temperature, F.....	244	230	240	239	239
Oil pressure, psi.....	37	43	41	42	42
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1248	1246	1248	1223	1220
Exhaust pressure, in H2O....	34.0	37.0	34.0	26.0	25.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0041	.0046	.0046	.0048	.0046
CO2, %.....	12.40	12.40	12.10	12.40	12.40
O2, %.....	4.10	3.95	4.20	3.80	3.75
HC, ppmC.....	27	23	28	45	45
NOx, ppm.....	200	260	190	160	165
Air-fuel ratio.....	18.17	18.05	18.33	17.92	17.89
Emission rates, g/hr:					
CO.....	5.7	7.1	6.6	5.8	5.5
HC.....	1.9	1.8	2.0	2.8	2.7
NOx**.....	40.3	57.5	38.5	27.8	28.2
Exhaust temperature, F.....	1155	1111	1157	1159	1127
Exhaust pressure, in H2O....	14.0	16.0	14.0	10.0	10.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	55	56	57	58	59
Test Date.....	1/28/76	1/28/76	1/28/76	1/28/76	1/28/76
Barometer, mm Hg.....	746.2	746.2	746.2	746.2	746.2
Humidity, grains/lb.....	42	42	42	42	42
Temperature, F.....	105	108	108	109	106
Engine speed, rpm.....	3300	3300	3300	3300	3300
Torque, lb-ft.....	67.0	60.0	50.0	40.0	27.0
Power, bhp*.....	42.7	38.4	32.0	25.6	17.2
Fuel rate, lb/hr.....	31.8	30.3	28.7	24.9	23.2
Ignition timing, deg BTC....	40.0	0.0	0.0	0.0	0.0
Manifold vacuum, in Hg.....	12.0	12.6	13.6	14.9	16.0
Throttle angle, deg.....	100.0	95.1	90.2	82.9	73.2
Intake man. temp., F.....	130	135	132	128	125
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1170	.1050	.0970	.0880	.0950
CO2, %.....	12.40	12.10	12.10	12.40	12.55
O2, %.....	3.80	4.05	4.00	3.70	3.75
HC, ppmC.....	85	79	62	57	102
NOx, ppm.....	750	600	500	450	325
Air-fuel ratio.....	17.96	18.13	18.10	17.79	17.78
Emission rates, g/hr:					
CO.....	271.9	236.1	206.8	159.5	159.8
HC.....	9.9	8.9	6.7	5.2	8.6
NOx**.....	247.6	191.7	151.5	115.9	77.7
Oil temperature, F.....	265	265	263	262	255
Oil pressure, psi.....	35	35	36	36	37
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1355	1342	1339	1315	1304
Exhaust pressure, in H2O....	90.0	84.0	76.0	60.0	50.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0064	.0062	.0053	.0044	.0041
CO2, %.....	12.40	12.10	12.10	12.40	12.70
O2, %.....	3.90	4.10	3.85	3.45	3.75
HC, ppmC.....	25	17	14	11	17
NOx, ppm.....	800	625	550	500	350
Air-fuel ratio.....	17.95	18.26	18.06	17.67	17.83
Emission rates, g/hr:					
CO.....	15.0	14.0	11.3	7.9	6.9
HC.....	2.9	1.9	1.5	1.0	1.4
NOx**.....	265.7	201.2	166.4	128.0	83.8
Exhaust temperature, F.....	1063	1053	1049	1023	997
Exhaust pressure, in H2O....	44.0	40.0	36.0	26.0	22.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	60	61	62	63	64
Test Date.....	1/28/76	1/28/76	1/28/76	1/29/76	1/29/76
Barometer, mm Hg.....	746.2	746.2	746.2	753.5	753.5
Humidity, grains/lb.....	42	42	42	44	44
Temperature, F.....	102	103	105	106	107
Engine speed, rpm.....	3300	3300	3300	3800	3800
Torque, lb-ft.....	17.0	7.0	0.0	43.0	39.0
Power, bhp*.....	10.8	4.5	0.0	31.3	28.4
Fuel rate, lb/hr.....	22.8	20.6	20.6	32.7	31.4
Ignition timing, deg BTC....	0.0	0.0	38.0	42.0	42.0
Manifold vacuum, in Hg.....	15.1	16.8	17.0	13.6	13.8
Throttle angle, deg.....	70.7	63.4	63.4	100.0	97.6
Intake man. temp., F.....	130	135	126	140	152
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1030	.1280	.1250	.1170	.1030
CO2, %.....	11.95	11.70	11.70	12.70	12.40
O2, %.....	4.15	4.30	4.05	3.20	3.65
HC, ppmC.....	84	140	112	85	62
NOx, ppm.....	210	150	170	680	550
Air-fuel ratio.....	18.24	18.40	18.20	17.33	17.74
Emission rates, g/hr:					
CO.....	175.8	199.8	192.6	270.9	234.8
HC.....	7.3	11.0	8.7	9.9	7.1
NOx**.....	50.9	33.3	37.2	225.7	179.7
Oil temperature, F.....	253	252	250	274	275
Oil pressure, psi.....	38	43	43	42	43
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1334	1321	1318	1402	1390
Exhaust pressure, in H2O....	48.0	42.0	41.0	95.0	90.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0044	.0046	.0041	.0097	.0073
CO2, %.....	11.95	11.80	11.80	12.55	12.25
O2, %.....	4.15	4.30	4.10	3.65	3.80
HC, ppmC.....	17	22	17	25	14
NOx, ppm.....	230	190	200	660	560
Air-fuel ratio.....	18.33	18.50	18.33	17.79	17.98
Emission rates, g/hr:					
CO.....	7.5	7.2	6.4	23.1	16.9
HC.....	1.5	1.3	1.3	2.0	1.5
NOx**.....	56.1	42.3	44.1	225.1	185.5
Exhaust temperature, F.....	1025	1020	1021	1251	1208
Exhaust pressure, in H2O....	22.0	18.0	17.0	47.0	41.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	65	66	67	68	69
Test Date.....	1/29/76	1/29/76	1/29/76	1/29/76	1/29/76
Barometer, mm Hg.....	753.5	753.5	753.5	753.5	753.5
Humidity, grains/lb.....	44	44	44	44	44
Temperature, F.....	106	109	110	83	84
Engine speed, rpm.....	3800	3800	3800	3800	3800
Torque, lb-ft.....	32.0	26.0	17.0	11.0	4.0
Power, bhp*.....	23.3	19.0	12.4	7.8	2.9
Fuel rate, lb/hr.....	30.8	28.9	26.8	26.5	25.1
Ignition timing, deg BTC....	42.0	42.0	42.0	42.0	42.0
Manifold vacuum, in Hg.....	14.0	14.6	15.4	15.8	16.0
Throttle angle, deg.....	95.1	92.7	85.4	82.9	78.1
Intake man. temp., F.....	147	132	130	131	118
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0900	.0800	.0970	.1100	.1250
CO2, %.....	12.40	11.95	11.95	11.40	11.25
O2, %.....	3.70	4.15	4.20	4.30	4.40
HC, ppmC.....	45	39	45	90	140
NOx, ppm.....	520	350	260	250	240
Air-fuel ratio.....	17.80	18.27	18.29	18.52	18.63
Emission rates, g/hr:					
CO.....	201.9	173.4	195.3	220.6	240.8
HC.....	5.1	4.3	4.6	9.1	13.6
NOx**.....	167.2	108.8	75.0	71.9	66.3
Oil temperature, F.....	276	274	271	261	265
Oil pressure, psi.....	43	43	45	38	37
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1393	1381	1367	1377	1374
Exhaust pressure, in H2O....	88.0	80.0	70.0	68.0	64.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0065	.0062	.0062	.0051	.0058
CO2, %.....	12.25	11.95	11.95	11.25	11.25
O2, %.....	3.95	4.20	4.30	4.45	4.55
HC, ppmC.....	11	9	9	16	16
NOx, ppm.....	490	370	290	260	240
Air-fuel ratio.....	18.10	18.38	18.46	18.81	18.89
Emission rates, g/hr:					
CO.....	14.8	13.5	12.6	10.4	11.3
HC.....	1.3	1.0	.9	1.6	1.5
NOx**.....	160.4	115.7	84.5	76.0	67.2
Exhaust temperature, F.....	1210	1203	1230	1063	1069
Exhaust pressure, in H2O....	42.0	38.0	32.0	31.0	29.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	70	72	75	76	79
Test Date.....	1/29/76	1/15/76	1/20/76	1/20/76	1/21/76
Barometer, mm Hg.....	753.5	742.4	758.0	758.0	752.7
Humidity, grains/lb.....	44	55	49	49	48
Temperature, F.....	79	96	100	99	97
Engine speed, rpm.....	3800	1000	1300	1300	1500
Torque, lb-ft.....	0.0	19.0	34.0	21.0	38.0
Power, bhp*.....	0.0	3.7	8.4	5.2	10.9
Fuel rate, lb/hr.....	25.0	7.5	10.6	9.5	11.8
Ignition timing, deg BTC....	42.0	24.0	25.0	25.0	29.0
Manifold vacuum, in Hg.....	16.1	13.8	14.0	15.4	13.5
Throttle angle, deg.....	76.8	57.1	63.2	52.6	63.6
Intake man. temp., F.....	115	112	152	170	170
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1350	.2530	.1950	.2230	.1970
CO2, %.....	11.40	11.80	11.80	11.95	11.70
O2, %.....	4.40	4.25	3.75	3.80	4.40
HC, ppmC.....	168	6979	2250	3944	1686
NOx, ppm.....	230	28	70	48	65
Air-fuel ratio.....	18.57	17.24	17.56	17.30	18.18
Emission rates, g/hr:					
CO.....	257.9	134.5	149.4	150.3	173.5
HC.....	16.2	187.0	86.9	133.9	74.8
NOx**.....	63.0	2.2	7.9	4.7	8.4
Oil temperature, F.....	264	198	198	205	212
Oil pressure, psi.....	37	34	32	35	32
Coolant temperature, F.....	180	175	175	170	185
Exhaust temperature, F.....	1372	940	1022	1004	1044
Exhaust pressure, in H2O....	63.0	3.0	9.0	8.0	12.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0055	.0044	.0041	.0039	.0065
CO2, %.....	11.25	12.85	12.40	12.40	12.10
O2, %.....	4.55	3.30	3.25	3.10	4.00
HC, ppmC.....	17	624	339	396	282
NOx, ppm.....	240	53	95	75	95
Air-fuel ratio.....	18.89	17.36	17.45	17.32	18.12
Emission rates, g/hr:					
CO.....	10.7	2.3	3.1	2.6	5.7
HC.....	1.6	16.7	13.0	13.4	12.4
NOx**.....	66.9	4.2	10.6	7.4	12.1
Exhaust temperature, F.....	1073	931	973	969	970
Exhaust pressure, in H2O....	28.0	0.0	3.0	2.0	4.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	81	82	83	84	85
Test Date.....	1/30/76	1/30/76	1/23/76	1/23/76	1/23/76
Barometer, mm Hg.....	743.2	743.2	744.1	744.1	744.1
Humidity, grains/lb.....	46	46	51	51	51
Temperature, F.....	90	91	120	115	121
Engine speed, rpm.....	1500	1500	1900	1900	1900
Torque, lb-ft.....	10.0	0.0	31.0	19.0	8.0
Power, bhp*.....	2.9	0.0	11.6	7.1	3.0
Fuel rate, lb/hr.....	9.6	8.8	13.5	12.4	10.7
Ignition timing, deg BTC....	30.0	29.0	32.5	33.0	33.0
Manifold vacuum, in Hg.....	16.2	16.8	14.4	15.4	16.5
Throttle angle, deg.....	50.1	45.5	68.0	60.0	50.0
Intake man. temp., F.....	229	218	128	132	147
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.2300	.2450	.2230	.2500	.2900
CO2, %.....	12.10	12.10	11.40	11.70	11.40
O2, %.....	4.10	3.95	4.25	4.00	4.50
HC, ppmC.....	2821	3725	4485	2811	6730
NOx, ppm.....	29	25	130	95	60
Air-fuel ratio.....	17.66	17.41	17.70	17.66	17.53
Emission rates, g/hr:					
CO.....	160.5	153.5	220.6	225.6	223.5
HC.....	99.2	117.6	223.6	127.9	261.4
NOx**.....	2.9	2.3	19.0	12.7	6.8
Oil temperature, F.....	204	203	215	209	210
Oil pressure, psi.....	39	39	35	35	35
Coolant temperature, F.....	170	170	175	175	175
Exhaust temperature, F.....	1020	995	1088	1079	1024
Exhaust pressure, in H2O....	10.0	8.0	16.0	13.0	11.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0093	.0097	.0073	.0071	.0080
CO2, %.....	12.55	12.70	12.10	12.25	12.25
O2, %.....	3.65	3.40	3.50	3.50	3.30
HC, ppmC.....	396	510	338	339	677
NOx, ppm.....	55	51	165	125	90
Air-fuel ratio.....	17.72	17.47	17.71	17.68	17.47
Emission rates, g/hr:					
CO.....	6.5	6.1	7.2	6.4	6.1
HC.....	13.9	16.1	16.8	15.4	26.1
NOx**.....	5.6	4.6	24.0	16.6	10.1
Exhaust temperature, F.....	795	988	1068	1045	1060
Exhaust pressure, in H2O....	2.0	1.0	6.0	5.0	3.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	87	88	91	92	93
Test Date.....	1/24/76	1/24/76	1/27/76	1/27/76	1/27/76
Barometer, mm Hg.....	753.6	753.6	751.1	751.1	751.1
Humidity, grains/lb.....	46	46	44	44	44
Temperature, F.....	97	97	97	99	94
Engine speed, rpm.....	2200	2200	2800	2800	2800
Torque, lb-ft.....	32.0	20.0	33.0	21.0	8.0
Power, bhp*.....	13.4	8.4	17.6	11.2	4.3
Fuel rate, lb/hr.....	15.8	14.3	20.8	18.5	16.5
Ignition timing, deg BTC....	36.0	36.0	39.0	39.0	39.0
Manifold vacuum, in Hg.....	14.9	15.9	15.5	16.7	17.8
Throttle angle, deg.....	59.0	54.0	69.2	59.0	53.9
Intake man. temp., F.....	119	127	110	113	121
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.2150	.2370	.1520	.1520	.1750
CO2, %.....	12.10	11.70	11.95	11.95	11.80
O2, %.....	4.00	4.65	4.40	4.15	4.25
HC, ppmC.....	1693	3148	180	180	844
NOx, ppm.....	178	115	220	175	125
Air-fuel ratio.....	17.76	18.14	18.39	18.18	18.13
Emission rates, g/hr:					
CO.....	247.2	252.2	238.8	210.2	215.1
HC.....	98.1	168.9	14.3	12.6	52.3
NOx**.....	29.6	17.7	49.6	34.7	22.0
Oil temperature, F.....	231	229	244	245	244
Oil pressure, psi.....	38	37	40	40	40
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1173	1150	1247	1235	1212
Exhaust pressure, in H2O....	23.0	20.0	40.0	33.0	27.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0069	.0071	.0051	.0046	.0053
CO2, %.....	12.40	12.25	12.10	12.10	11.95
O2, %.....	3.95	3.95	4.25	4.05	4.05
HC, ppmC.....	119	203	27	26	79
NOx, ppm.....	215	160	260	200	150
Air-fuel ratio.....	18.03	18.06	18.37	18.21	18.24
Emission rates, g/hr:					
CO.....	8.0	7.5	8.0	6.4	6.5
HC.....	7.0	10.8	2.1	1.8	4.9
NOx**.....	36.2	24.4	58.5	39.7	26.5
Exhaust temperature, F.....	1105	1105	1165	1149	1134
Exhaust pressure, in H2O....	10.0	8.0	18.0	14.0	11.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	94	95	97	98	99
Test Date.....	1/27/76	1/28/76	1/28/76	1/28/76	1/29/76
Barometer, mm Hg.....	751.1	746.2	746.2	746.2	753.5
Humidity, grains/lb.....	44	42	42	42	44
Temperature, F.....	97	100	101	105	109
Engine speed, rpm.....	2800	3300	3300	3300	3800
Torque, lb-ft.....	0.0	27.0	7.0	0.0	17.0
Power, bhp*.....	0.0	17.1	4.4	0.0	12.4
Fuel rate, lb/hr.....	16.2	24.7	20.7	20.7	26.8
Ignition timing, deg BTC....	39.0	38.0	38.0	38.0	42.0
Manifold vacuum, in Hg.....	18.0	15.4	17.0	17.0	15.4
Throttle angle, deg.....	51.3	75.6	63.4	63.4	85.4
Intake man. temp., F.....	120	130	120	119	131
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1750	.0880	.1300	.1200	.1030
CO2, %.....	11.80	12.10	11.70	11.80	11.95
O2, %.....	4.25	3.95	4.30	4.10	4.20
HC, ppmC.....	844	85	169	169	68
NOx, ppm.....	120	240	165	180	265
Air-fuel ratio.....	18.18	18.05	18.40	18.21	18.28
Emission rates, g/hr:					
CO.....	211.7	160.8	203.4	185.6	207.0
HC.....	51.5	7.8	13.3	13.2	6.8
NOx**.....	20.8	62.3	36.7	39.6	76.3
Oil temperature, F.....	241	251	250	250	267
Oil pressure, psi.....	40	43	43	43	44
Coolant temperature, F.....	180	180	180	180	180
Exhaust temperature, F.....	1210	1331	1320	1317	1371
Exhaust pressure, in H2O....	26.0	53.0	42.0	41.0	70.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0050	.0046	.0046	.0039	.0064
CO2, %.....	12.10	12.10	11.70	11.80	11.80
O2, %.....	3.95	4.00	4.30	4.10	4.40
HC, ppmC.....	79	25	20	17	11
NOx, ppm.....	150	290	185	180	265
Air-fuel ratio.....	18.11	18.17	18.53	18.33	18.58
Emission rates, g/hr:					
CO.....	6.0	8.5	7.3	6.1	13.1
HC.....	4.8	2.3	1.6	1.3	1.2
NOx**.....	25.9	75.8	41.5	39.8	77.7
Exhaust temperature, F.....	1130	1014	1022	1024	1069
Exhaust pressure, in H2O....	10.0	24.0	18.0	17.0	33.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	100	101	102	103	104
Test Date.....	1/29/76	1/29/76	1/29/76	1/30/76	1/30/76
Barometer, mm Hg.....	753.5	753.5	753.5	743.2	743.2
Humidity, grains/lb.....	44	44	44	46	46
Temperature, F.....	107	86	80	91	90
Engine speed, rpm.....	3800	3800	3800	1500	1500
Torque, lb-ft.....	11.0	4.0	0.0	10.0	0.0
Power, bhp*.....	8.0	2.9	0.0	2.9	0.0
Fuel rate, lb/hr.....	26.4	24.9	24.8	9.6	8.7
Ignition timing, deg BTC....	42.0	43.0	43.0	30.0	29.0
Manifold vacuum, in Hg.....	15.8	16.0	16.1	16.2	17.0
Throttle angle, deg.....	82.9	80.5	78.1	50.0	40.9
Intake man. temp., F.....	128	110	111	223	206
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1200	.1200	.1250	.2300	.2450
CO2, %.....	11.40	11.40	11.40	12.25	12.40
O2, %.....	4.30	4.40	4.40	4.03	3.70
HC, ppmC.....	168	140	168	2543	3961
NOx, ppm.....	240	220	220	28	26
Air-fuel ratio.....	18.50	18.59	18.58	17.61	17.13
Emission rates, g/hr:					
CO.....	241.1	228.9	237.7	159.8	150.1
HC.....	17.0	13.5	16.1	89.1	122.3
NOx**.....	69.1	60.1	60.0	2.8	2.3
Oil temperature, F.....	242	265	265	202	202
Oil pressure, psi.....	40	38	37	38	38
Coolant temperature, F.....	180	180	180	170	175
Exhaust temperature, F.....	1378	1370	1371	1012	653
Exhaust pressure, in H2O....	67.0	64.0	63.0	9.0	9.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0053	.0055	.0058	.0093	.0097
CO2, %.....	11.40	11.40	11.40	12.55	12.85
O2, %.....	4.40	4.50	4.55	3.65	3.27
HC, ppmC.....	18	15	17	396	511
NOx, ppm.....	260	240	230	55	51
Air-fuel ratio.....	18.71	18.80	18.84	17.72	17.35
Emission rates, g/hr:					
CO.....	10.8	10.6	11.2	6.5	6.2
HC.....	1.8	1.3	1.6	13.9	15.2
NOx**.....	75.7	66.4	63.6	5.8	4.8
Exhaust temperature, F.....	1045	1067	1067	786	781
Exhaust pressure, in H2O....	31.0	29.0	28.0	2.0	2.2

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	107	108	109	110	150
Test Date.....	1/31/76	1/31/76	1/31/76	1/31/76	1/15/76
Barometer, mm Hg.....	743.6	743.6	743.6	743.6	742.4
Humidity, grains/lb.....	46	46	46	46	55
Temperature, F.....	90	91	93	92	97
Engine speed, rpm.....	1900	1900	1900	1900	1000
Torque, lb-ft.....	31.0	19.0	8.0	0.0	30.0
Power, bhp*.....	11.3	6.9	2.9	0.0	5.8
Fuel rate, lb/hr.....	13.6	12.4	11.1	10.5	8.2
Ignition timing, deg BTC....	35.0	35.0	35.0	34.0	24.5
Manifold vacuum, in Hg.....	15.4	16.4	17.4	17.7	12.7
Throttle angle, deg.....	64.0	60.0	52.0	48.0	64.3
Intake man. temp., F.....	150	152	162	166	114
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1880	.1900	.2150	.2300	.2230
CO2, %.....	11.95	12.10	11.80	11.80	11.80
O2, %.....	4.10	3.92	4.05	4.07	4.40
HC, ppmC.....	755	733	1688	1744	5627
NOx, ppm.....	80	65	48	44	33
Air-fuel ratio.....	18.02	17.84	17.86	17.86	17.57
Emission rates, g/hr:					
CO.....	188.8	172.8	174.9	177.5	132.6
HC.....	38.2	33.6	69.2	67.8	168.7
NOx**.....	11.6	8.6	5.7	4.9	2.9
Oil temperature, F.....	221	215	209	210	193
Oil pressure, psi.....	35	35	36	36	35
Coolant temperature, F.....	175	175	175	175	174
Exhaust temperature, F.....	1106	1098	1082	726	920
Exhaust pressure, in H2O....	17.0	15.0	12.0	11.0	5.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0053	.0053	.0060	.0041	.0039
CO2, %.....	12.10	12.10	12.25	12.10	12.55
O2, %.....	3.95	3.82	3.77	3.70	3.55
HC, ppmC.....	113	90	192	203	509
NOx, ppm.....	118	95	72	72	61
Air-fuel ratio.....	18.11	18.01	17.91	17.89	17.63
Emission rates, g/hr:					
CO.....	5.3	4.9	4.9	3.2	2.3
HC.....	5.7	4.2	7.9	7.9	15.2
NOx**.....	17.2	12.6	8.5	8.0	5.4
Exhaust temperature, F.....	857	1013	1001	960	917
Exhaust pressure, in H2O....	6.0	5.0	4.0	3.0	0.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	151	152	153	154	155
Test Date.....	1/24/76	1/28/76	2/ 2/76	2/ 2/76	2/ 2/76
Barometer, mm Hg.....	753.6	746.2	743.4	743.4	743.4
Humidity, grains/lb.....	46	42	47	47	47
Temperature, F.....	97	100	105	105	102
Engine speed, rpm.....	2200	3300	800	800	800
Torque, lb-ft.....	8.0	17.0	0.0	5.0	10.0
Power, bhp*.....	3.3	10.8	0.0	.8	1.5
Fuel rate, lb/hr.....	13.3	22.8	4.3	4.2	4.4
Ignition timing, deg BTC....	36.0	38.0	22.0	22.0	23.0
Manifold vacuum, in Hg.....	17.2	15.0	19.2	18.4	19.0
Throttle angle, deg.....	52.0	90.6	9.4	10.9	12.5
Intake man. temp., F.....	137	123	140	145	140
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.2450	.0950	.1620	.1650	.1500
CO2, %.....	11.80	11.95	12.85	12.40	12.40
O2, %.....	4.50	4.10	3.20	3.90	3.75
HC, ppmC.....	3377	73	2272	2545	1753
NOx, ppm.....	85	200	30	28	33
Air-fuel ratio.....	17.95	18.21	16.96	17.53	17.53
Emission rates, g/hr:					
CO.....	241.0	162.1	47.9	49.1	47.5
HC.....	167.4	6.3	33.9	38.2	28.0
NOx**.....	12.1	48.5	1.3	1.2	1.5
Oil temperature, F.....	227	254	195	198	201
Oil pressure, psi.....	40	43	35	33	35
Coolant temperature, F.....	180	180	165	165	165
Exhaust temperature, F.....	1122	1336	660	656	659
Exhaust pressure, in H2O....	17.0	48.0	2.0	2.0	2.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0078	.0042	.0053	.0055	.0053
CO2, %.....	12.40	11.95	13.15	12.70	12.40
O2, %.....	3.85	4.10	2.95	3.53	3.55
HC, ppmC.....	294	17	250	340	260
NOx, ppm.....	115	220	54	51	55
Air-fuel ratio.....	17.92	18.29	17.09	17.60	17.60
Emission rates, g/hr:					
CO.....	7.6	7.2	1.6	1.6	1.7
HC.....	14.5	1.5	3.8	5.1	4.2
NOx**.....	16.2	53.6	2.3	2.2	2.6
Exhaust temperature, F.....	1101	1020	577	582	589
Exhaust pressure, in H2O....	6.0	22.0	0.0	0.0	0.0

* Corrected - SAE J816b

** Corrected for humidity.

Engine..... Chev 350-Dresser
 Fuel..... 7516

Test Number.....	156	157	158	159	160
Test Date.....	2/ 2/76	2/ 2/76	2/ 2/76	2/ 2/76	2/ 2/76
Barometer, mm Hg.....	743.4	743.4	743.4	743.4	743.4
Humidity, grains/lb.....	47	47	47	47	47
Temperature, F.....	102	102	101	101	101
Engine speed, rpm.....	800	650	650	650	650
Torque, lb-ft.....	15.0	0.0	5.0	10.0	15.0
Power, bhp*.....	2.3	0.0	.6	1.3	1.9
Fuel rate, lb/hr.....	4.6	3.4	3.4	3.6	3.7
Ignition timing, deg BTC....	23.0	22.0	23.0	23.0	23.0
Manifold vacuum, in Hg.....	17.5	18.4	18.0	17.5	17.1
Throttle angle, deg.....	12.5	7.8	7.8	9.4	9.4
Intake man. temp., F.....	139	140	135	134	131
<u>Before Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.1370	.1780	.1750	.1520	.1420
CO2, %.....	12.70	12.25	11.95	11.95	12.10
O2, %.....	3.50	4.00	4.35	4.30	4.08
HC, ppmC.....	1616	6779	6084	3943	2820
NOx, ppm.....	37	20	20	20	24
Air-fuel ratio.....	17.31	17.06	17.47	17.75	17.71
Emission rates, g/hr:					
CO.....	44.2	41.8	43.0	39.6	38.5
HC.....	26.3	80.3	75.3	51.8	38.5
NOx**.....	1.7	.7	.7	.8	.9
Oil temperature, F.....	197	196	210	211	213
Oil pressure, psi.....	35	30	30	30	32
Coolant temperature, F.....	165	165	170	170	170
Exhaust temperature, F.....	661	573	563	573	580
Exhaust pressure, in H2O....	2.0	2.0	2.0	2.0	2.0
<u>After Catalyst</u>					
Concentrations, dry basis:					
CO, %.....	.0052	.0080	.0115	.0111	.0120
CO2, %.....	12.85	12.85	12.55	12.55	12.55
O2, %.....	3.32	3.23	3.65	3.75	3.70
HC, ppmC.....	233	1135	1019	849	679
NOx, ppm.....	65	42	39	42	47
Air-fuel ratio.....	17.43	17.23	17.63	17.73	17.71
Emission rates, g/hr:					
CO.....	1.7	1.9	2.8	2.9	3.2
HC.....	3.8	13.5	12.7	11.1	9.2
NOx**.....	3.1	1.4	1.4	1.6	1.8
Exhaust temperature, F.....	585	593	584	567	537
Exhaust pressure, in H2O....	0.0	0.0	0.0	0.0	0.0

* Corrected - SAE J816b

** Corrected for humidity.

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