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HS-803-839

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES
IN THE UNITED STATES
Third Series - Report No. 10
1978 Honda, 98 CID (1.6 Liters)

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INTERIM REPORT

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NOTICE

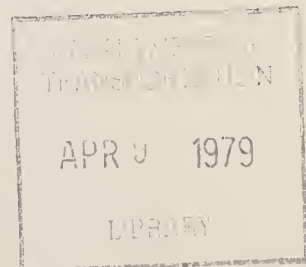
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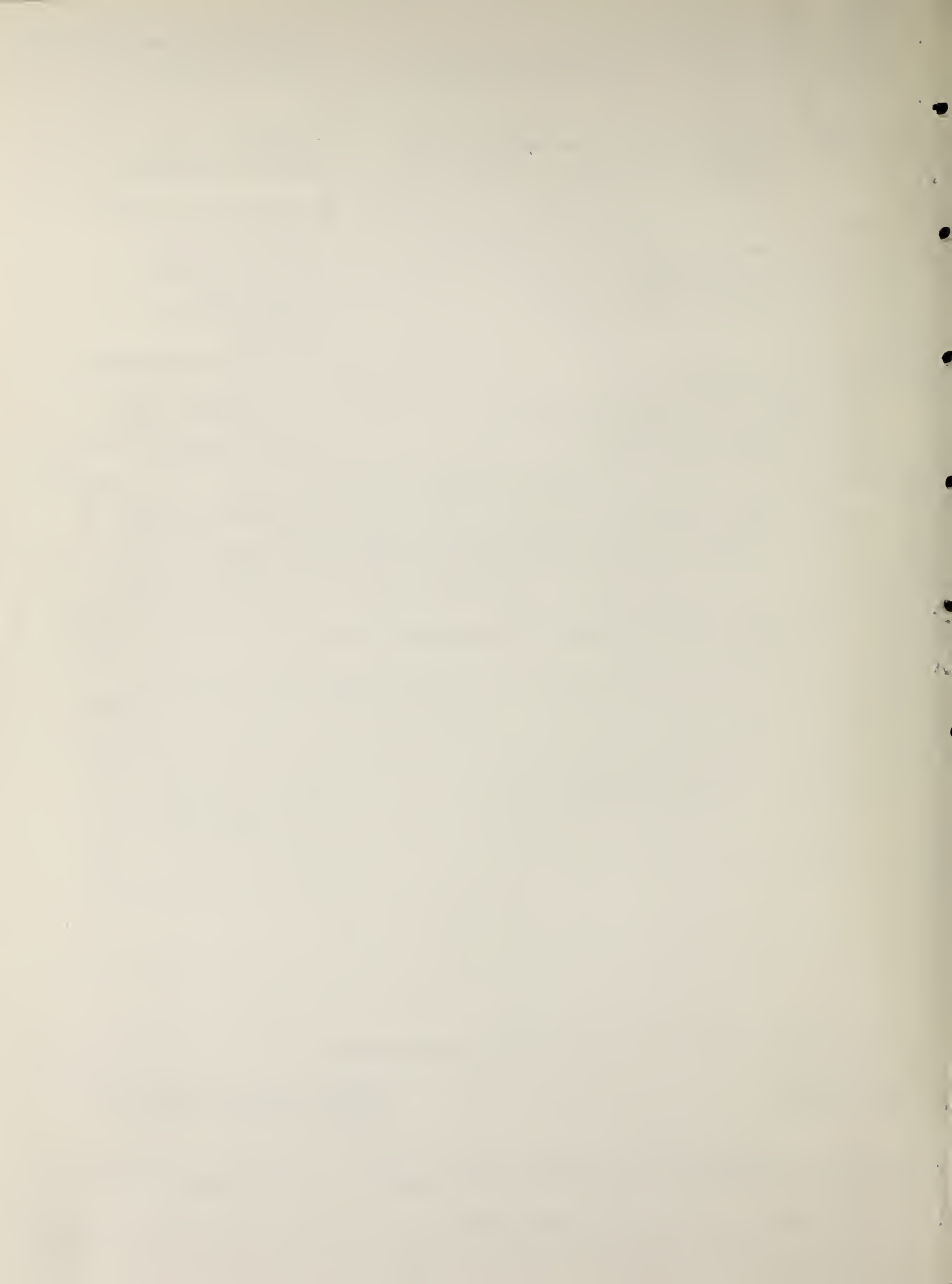
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NO. DOT-TSC-NHTSA 79-10

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16. Abstract Experimental data were obtained in dynamometer tests of a 1978 Honda 98 CID engine 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 transporatation.					
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PREFACE

This report, prepared by the U.S. Department of Energy, Bartlesville Energy Technology 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 United States. The 1978 Honda 98 CID engine used in this work is one of a series of 15 engines to be tested in the current program. This is the tenth 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.

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

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	meters	m
yd	yards	0.9	kilometers	km
mi	miles	1.6		
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 kilometers	km ²
mi ²	square miles	2.6	hectares	ha
acres	acres	0.4		
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tone (2000 lb)	0.9	tonnes	t
VOLUME				
teap	teaspoons	5	milliliters	ml
fl oz	fluid ounces	15	milliliters	ml
c	cup	30	liters	l
pt	pints	0.24	liters	l
qt	quarts	0.47	liters	l
gal	gallons	0.95	liters	l
ft ³	cubic feet	3.0	cubic meters	m ³
yd ³	cubic yards	0.03	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

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



1. INTRODUCTION

The objective of this program is to obtain engine performance data for estimating fuel economy and emissions for varied engine service and duty. The intent of the work done at the Bartlesville Energy Technology Center is to provide basic engine characteristic data required as input for engineering calculations of fuel consumption and emissions involving ground transportation.

The data acquired from tests of a 1978 Honda 98 CID engine are presented in this report. Honda uses the 98 CID engine in the Accord. The Accord is in the 2,250 lb inertia weight class. The engine, as equipped, is intended for use in a forty-nine state (Federal) vehicle with automatic transmission. The test results are sufficient to establish steady-state maps for fuel consumption and emissions (carbon monoxide, unburned hydrocarbons, and oxides of nitrogen) over the entire operating range of the engine.

2. ENGINE TEST REPORT

The engine test setup included a complete mean tolerance engine (SAE definition) coupled to an eddy-current dynamometer. A cooling tower was used in place of the fan and radiator. The alternator was included but was not wired into the engine's electrical system. The emission control systems included positive crankcase ventilation and a charcoal canister for evaporative emissions. The manufacturer's specifications for the 1978 Honda CVCC (compound vortex controlled combustion) engine are given in Table 1.

Prior to testing, break-in consisted of 40 hours of operation at various speed/load modes representative of normal engine operation. Table 2 contains details of the break-in schedule. A single batch of unleaded regular grade gasoline was used throughout the break-in and test; a detailed fuel analysis is given in Table 3. Engine testing began on September 20, 1978, and ended on October 5, 1978.

During steady-state tests, the engine was operated at the following speed/load modes:

Speeds: 1,000; 1,500; 2,000; 2,500; 3,600; 4,300 rpm

Loads: 0, 10, 25, 40, 60, 75, 90, 100 pct of full load
(0, 10, 25, 60, and 75 pct points were repeated at all engine speeds)

Idle speed/load modes: 800 rpm -- 0, 7, 15 lb-ft
650 rpm -- 8 lb-ft

Over-speed mode: 5,200 rpm -- 63 lb-ft (wide-open-throttle)

Total number of test modes.....	69
Total number of repeats.....	57
Total number of tests.....	<u>126</u>

The following data were recorded for each test point:

Test number
Data source code
Date
Barometric pressure, mm Hg
Wet bulb temperature, °F
Dry bulb temperature, °F
Inlet air temperature, °F
Speed, rpm
Torque, lb-ft -- Daytronic strain gauge load cell
Fuel rate, lb/hr -- Fluidyne positive displacement fuel flow meter
Ignition timing, °BTC
Manifold vacuum, in. Hg
Intake manifold pressure, 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
 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 = Dew point, °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. 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)

x = Fuel hydrogen/carbon atomic ratio

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

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

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

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

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

6. Air-fuel ratio (dimensionless):

$$AF = \frac{68.9994}{MW_{fuel}} \left[\frac{(1 + \frac{x}{2} - y)(CO) + (2 + \frac{x}{2} - y)(CO_2) + 2(O_2) + \frac{NO_x}{10^4} - H_2}{CO + CO_2 + C_w(HC/10^4)} \right]$$

where O_2 = Oxygen concentration (percent)

NO_x = Oxides of nitrogen (ppm)

HC = Unburned hydrocarbon concentration (ppmC)

y = Fuel oxygen/carbon atomic ratio

MW_{fuel} = Fuel molecular weight per carbon atom
 $= 12.01115 + 1.0079x + 15.9994y$

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

$$M_{CO} = \left(\frac{MW_{CO}}{MW_{fuel}} \right) \left[\frac{CO (M_f)}{CO + CO_2 + C_w(\%HC)} \right] \quad (453.59237)$$

MW_{CO} = Molecular weight of CO (28.01055)

M_f = Fuel rate in lb/hr

$\%HC$ = HC (ppmC)/10⁴

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

$$M_{HC} = \left(\frac{MW_{HC}}{MW_{fuel}} \right) \left[\frac{(\%HC) (M_f) (C_w)}{\%CO + \%CO_2 + C_w(\%HC)} \right] \quad (453.59237)$$

MW_{HC} = Molecular weight of hydrocarbon per carbon atom
 $= 12.01115 + 1.00797x + 15.9994y$

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

$$M_{NO_x} = \left(\frac{MW_{NO_x}}{MW_{fuel}} \right) \left[\frac{(\%NO_x) (M_f)}{CO + CO_2 + C_w(\%HC)} \right] (453.59237) K_H$$

MW_{NO_x} = Molecular weight of NO_2 = 46.0055

$\%NO_x$ = NO_x (ppm) 10^4

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

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

where N = Engine speed (revolutions per minute)

T = Brake torque (lb-ft)

t = Air temperature (°F)

3. DISCUSSION OF TEST RESULTS

Maximum corrected brake horsepower, maximum torque, and brake specific fuel consumption (bsfc) are plotted as functions of engine speed at wide-open-throttle (WOT) in Figure 1. The maximum brake horsepower and the maximum torque produced by the engine were similar to the values quoted in Table 1 and were produced at the same speeds. Minimum bsfc occurred at 1,500 rpm indicating a high efficiency mode at this speed.

The fuel rates were found to be nearly a linear function of power for most engine speeds except for the 100 pct load mode for each speed where fuel-rich operation caused a significant increase in fuel rates (Figure 2). Fuel rates were repeatable for all speeds duplicated. The air-fuel ratios were maintained between 16 and 19 for all light and moderate speed/load modes (Figure 3). At the heavy load operating modes (greater than 60 percent of full load) air-fuel ratios were significantly reduced due to operation at the near WOT.

Emissions of CO, HC and NO_x are plotted as a function of power for all engine speeds (Figures 4 thru 6). Emissions of CO and HC were maintained at reasonably low levels for most speed/load modes. At WOT and at the two higher speeds (4,300 rpm and 5,000 rpm), significant increases in the emissions of CO and HC were observed. These increases correspond to fluctuations in the air-fuel ratio. Emission rates of NO_x tended to peak between 75 and 90 percent of full load for all engine speeds. These NO_x peaks correspond to engine operation near stoichiometric where emissions of NO_x are typically at their highest level. The emission rates of CO, HC, and NO_x were repeatable for all speeds tested.

4. CONCLUSIONS

The experimental work to obtain performance data for a 1978 Honda 98 CID engine has been completed; these data are presented in the tables accompanying this report.

TABLE 1. MANUFACTURER'S ENGINE SPECIFICATIONS

Displacement, cubic inches.....	98-CID
Maximum horsepower, bhp @ 5,000 rpm.....	68
Maximum torque, lb-ft @ 3,000 rpm.....	85
Bore and stroke, inches.....	2.91 x 3.66
Configuration.....	4-Cylinder in- line, transverse
Compression ratio.....	8.0 to 1
Firing order.....	1-3-4-2
Ignition timing at idle speed, BTDC @ 650 rpm.....	6°
Block material.....	cast iron
Head material.....	aluminum alloy
Number of crankshaft main bearing.....	5
Number of compression rings/piston.....	2
Number of oil rings/piston.....	1
Cam drive type.....	belt
Valve timing:	
Intake opens, °BTDC	42
Intake closes, °ABDC	87
Exhaust opens, °BBDC	92
Exhaust closes, °ATDC	42
Auxiliary valve:	
Opens, °BTDC	8
Closes, °ABDC.....	48
Spark plug gap, inches.....	.030
Weight of engine, lb.....	368
Crankcase emission control:	
Control method.....	positive crankcase ventilation
Point of discharge.....	air cleaner
Carburetor type.....	3-Barrel downdraft
Distributor specifications:	
Centrifugal advance, begins, ° @ 1,075 rpm....	0
Centrifugal advance, intermediate, ° @ 1,800 rpm.....	11
Centrifugal advance, full, ° @ 2,800 rpm.....	18
Vacuum advance, begins, ° @ 4.72 in. Hg.....	0
Vacuum advance, maximum, ° @ 8.27 in. Hg.....	15
Carburetor number.....	CA24B013855
Distributor number.....	D409-66 803

TABLE 2. ENGINE BREAK IN SCHEDULE

Simulated vehicle speed, mph	Engine speed, rpm	Intake manifold vacuum, in. Hg	Fraction of time in mode
Idle	650	20.5	1/10
20	1,150	18	"
30	1,700	17.5	"
40	2,300	16	"
50	2,850	13.5	"
60	3,400	10	"
25	1,400	17	"
35	2,000	16.5	"
45	2,600	14.5	"
55	3,150	11.6	"

Mileage per cycle = 90 miles.

Total mileage accumulated over 40 hours break-in period = 1,440 miles.

TABLE 3. FUEL ANALYSIS

Fuel No.....	7718
Research octane No.....	91.8
Motor octane No.....	84.0
Specific gravity.....	0.717
API gravity, degrees.....	65.9
Distillation, °F:	
10 pct evaporated.....	123
50 pct ".....	209
95 pct ".....	402
100 pct ".....	413
Reid vapor pressure, psi.....	11.26
FIA analysis, pct:	
Aromatics.....	9
Olefins.....	15
Paraffins.....	76
Sulfur, pct.....	0.016
Lead, grams per gallon.....	Trace
Hydrogen/carbon atomic ratio.....	2.038

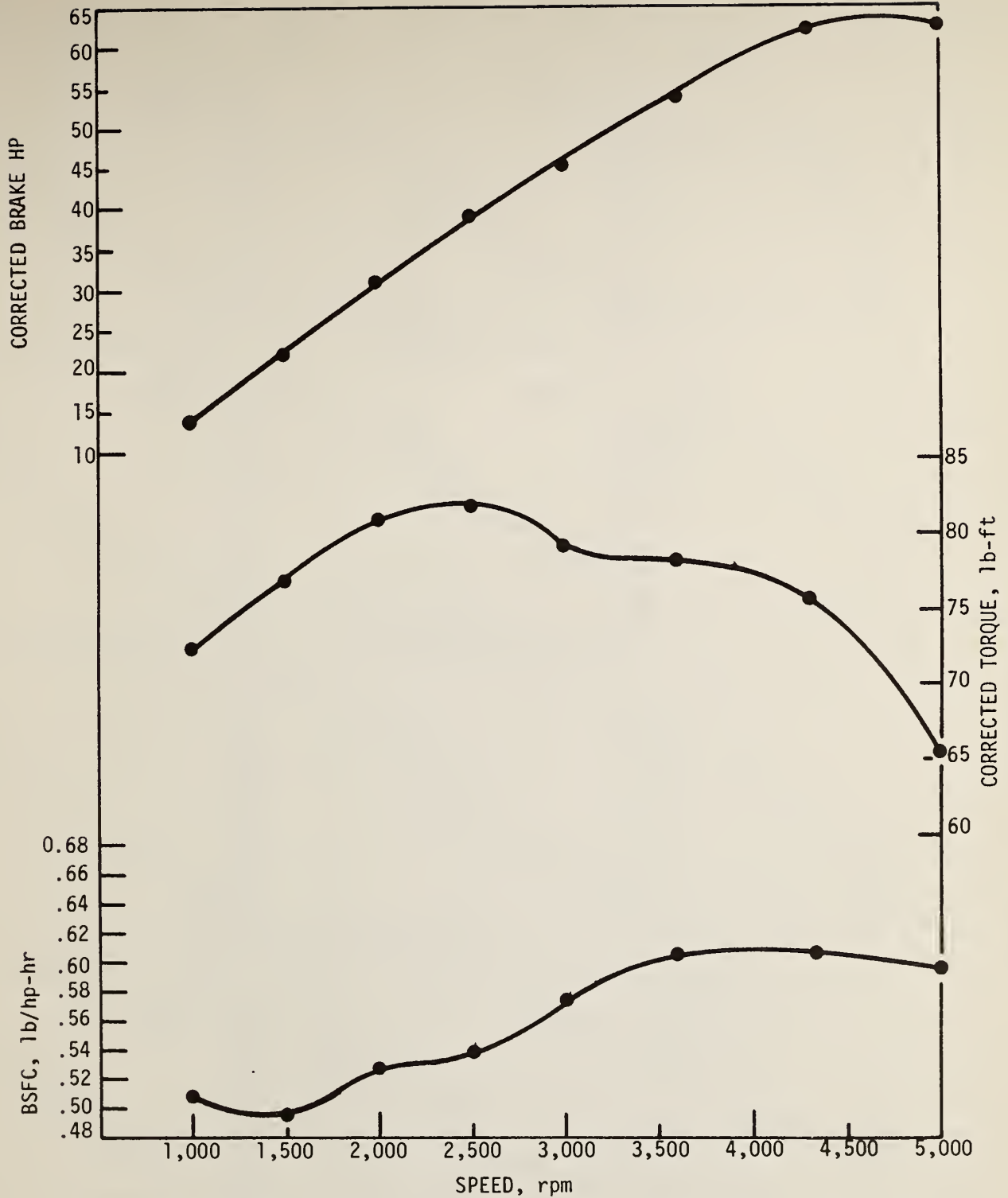


FIGURE 1. Brake Specific Fuel Consumption, Torque, and Brake Horsepower versus Engine rpm at Wide-Open-Throttle--Honda 98-CID Engine.

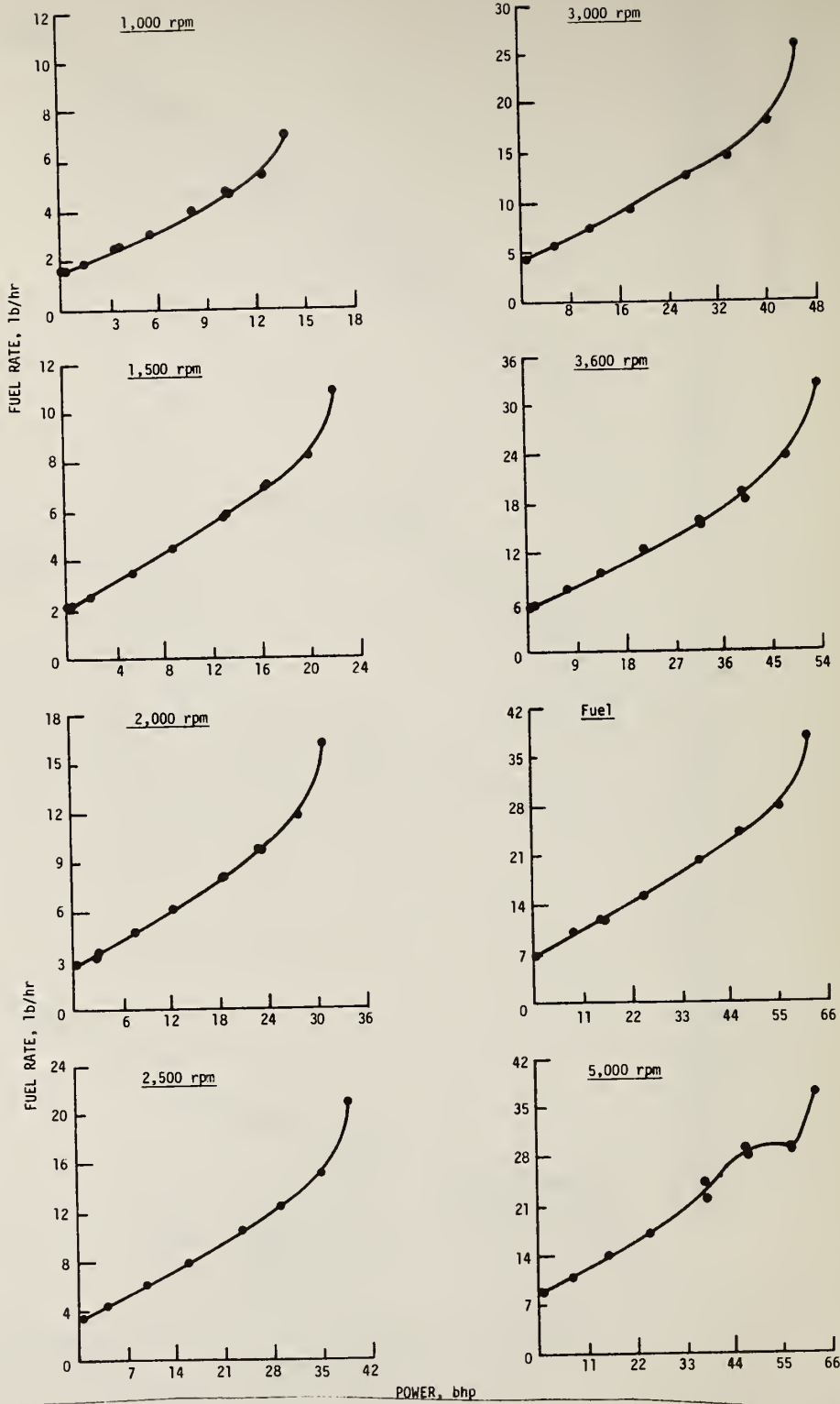


FIGURE 2. Fuel Rate versus Power at Various Speed and Load Conditions--Honda 98-CID Engine.

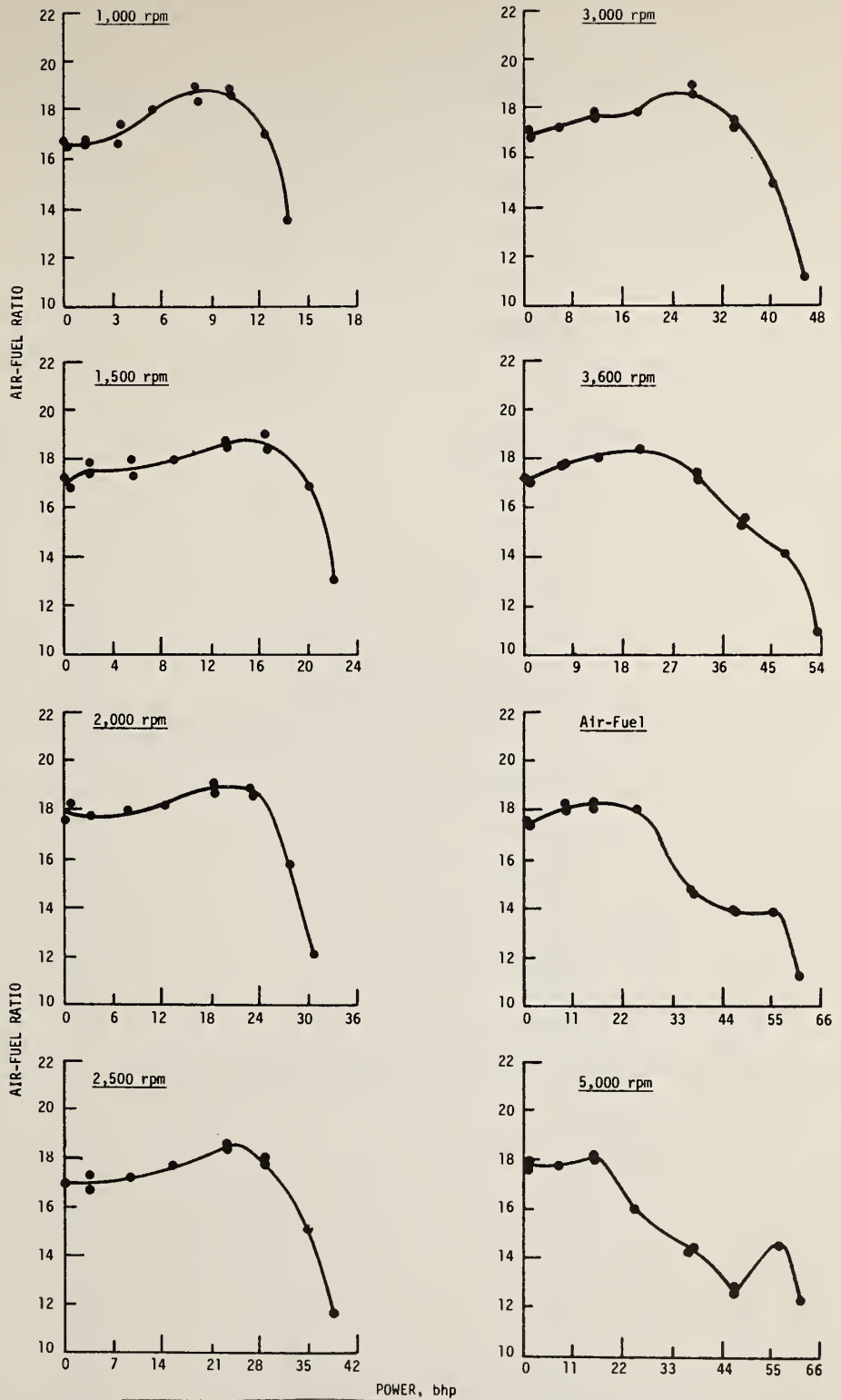


FIGURE 3. Air-Fuel Ratio versus Power at Various Speed and Load Conditions --Honda 98-CID Engine.

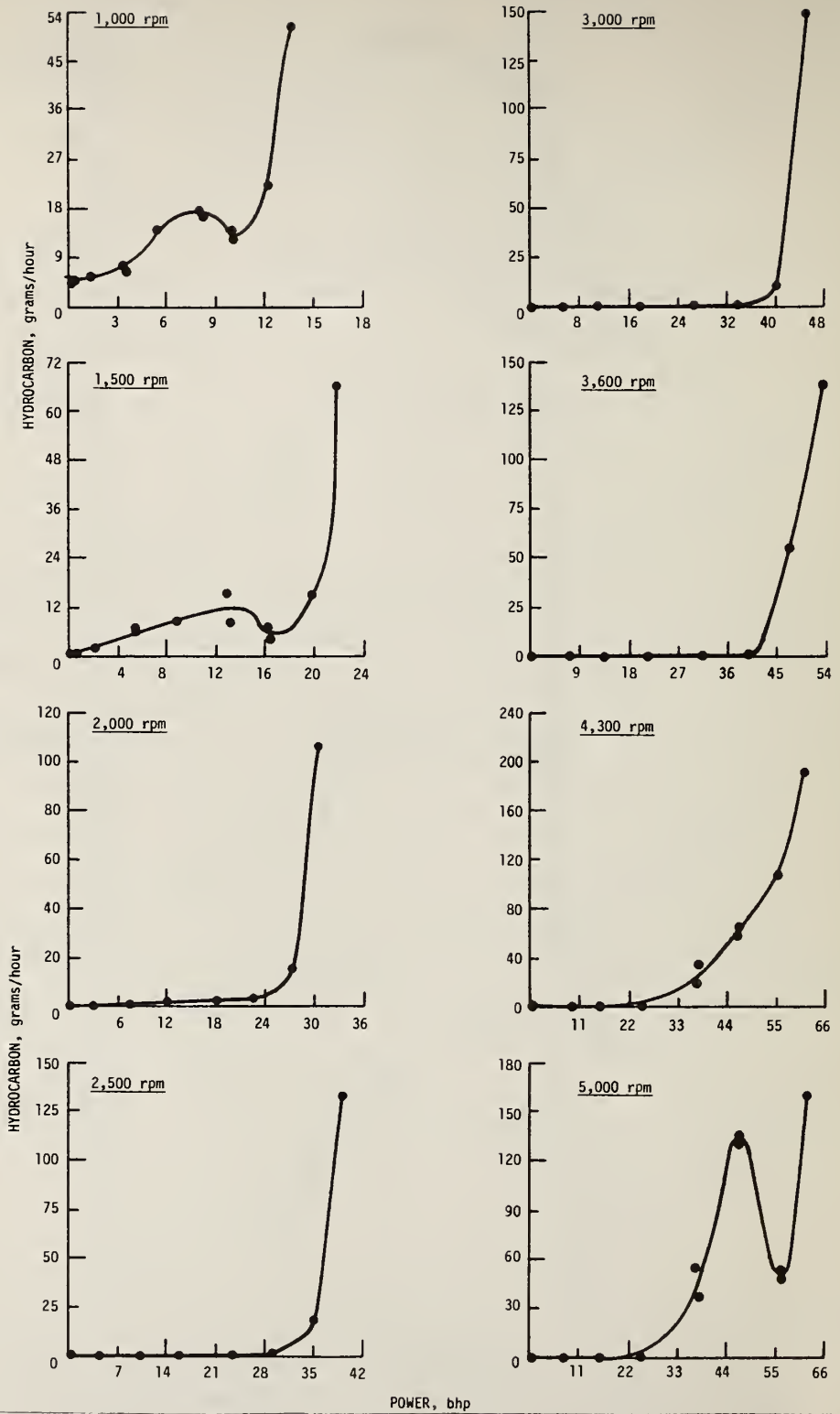


FIGURE 4. Hydrocarbon Emissions versus Power at Various Speed and Load Conditions-- Honda 98-CID Engine.

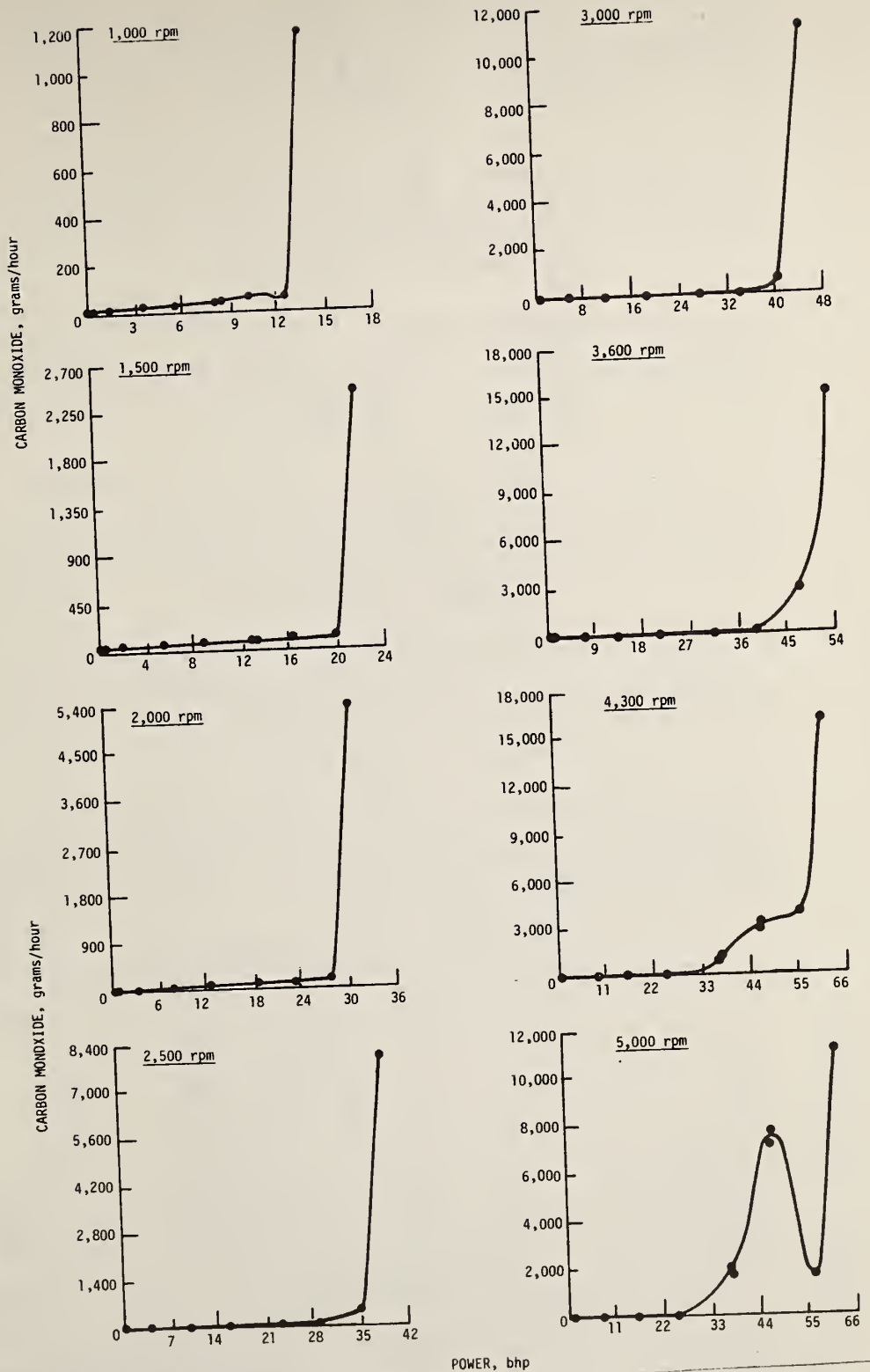


FIGURE 5. Carbon Monoxide Emissions versus Power at Various Speed and Load Conditions-- Honda 98-CID Engine.

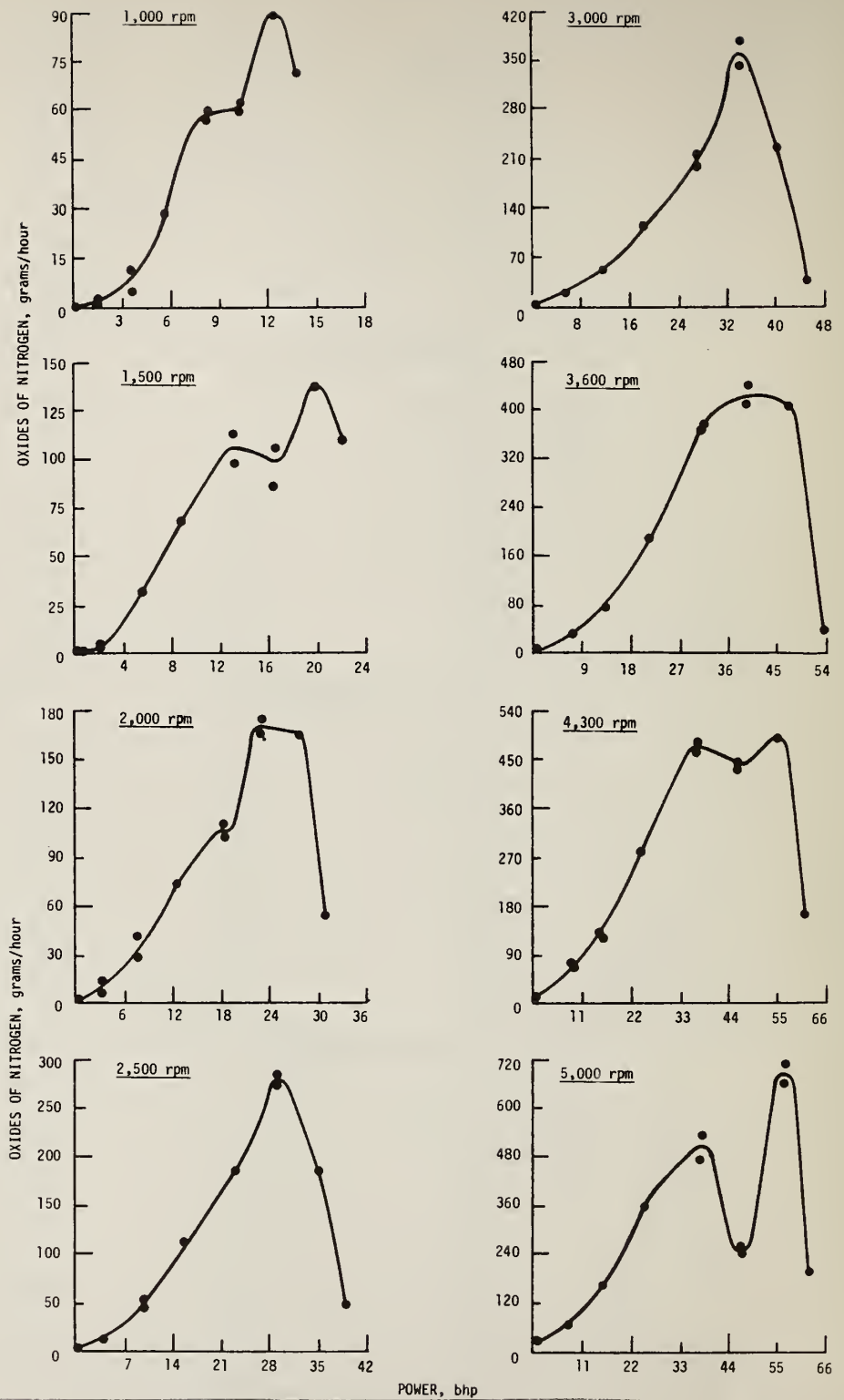


FIGURE 6. Oxides of Nitrogen Emissions versus Power at Various Speed and Load Conditions--Honda 98-CID Engine.

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER 1

DATA SOURCE CODE 1

TEST DATE 9/20/78

BAROMETER, MMHG 744.0

HUMIDITY, GRAINS/LB 75

TEMPERATURE, F 68

ENGINE SPEED, RPM 800

TORQUE, FT-LB .0

POWER, 8HP* .0

FUEL RATE, LB/HR 1.1

IGNITION TIMING, DEG BTDC 6.0

MANIFOLD VACUUM, IN HG 21.0

THROTTLE ANGLE, DEG .0

INTAKE MAN. TEMP., F 95

CONCENTRATIONS, DRY BASIS

CO, % .2049

CO2, % 12.68

O2, % 2.59

HC, PPMC 1328

NOX, PPM 29

AIR/FUEL RATIO 16.51

EMISSION RATES, G/HR

CO 16.0

HC 5.2

NOX+ .4

OIL TEMPERATURE, F 185

OIL PRESSURE, PSI 29

COOLANT TEMPERATURE, F 187

EXHAUST PRESSURE, IN. H2O 1.0

EXHAUST TEMPERATURE, F 674

6.01

1

9/20/78

744.0

75

70

1000

65.4

12.4

5.4

9.0

1.0

29.0

96

5.01

1

9/20/78

744.0

75

71

1000

72.7

13.8

7.0

6.0

.0

71.0

94

4.01

1

9/20/78

744.0

75

70

650

7.9

1.0

1.1

6.0

19.5

.0

102

3.01

1

9/20/78

744.0

75

69

800

15.0

2.3

1.8

6.0

17.0

2.0

102

2.01

1

9/20/78

744.0

75

70

800

7.0

1.1

1.3

6.0

19.5

1.0

102

1.01

1

9/20/78

744.0

75

68

800

.0

.0

1.1

6.0

21.0

.0

95

.1391

12.73

2.70

2209

75

16.52

12.4

9.9

1.1

179

36

187

1.0

571

6.01

1

9/20/78

744.0

75

70

1000

65.4

12.4

5.4

9.0

1.0

29.0

96

5.01

1

9/20/78

744.0

75

71

1000

72.7

13.8

7.0

6.0

.0

71.0

94

4.01

1

9/20/78

744.0

75

70

650

7.9

1.0

1.1

6.0

19.5

.0

102

3.01

1

9/20/78

744.0

75

69

800

15.0

2.3

1.8

6.0

17.0

2.0

102

2.01

1

9/20/78

744.0

75

70

800

7.0

1.1

1.3

6.0

19.5

1.0

102

.1391

12.73

2.70

2209

75

16.52

12.4

9.9

1.1

179

36

187

1.0

571

* CORRECTED SAE J8168
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

	7.01	8.01	9.01	10.01	11.01	12.01
	1	1	1	1	1	1
	9/20/78	9/20/78	9/20/78	9/20/78	9/20/78	9/20/78
BAROMETER, MMHG	744.0	744.0	744.0	744.0	744.0	744.0
HUMIDITY, GRAINS/LB	75	75	75	75	75	75
TEMPERATURE, F	70	71	71	70	71	71
ENGINE SPEED, RPM	1000	1000	1000	1000	1000	1000
TORQUE, FT-LB	54.5	43.6	29.1	18.2	7.3	1.5
POWER, BHP*	10.3	8.3	5.5	3.5	1.4	.3
FUEL RATE, LB/HR	4.6	3.9	3.0	2.5	1.7	1.5
IGNITION TIMING, DEG BTDC	9.0	15.0	17.0	7.5	7.0	7.0
MANIFOLD VACUUM, IN HG	2.5	7.0	12.0	15.5	19.8	21.0
THROTTLE ANGLE, DEG	26.0	10.0	6.4	4.5	2.0	1.0
INTAKE MAN. TEMP., F	99	99	99	100	98	97
CONCENTRATIONS, DRY BASIS						
CO, %	.1799	.1479	.1478	.1818	.1773	.1764
CO2, %	11.08	11.37	11.57	12.06	12.64	12.66
O2, %	4.65	4.47	4.19	3.53	2.68	2.56
HC, PPMC	664	1103	1226	725	866	898
NOX, PPM	1025	1188	767	168	56	28
AIR/FUEL RATIO	18.69	18.41	18.08	17.45	16.66	16.56
EMISSION RATES, G/HR						
CO	66.0	45.1	33.5	32.9	21.6	18.0
HC	12.2	16.9	14.0	6.6	5.3	4.6
NOX+	62.0	59.8	28.7	5.0	1.1	.5
OIL TEMPERATURE, F	195	193	191	189	187	184
OIL PRESSURE, PSI	36	40	40	40	40	45
COOLANT TEMPERATURE, F	188	189	188	188	188	187
EXHAUST PRESSURE, IN. H2O	5.0	4.0	3.0	2.0	1.0	.0
EXHAUST TEMPERATURE, F	934	879	820	780	714	672

* CORRECTED SAE J816B
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-C10

TEST NUMBER	13.01	14.01	15.01	16.01	17.01	19.01
DATA SOURCE CODE	1	1	1	1	1	1
TEST DATE	9/20/78	9/20/78	9/20/78	9/20/78	9/20/78	9/20/78
BAROMETER, MMHG	744.0	744.0	744.0	744.0	744.0	744.0
HUMIDITY, GRAINS/LB	75	75	75	75	75	75
TEMPERATURE, F	72	73	75	73	72	72
ENGINE SPEED, RPM	1500	1500	1500	1500	1500	1500
TORQUE, FT-LB	77.5	69.8	58.1	46.5	31.0	7.0
POWER, BHP*	22.0	19.9	16.5	13.2	8.8	2.0
FUEL RATE, LB/HR	10.9	8.2	7.1	5.9	4.5	2.5
IGNITION TIMING, DEG BTDC	15.0	15.0	15.0	24.0	28.0	15.0
MANIFOLD VACUUM, IN HG	.5	1.4	3.5	7.4	12.5	20.0
THROTTLE ANGLE, DEG	71.0	28.0	23.0	15.0	10.0	4.5
INTAKE MAN. TEMP., F	78	90	93	95	96	97
CONCENTRATIONS, DRY BASIS						
CO, %	4.0634	.1898	.1928	.2092	.2162	.2297
CO2, %	12.02	12.44	11.40	11.32	11.67	12.14
O2, %	.22	2.84	4.37	4.46	4.01	3.43
HC, PPMC	2161	506	149	363	500	210
NOX, PPM	1099	1412	1155	1286	1207	69
AIR/FUEL RATIO	13.06	16.91	18.43	18.49	17.97	17.39
EMISSION RATES, G/HR						
CO	2453.2	111.5	106.7	96.1	73.3	42.2
HC	65.5	14.9	4.1	8.4	8.5	1.9
NOX+	109.4	136.7	105.4	97.4	67.5	2.1
OIL TEMPERATURE, F	199	207	208	206	203	196
OIL PRESSURE, PSI	50	50	50	50	50	50
COOLANT TEMPERATURE, F	189	189	189	189	189	188
EXHAUST PRESSURE, IN. H2O	9.0	8.0	7.0	5.0	5.0	4.0
EXHAUST TEMPERATURE, F	1109	1134	1117	1059	975	880

* CORRECTED SAE J8168
 + CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER 1

DATA SOURCE CODE 1

TEST DATE 9/20/78

BAROMETER, MMHG 744.0

HUMIDITY, GRAINS/LB 75

TEMPERATURE, F 72

ENGINE SPEED, RPM 1500

TORQUE, FT-LB 1.6

POWER, BHP* .5

FUEL RATE, LB/HR 2.2

IGNITION TIMING, DEG BTDC 15.0

MANIFOLD VACUUM, IN HG 21.0

THROTTLE ANGLE, DEG 3.0

INTAKE MAN. TEMP., F 97

CONCENTRATIONS, DRY BASIS

CO, % .1836

CO2, % 12.59

O2, % 2.80

HC, PPMC 94

NOX, PPM 51

AIR/FUEL RATIO 16.86

EMISSION RATES, G/HR

CO 29.1

HC .7

NOX+ 1.3

OIL TEMPERATURE, F 193

OIL PRESSURE, PSI 50

COOLANT TEMPERATURE, F 187

EXHAUST PRESSURE, IN. H2O 3.0

EXHAUST TEMPERATURE, F 850

20.01 1

9/20/78 1

744.0 745.0

75 67

72 75

1500 2000

1.6 81.9

.5 30.9

2.2 16.3

15.0 19.0

21.0 1.0

3.0 71.0

97 65

6.3043

10.68

.16

2477

394

12.10

5384.6

106.2

53.4

221

50

190

15.0

1217

22.01 1

9/20/78 1

745.0 745.0

67 67

76 76

2000 2000

73.7 49.0

27.8 18.5

11.9 8.2

19.0 24.0

2.0 6.5

40.0 21.0

69 93

.2290

13.40

1.60

400

1315

15.85

180.3

15.8

164.5

222

50

189

14.0

1299

24.01 1

9/20/78 1

745.0 745.0

67 67

77 76

2000 2000

49.0 32.8

18.5 12.4

8.2 6.2

24.0 32.0

6.5 11.8

21.0 14.0

93 96

.1698

11.36

4.69

65

1010

18.74

108.6

2.1

102.6

216

50

189

11.0

1195

25.01 1

9/20/78 1

745.0 745.0

67 67

76 76

2000 2000

32.8 20.5

12.4 7.7

6.2 4.8

32.0 32.0

11.8 15.6

14.0 10.0

96 97

.1980

11.66

4.23

110

977

18.23

93.6

2.6

73.4

211

50

189

10.0

1105

26.01 1

9/20/78 1

745.0 745.0

67 67

76 76

2000 2000

20.5 20.5

7.7 7.7

4.8 4.8

32.0 32.0

15.6 15.6

10.0 10.0

97 97

.1920

11.79

4.04

65

492

18.03

69.6

1.2

28.3

207

50

189

8.0

1064

* CORRECTED SAE J8168
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER	27.01	28.01	29.01	30.01	33.01	34.01
DATA SOURCE CODE	1	1	1	1	1	1
TEST DATE	9/20/78	9/20/78	9/20/78	9/20/78	9/20/78	9/20/78
BAROMETER, MMHG	745.0	745.0	745.0	745.0	745.0	745.0
HUMIDITY, GRAINS/LB	67	67	67	67	67	67
TEMPERATURE, F	75	75	77	79	80	80
ENGINE SPEED, RPM	2000	2000	2500	2500	2500	2500
TORQUE, FT-LB	8.2	1.7	82.5	74.3	33.0	20.6
POWER, BHP*	3.1	.6	39.0	35.1	15.6	9.7
FUEL RATE, LB/HR	3.3	2.9	21.0	15.2	7.9	6.0
IGNITION TIMING, DEG BTDC	31.0	21.0	21.0	21.0	35.0	35.0
MANIFOLD VACUUM, IN HG	19.5	21.0	1.0	2.4	11.5	15.5
THROTTLE ANGLE, DEG	6.5	5.5	71.0	41.5	17.0	12.5
INTAKE MAN. TEMP., F	100	99	67	71	97	99
CONCENTRATIONS, DRY BASIS						
CO, %	.2019	.1208	7.4971	.4755	.1176	.0719
CO2, %	11.93	11.76	9.97	13.84	12.08	12.48
O2, %	3.78	4.22	.14	.74	3.66	3.17
HC, PPMC	63	82	2448	373	17	8
NOX, PPM	178	82	277	1207	1199	660
AIR/FUEL RATIO	17.76	18.22	11.63	15.10	17.73	17.28
EMISSION RATES, G/HR						
CO	49.6	26.2	8020.7	455.8	68.9	30.9
HC	.8	.9	131.5	18.0	.5	.2
NOX+	7.0	2.8	47.1	183.9	111.6	45.0
OIL TEMPERATURE, F	207	200	219	228	223	219
OIL PRESSURE, PSI	50	50	55	55	55	55
COOLANT TEMPERATURE, F	188	188	188	190	189	189
EXHAUST PRESSURE, IN. H2O	5.0	4.0	26.0	25.0	12.0	6.0
EXHAUST TEMPERATURE, F	994	989	1378	1408	1220	1172

* CORRECTED SAE J816B
 + CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER 1

DATA SOURCE CODE 1

TEST DATE 9/20/78

BAROMETER, MMHG 745.0

HUMIDITY, GRAINS/LB 67

TEMPERATURE, F 79

ENGINE SPEED, RPM 2500

TORQUE, FT-LB 8.3

POWER, BHP* 3.9

FUEL RATE, LB/HR 4.3

IGNITION TIMING, DEG BTDC 34.0

MANIFOLD VACUUM, IN HG 19.2

THROTTLE ANGLE, DEG 9.0

INTAKE MAN. TEMP., F 100

CONCENTRATIONS, DRY BASIS

CO, % .0511

CO2, % 12.44

O2, % 3.26

HC, PPMC 4

NOX, PPM 245

AIR/FUEL RATIO 17.36

EMISSION RATES, G/HR

CO 16.1

HC .1

NOX+ 12.2

OIL TEMPERATURE, F 215

OIL PRESSURE, PSI 55

COOLANT TEMPERATURE, F 189

EXHAUST PRESSURE, IN. H2O 4.0

EXHAUST TEMPERATURE, F 1131

35.01	1	36.01	1	37.01	1	38.01	1	41.01	1	42.01
9/20/78	745.0	9/20/78	745.0	9/20/78	745.0	9/20/78	745.0	9/20/78	745.0	9/20/78
67	67	67	67	67	67	67	67	67	67	67
79	79	79	79	79	79	79	79	78	79	79
2500	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000
8.3	1.5	80.0	72.0	72.0	72.0	72.0	72.0	32.0	32.0	20.0
3.9	.7	45.3	40.8	40.8	40.8	40.8	40.8	18.1	18.1	11.3
4.3	3.5	26.0	18.2	26.0	18.2	18.2	18.2	9.3	9.3	7.4
34.0	34.0	25.0	25.0	25.0	25.0	25.0	25.0	38.0	38.0	37.0
19.2	21.0	1.0	2.5	1.0	2.5	2.5	2.5	11.5	11.5	15.2
9.0	6.0	71.0	44.0	71.0	44.0	44.0	44.0	19.5	19.5	15.0
100	102	60	70	60	70	70	70	95	95	95
.0511	.0229	8.6673	.5621	.0722	.0721	.5621	.5621	.0702	.0702	.0480
12.44	12.64	9.17	14.11	11.15	14.11	14.11	14.11	11.96	11.96	12.10
3.26	2.89	.10	.54	.10	.54	.54	.54	3.73	3.73	3.56
4	2	2258	183	2258	183	183	183	17	17	8
245	117	181	1261	181	1261	1261	1261	1017	1017	577
17.36	17.04	11.15	14.94	11.15	14.94	14.94	14.94	17.86	17.86	17.68
16.1	5.7	11268.6	629.6	11268.6	629.6	629.6	629.6	49.2	49.2	26.3
.1	.0	147.4	10.3	147.4	10.3	10.3	10.3	.6	.6	.2
12.2	4.6	37.5	224.5	37.5	224.5	224.5	224.5	113.2	113.2	50.2
215	211	228	238	228	238	238	238	206	206	219
55	55	55	55	55	55	55	55	55	55	55
189	188	190	190	190	190	190	190	189	189	188
4.0	4.0	40.0	35.0	40.0	35.0	35.0	35.0	13.0	13.0	10.0
1131	1094	1306	1505	1306	1505	1505	1505	1251	1251	1243

* CORRECTED SAE J816B
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

43.01	44.01	45.01	46.01	47.01	48.01
1	1	1	1	1	1
9/20/78	9/20/78	9/20/78	9/22/78	9/22/78	9/22/78
745.0	745.0	745.0	755.0	755.0	755.0
67	67	67	54	54	54
80	80	80	68	69	69
3000	3000	3600	3600	3600	3600
9.6	1.4	78.9	71.0	59.2	47.0
5.4	.8	53.7	47.6	39.7	31.5
5.6	4.3	32.5	23.7	19.2	15.9
37.0	37.0	26.0	26.0	27.0	32.0
18.5	20.8	1.2	3.2	5.5	6.4
11.5	9.0	71.0	46.5	35.0	32.0
97	99	71	61	68	65
.0261	.0110	9.5959	1.9786	.1907	.0385
12.45	12.87	8.77	13.43	14.12	12.49
3.09	2.74	.08	.17	.75	3.17
4	3	1726	780	30	15
271	122	138	1959	2240	2139
17.24	16.89	10.86	14.05	15.31	17.36
10.6	3.3	15213.3	2732.5	231.2	44.1
.1	.0	137.5	54.1	1.8	.8
17.6	5.8	34.8	404.8	406.5	366.7
220	218	240	220	245	247
55	55	55	55	55	55
189	188	190	190	190	191
8.0	6.0	65.0	54.0	45.0	36.0
1215	1185	1362	1563	1580	1441

* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718	49.01	50.01	51.01	52.01	53.01	54.01
TEST NUMBER	1	1	1	1	1	1
DATA SOURCE CODE	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78
TEST DATE	755.0	755.0	755.0	755.0	755.0	755.0
BAROMETER, MMHG	54	54	54	54	54	54
HUMIDITY, GRAINS/LB	67	67	67	67	69	70
TEMPERATURE, F	3600	3600	3600	3600	4300	4300
ENGINE SPEED, RPM	31.6	19.7	10.6	5	77.6	69.8
TORQUE, FT-LB	21.2	13.2	7.1	.3	62.1	55.9
POWER, BHP*	12.3	9.4	7.3	5.4	33.0	28.0
FUEL RATE, LB/HR	39.0	38.0	38.0	38.0	28.0	27.0
IGNITION TIMING, DEG BTDC	10.5	14.6	17.4	20.8	1.5	3.0
MANIFOLD VACUUM, IN HG	24.5	18.5	15.0	10.0	71.0	51.0
THROTTLE ANGLE, DEG	75	81	82	82	63	71
INTAKE MAN. TEMP., F						
CONCENTRATIONS, DRY BASIS						
CO, %	.0460	.0314	.0256	.0096	5.0174	2.4073
CO2, %	11.75	11.99	12.09	12.60	11.71	13.25
O2, %	4.29	3.89	3.75	2.99	.03	.16
HC, PPMC	9	6	4	3	1585	1326
NOX, PPM	1349	706	400	174	973	2029
AIR/FUEL RATIO	18.41	18.00	17.85	17.14	12.64	13.82
EMISSION RATES, G/HR						
CO	43.2	22.2	14.0	3.7	8868.4	3855.4
HC	.4	.2	.1	.1	140.7	106.6
NOX+	189.7	74.7	32.7	10.0	257.3	486.3
OIL TEMPERATURE, F	243	238	234	229	259	270
OIL PRESSURE, PSI	55	55	55	55	55	55
COOLANT TEMPERATURE, F	190	190	189	189	192	192
EXHAUST PRESSURE, IN. H2O	35.0	16.0	11.0	6.0	90.0	75.0
EXHAUST TEMPERATURE, F	1379	1336	1291	1252	1524	1571

* CORRECTED SAE J816B
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER 1

DATA SOURCE CODE 1

TEST DATE 9/22/78

BAROMETER, MMHG 755.0

HUMIDITY, GRAINS/LB 54

TEMPERATURE, F 69

ENGINE SPEED, RPM 4300

TORQUE, FT-LB 58.2

POWER, BHP* 46.6

FUEL RATE, LB/HR 24.1

IGNITION TIMING, DEG BTDC 28.0

MANIFOLD VACUUM, IN HG 5.5

THROTTLE ANGLE, DEG 36.0

INTAKE MAN. TEMP., F 70

CONCENTRATIONS, DRY BASIS

CO, % 2.0793

CO2, % 13.46

O2, % .16

HC, PPMC 820

NOX, PPM 2054

AIR/FUEL RATIO 14.01

EMISSION RATES, G/HR

CO 2897.0

HC 57.4

NOX+ 428.2

OIL TEMPERATURE, F 274

OIL PRESSURE, PSI 55

COOLANT TEMPERATURE, F 190

EXHAUST PRESSURE, IN. H2O 60.0

EXHAUST TEMPERATURE, F 1583

55.01	56.01	57.01	58.01	59.01	60.01
1	1	1	1	1	1
9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78
755.0	755.0	755.0	755.0	755.0	755.0
54	54	54	54	54	54
69	67	69	69	68	69
4300	4300	4300	4300	4300	4300
58.2	46.6	31.0	19.4	11.4	.6
46.6	37.3	24.8	15.5	9.1	.5
24.1	20.3	15.1	11.8	10.2	6.9
28.0	39.0	39.0	39.0	39.0	39.0
5.5	8.2	10.0	13.5	15.0	20.0
36.0	31.0	29.0	22.0	19.5	13.5
70	63	69	80	82	84
2.0793	.6983	.0373	.0326	.0252	.0095
13.46	14.00	11.87	11.69	11.74	12.27
.16	.35	3.90	4.18	4.12	3.40
820	305	11	6	4	2
2054	2479	1631	954	623	218
14.01	14.78	18.07	18.33	18.26	17.53
2897.0	870.2	42.7	29.7	19.8	4.8
57.4	19.1	.6	.3	.2	.1
428.2	462.2	279.7	130.1	73.3	16.5
274	230	250	251	250	246
55	55	55	55	55	55
190	190	190	190	189	188
60.0	44.0	38.0	24.0	19.0	10.0
1583	1541	1432	1380	1360	1318

* CORRECTED SAE J8168
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

61.01	1	63.01	1	64.01	1	65.01	1	66.01	1	67.01
9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/25/78
755.0	755.0	755.0	755.0	755.0	755.0	755.0	755.0	755.0	755.0	749.5
54	54	54	54	54	54	54	54	54	54	76
70	72	72	71	71	72	72	71	71	71	79
5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
67.0	50.3	50.3	40.2	40.2	26.8	26.8	16.7	16.7	16.7	8.3
62.4	46.8	46.8	37.4	37.4	24.9	24.9	15.5	15.5	15.5	7.8
37.1	29.2	29.2	24.3	24.3	17.0	17.0	13.8	13.8	13.8	10.7
25.0	27.0	27.0	35.0	35.0	38.0	38.0	38.0	38.0	38.0	39.0
1.6	6.0	6.0	9.0	9.0	12.0	12.0	13.5	13.5	13.5	17.0
71.0	35.0	35.0	32.0	32.0	28.0	28.0	25.0	25.0	25.0	21.0
67	72	72	73	73	67	67	81	81	81	90
5.8203	4.5687	4.5687	1.3876	1.3876	.0239	.0239	.0231	.0231	.0231	.0152
11.28	11.88	11.88	13.81	13.81	13.56	13.56	11.82	11.82	11.82	12.30
.01	.04	.04	.14	.14	1.58	1.58	4.11	4.11	4.11	3.77
1643	1702	1702	753	753	12	12	6	6	6	4
657	1062	1062	2180	2180	2104	2104	1011	1011	1011	480
12.32	12.80	12.80	14.29	14.29	16.02	16.02	18.25	18.25	18.25	17.83
11282.8	7261.0	7261.0	1994.8	1994.8	26.9	26.9	24.4	24.4	24.4	11.9
160.0	135.8	135.8	54.4	54.4	.7	.7	.3	.3	.3	.2
190.6	252.6	252.6	469.1	469.1	354.9	354.9	159.7	159.7	159.7	62.2
283	289	289	291	291	285	285	272	272	272	243
55	55	55	55	55	55	55	55	55	55	55
192	192	192	190	190	190	190	189	189	189	190
112.0	75.0	75.0	60.0	60.0	39.0	39.0	30.0	30.0	30.0	16.0
1561	1541	1541	1549	1549	1528	1528	1438	1438	1438	1397

* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718	68.01	69.01	70.01	71.01	72.01	73.01
TEST NUMBER	1	1	1	1	1	1
DATA SOURCE CODE	9/22/78	9/22/78	9/22/78	5/28/78	9/22/78	9/22/78
TEST DATE	755.0	753.1	753.1	753.1	753.1	753.1
BAROMETER, MMHG	54	54	54	54	54	54
HUMIDITY, GRAINS/LB	72	75	74	73	75	76
TEMPERATURE, F	5000	800	800	800	650	1000
ENGINE SPEED, RPM	1.0	.0	7.0	15.0	5.6	54.5
TORQUE, FT-LB	.9	.0	1.0	2.2	.7	10.2
POWER, BHP*	8.6	1.1	1.4	1.8	1.3	4.7
FUEL RATE, LB/HR	38.0	6.0	6.0	6.0	6.0	9.0
IGNITION TIMING, DEG BTDC	18.8	21.5	19.8	17.0	20.5	3.5
MANIFOLD VACUUM, IN HG	17.0	.0	1.0	2.0	.0	18.0
THROTTLE ANGLE, DEG	86	85	88	87	87	86
INTAKE MAN. TEMP., F						
CONCENTRATIONS, DRY BASIS						
CO, %	.0088	.2405	.1560	.1238	.1734	.1784
CO2, %	12.25	12.50	12.57	12.39	12.89	11.17
O2, %	3.54	2.94	2.93	3.21	2.37	4.98
HC, PPMC	2	1503	2853	2633	3163	759
NOX, PPM	276	44	136	340	115	1075
AIR/FUEL RATIO	17.65	16.76	16.63	16.92	16.12	18.93
EMISSION RATES, G/HR						
CO	5.6	18.0	15.2	15.7	15.1	65.7
HC	.1	5.6	14.0	16.8	13.9	14.0
NOX+	26.3	.5	2.0	6.5	1.5	59.3
OIL TEMPERATURE, F	268	186	178	177	176	187
OIL PRESSURE, PSI	55	35	35	35	35	40
COOLANT TEMPERATURE, F	188	187	187	188	187	188
EXHAUST PRESSURE, IN. H2O	15.0	1.0	1.0	2.0	2.0	5.0
EXHAUST TEMPERATURE, F	1388	703	588	587	538	917

* CORRECTED SAE J816B
 + CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER 1

DATA SOURCE CODE 1

TEST DATE 9/22/78

BAROMETER, MMHG 753.1

HUMIDITY, GRAINS/LB 54

TEMPERATURE, F 75

ENGINE SPEED, RPM 1000

TORQUE, FT-LB 43.6

POWER, BHP* 8.1

FUEL RATE, LB/HR 3.9

IGNITION TIMING, DEG BTDC 12.0

MANIFOLD VACUUM, IN HG 7.0

THROTTLE ANGLE, DEG 11.0

INTAKE MAN. TEMP., F 86

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

	74.01	75.01	76.01	77.01	78.01	79.01
	1	1	1	1	1	1
	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78	9/22/78
BAROMETER, MMHG	753.1	753.1	753.1	753.1	753.1	753.1
HUMIDITY, GRAINS/LB	54	54	54	54	54	54
TEMPERATURE, F	75	76	75	75	72	74
ENGINE SPEED, RPM	1000	1000	1000	1000	1500	1500
TORQUE, FT-LB	43.6	18.2	7.3	.0	58.1	46.5
POWER, BHP*	8.1	3.4	1.4	.0	16.3	13.0
FUEL RATE, LB/HR	3.9	2.4	1.8	1.5	7.0	5.8
IGNITION TIMING, DEG BTDC	12.0	7.0	7.0	7.0	14.0	23.0
MANIFOLD VACUUM, IN HG	7.0	16.5	19.8	21.5	4.0	7.5
THROTTLE ANGLE, DEG	11.0	4.0	2.0	1.0	22.0	15.0
INTAKE MAN. TEMP., F	86	87	87	87	80	84
CONCENTRATIONS, DRY BASIS						
CO, %	.1425	.1912	.2030	.1977	.1955	.1860
CO2, %	11.00	12.72	12.51	12.67	11.05	11.17
O2, %	5.07	2.74	2.89	2.82	4.98	4.73
HC, PPMC	1108	866	846	834	255	660
NOX, PPM	1200	455	144	75	1020	1629
AIR/FUEL RATIO	19.06	16.71	16.83	16.76	19.04	18.75
EMISSION RATES, G/HR						
CO	45.0	32.0	25.7	20.1	110.0	85.9
HC	17.6	7.3	5.4	4.3	7.2	15.3
NOX+	56.7	11.4	2.7	1.1	86.0	112.6
OIL TEMPERATURE, F	188	187	184	181	166	186
OIL PRESSURE, PSI	40	40	40	40	45	45
COOLANT TEMPERATURE, F	188	187	187	187	178	189
EXHAUST PRESSURE, IN. H2O	5.0	4.0	2.0	1.0	6.0	5.0
EXHAUST TEMPERATURE, F	866	781	728	669	1082	1030

* CORRECTED SAE J816B
 + CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO₂, %

O₂, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H₂O

EXHAUST TEMPERATURE, F

80.01	1	80.01	1	81.01	1	82.01	1	83.01	1	84.01	1	85.01
9/22/78	753.1	9/22/78	753.1	9/22/78	753.1	9/22/78	753.1	9/22/78	753.1	9/22/78	753.1	9/22/78
54	54	54	54	54	54	54	54	54	54	54	54	54
75	75	75	75	75	75	75	75	75	75	75	75	76
1500	1500	1500	1500	1500	1500	1500	1500	2000	2000	2000	2000	2000
19.4	7.1	7.1	2	61.4	49.0	49.0	49.0	61.4	49.0	49.0	49.0	20.5
5.4	2.0	2.0	.1	22.9	18.3	18.3	18.3	22.9	18.3	18.3	18.3	7.7
3.5	2.6	2.6	.1	9.9	8.1	8.1	8.1	9.9	8.1	8.1	8.1	4.8
26.0	13.0	13.0	2.1	17.0	24.0	24.0	24.0	17.0	24.0	24.0	24.0	30.0
16.5	19.5	19.5	2.1	2.1	6.2	6.2	6.2	2.1	6.2	6.2	6.2	16.0
7.5	5.0	5.0	3.0	37.0	21.5	21.5	21.5	37.0	21.5	21.5	21.5	10.0
85	85	85	87	85	85	85	85	85	85	85	85	85
.2303	.2307	.2307	.1908	.1569	.1722	.1722	.1722	.1569	.1722	.1722	.1722	.1760
11.67	11.86	11.86	12.31	11.20	11.09	11.09	11.09	11.20	11.09	11.09	11.09	11.84
4.06	3.92	3.92	3.16	4.83	5.04	5.04	5.04	4.83	5.04	5.04	5.04	3.93
500	228	228	112	90	91	91	91	90	91	91	91	54
783	168	168	99	1411	1138	1138	1138	1411	1138	1138	1138	763
17.99	17.84	17.84	17.18	18.94	19.14	19.14	19.14	18.94	19.14	19.14	19.14	17.95
61.6	45.4	45.4	29.4	123.1	111.4	111.4	111.4	123.1	111.4	111.4	111.4	63.8
6.7	2.3	2.3	.9	3.5	3.0	3.0	3.0	3.5	3.0	3.0	3.0	1.0
31.3	5.0	5.0	2.3	165.8	110.3	110.3	110.3	165.8	110.3	110.3	110.3	41.4
191	189	189	188	195	201	201	201	195	201	201	201	201
50	50	50	50	55	55	55	55	55	55	55	55	55
188	188	188	187	189	189	189	189	189	189	189	189	188
4.0	3.0	3.0	2.0	15.0	11.0	11.0	11.0	15.0	11.0	11.0	11.0	7.0
938	879	879	843	1198	1162	1162	1162	1198	1162	1162	1162	1067

* CORRECTED SAE J8168
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

	86.01	87.01	88.01	89.01	90.01	91.01
TEST NUMBER	1	1	1	1	1	1
DATA SOURCE CODE	1	1	1	1	1	1
TEST DATE	9/22/78	9/22/78	9/25/78	9/25/78	9/25/78	9/25/78
BAROMETER, MMHG	753.1	753.1	749.6	749.6	749.6	749.6
HUMIDITY, GRAINS/LB	54	54	76	76	76	76
TEMPERATURE, F	75	76	73	74	77	78
ENGINE SPEED, RPM	2000	2000	2500	2500	2500	2500
TORQUE, FT-LB	8.2	3	61.9	49.5	20.6	8.3
POWER, BHP*	3.1	.1	29.1	23.3	9.7	3.9
FUEL RATE, LB/HR	3.6	2.9	12.7	10.5	6.2	4.4
IGNITION TIMING, DEG BTDC	30.0	17.0	21.0	27.0	35.0	35.0
MANIFOLD VACUUM, IN HG	19.5	22.0	3.0	6.2	15.5	19.5
THROTTLE ANGLE, DEG	7.0	5.0	38.0	26.0	13.5	10.0
INTAKE MAN. TEMP., F	86	87	76	81	85	86
CONCENTRATIONS, DRY BASIS						
CO, %	.1694	.0733	.0682	.0932	.0688	.0418
CO2, %	12.10	12.12	12.06	11.74	12.54	12.93
O2, %	3.68	3.50	3.70	4.31	3.20	2.56
HC, PPMC	44	14	44	32	19	13
NOX, PPM	347	108	1754	1384	714	247
AIR/FUEL RATIO	17.68	17.59	17.83	18.39	17.29	16.74
EMISSION RATES, G/HR						
CO	45.5	15.5	64.3	74.9	30.6	12.9
HC	.6	.1	2.1	1.3	.4	.2
NOX+	13.9	3.4	273.9	184.3	52.6	12.6
OIL TEMPERATURE, F	198	196	218	218	215	210
OIL PRESSURE, PSI	55	55	55	55	55	55
COOLANT TEMPERATURE, F	188	188	189	189	188	187
EXHAUST PRESSURE, IN. H2O	5.0	4.0	24.0	18.0	6.0	4.0
EXHAUST TEMPERATURE, F	992	967	1336	1288	1184	1125

* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER 1

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

92.01	1	93.01	1	94.01	1	95.01	1	96.01	1	97.01
9/25/78	749.6	9/25/78	749.6	9/25/78	749.6	9/25/78	749.6	9/25/78	749.6	9/25/78
76	76	76	76	76	76	76	76	76	76	76
77	74	74	77	77	76	76	77	76	77	77
2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
.9	60.0	60.0	48.0	48.0	20.0	20.0	9.6	9.6	1.0	1.0
.4	33.9	33.9	27.1	27.1	11.3	11.3	5.4	5.4	.6	.6
3.5	14.8	14.8	12.8	12.8	7.6	7.6	5.8	5.8	4.4	4.4
33.0	25.0	25.0	29.0	29.0	38.0	38.0	38.0	38.0	38.0	38.0
21.5	4.5	4.5	6.0	6.0	15.2	15.2	18.5	18.5	21.5	21.5
7.0	35.0	35.0	31.0	31.0	16.0	16.0	12.0	12.0	10.0	10.0
88	68	68	78	78	84	84	85	85	88	88
.0246	.0481	.0481	.0651	.0651	.0474	.0474	.0266	.0266	.0122	.0122
12.75	12.63	12.63	11.64	11.64	12.18	12.18	12.63	12.63	12.83	12.83
2.89	3.07	3.07	4.53	4.53	3.80	3.80	3.16	3.16	2.99	2.99
10	19	19	14	14	9	9	7	7	5	5
121	1965	1965	1316	1316	618	618	314	314	148	148
17.03	17.23	17.23	18.62	18.62	17.86	17.86	17.26	17.26	17.09	17.09
6.0	50.7	50.7	64.1	64.1	26.4	26.4	10.9	10.9	3.8	3.8
.1	1.0	1.0	.7	.7	.2	.2	.1	.1	.1	.1
4.9	342.8	342.8	214.6	214.6	57.1	57.1	21.4	21.4	7.6	7.6
204	218	218	224	224	223	223	218	218	214	214
55	55	55	55	55	55	55	55	55	55	55
187	189	189	189	189	189	189	189	189	189	189
2.0	30.0	30.0	25.0	25.0	9.0	9.0	5.0	5.0	3.0	3.0
1086	1388	1388	1352	1352	1255	1255	1212	1212	1179	1179

* CORRECTED SAE J8168

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

	98.01	99.01	100.01	101.01	102.01	103.01
TEST NUMBER	1	1	1	1	1	1
DATA SOURCE CODE	9/25/78	9/25/78	9/25/78	9/25/78	9/25/78	9/25/78
TEST DATE	749.6	749.6	749.6	749.6	749.6	749.6
BAROMETER, MMHG	76	76	76	76	76	76
HUMIDITY, GRAINS/LB	75	77	79	79	80	79
TEMPERATURE, F	3600	3600	3600	3600	3600	4300
ENGINE SPEED, RPM	59.2	47.0	19.7	10.6	1.3	58.2
TORQUE, FT-LB	40.1	31.8	13.3	7.2	.9	47.1
POWER, BHP*	18.5	15.4	9.6	7.5	5.5	24.2
FUEL RATE, LB/HR	27.0	35.0	39.0	38.0	38.0	29.0
IGNITION TIMING, DEG BTDC	5.5	7.5	14.0	17.4	20.5	5.5
MANIFOLD VACUUM, IN HG	35.0	31.0	19.0	15.0	11.0	36.0
THROTTLE ANGLE, DEG	73	73	84	88	90	78
INTAKE MAN. TEMP., F						
CONCENTRATIONS, DRY BASIS						
CO, %	.1174	.0369	.0301	.0221	.0085	2.3434
CO2, %	13.99	12.65	12.00	12.29	12.80	13.24
O2, %	.90	2.95	3.97	3.61	2.88	.20
HC, PPMC	28	15	6	5	3	920
NOX, PPM	2235	2055	637	359	161	1923
AIR/FUEL RATIO	15.46	17.15	18.06	17.69	17.02	13.90
EMISSION RATES, G/HR						
CO	138.9	40.5	21.6	12.1	3.3	3262.2
HC	1.7	.8	.2	.1	.1	64.3
NOX+	438.0	374.2	75.7	32.6	10.4	443.5
OIL TEMPERATURE, F	221	243	238	234	228	255
OIL PRESSURE, PSI	55	55	55	55	55	55
COOLANT TEMPERATURE, F	190	190	189	189	189	190
EXHAUST PRESSURE, IN. H2O	40.0	33.0	14.0	9.0	4.0	56.0
EXHAUST TEMPERATURE, F	1530	1440	1342	1300	1256	1548

* CORRECTED SAE J8168
 + CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, 8HP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG 8TDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

	104.01	105.01	106.01	107.01	108.01	110.01
	1	1	1	1	1	1
	9/25/78	9/25/78	9/25/78	9/25/78	9/25/78	9/25/78
	749.6	749.6	749.6	749.6	749.6	749.6
	76	76	76	76	76	76
	80	81	80	83	80	83
	4300	4300	4300	4300	5000	5000
	46.6	19.4	11.4	1.2	50.3	16.8
	37.7	15.7	9.2	1.0	47.3	15.8
	20.3	11.5	10.0	6.9	28.1	13.7
	37.0	39.0	39.0	39.0	32.0	39.0
	8.0	13.5	15.0	19.5	7.0	13.0
	32.0	23.0	20.0	14.0	33.0	26.0
	78	87	92	94	78	88
	.9259	.0286	.0253	.0085	5.2037	.0226
	14.00	11.95	12.06	12.55	11.58	11.95
	.30	3.98	3.90	3.28	.06	3.96
	548	7	5	3	1738	7
	2363	870	565	191	963	928
	14.62	18.09	17.99	17.38	12.57	18.08
	1132.7	24.8	18.9	4.2	7789.9	23.4
	33.7	.3	.2	.1	130.6	.4
	478.9	124.7	69.8	15.6	238.9	159.2
	264	261	252	247	276	284
	55	55	55	55	55	55
	190	190	189	188	191	190
	45.0	21.0	15.0	8.0	66.0	30.0
	1551	1404	1357	1325	1500	1447

* CORRECTED SAE J8168

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER 1

DATA SOURCE CODE 1

TEST DATE 9/25/78

BAROMETER, MMHG 749.5

HUMIDITY, GRAINS/LB 76

TEMPERATURE, F 79

ENGINE SPEED, RPM 5000

TORQUE, FT-LB 8.3

POWER, BHP* 7.8

FUEL RATE, LB/HR 10.5

IGNITION TIMING, DEG BTDC 38.5

MANIFOLD VACUUM, IN HG 17.0

THROTTLE ANGLE, DEG 21.0

INTAKE MAN. TEMP., F 92

CONCENTRATIONS, DRY BASIS

CO, % .0156

CO2, % 12.32

O2, % 3.74

HC, PPMC 3

NOX, PPM 506

AIR/FUEL RATIO 17.79

EMISSION RATES, G/HR

CO 12.0

HC 1

NOX+ 64.8

OIL TEMPERATURE, F 244

OIL PRESSURE, PSI 55

COOLANT TEMPERATURE, F 190

EXHAUST PRESSURE, IN. H2O 16.0

EXHAUST TEMPERATURE, F 1379

111.01	112.01	113.01	114.01	118.01	119.01
1	1	1	1	1	1
9/25/78	9/25/78	9/25/78	9/25/78	9/29/78	9/29/78
749.5	749.6	749.6	749.5	744.5	744.5
76	76	76	76	71	71
79	85	80	78	73	72
5000	5000	5200	2500	1500	2000
8.3	1.2	64.0	61.9	19.4	61.4
7.8	1.1	62.6	29.1	5.5	23.2
10.5	8.6	37.8	12.5	3.5	9.8
38.5	38.0	22.0	21.0	26.0	17.0
17.0	18.5	2.0	3.0	16.5	2.5
21.0	18.0	71.0	38.5	7.0	36.0
92	93	78	81	84	84
.0156	.0095	6.7376	.0744	.2414	.1636
12.32	12.05	10.64	11.97	12.17	11.38
3.74	3.90	.02	3.95	3.33	4.55
3	3	1680	23	460	94
506	225	363	1829	769	1408
17.79	17.99	11.94	18.06	17.28	18.63
12.0	6.1	13111.2	69.7	61.0	125.9
1	1	164.2	1.1	5.8	3.6
64.8	23.9	116.9	283.9	31.4	174.8
244	274	287	208	202	204
55	55	55	55	50	53
190	190	190	190	189	189
16.0	11.0	112.0	22.0	1.0	15.0
1379	1395	1540	1318	920	1192

* CORRECTED SAE J8168
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

120.01	121.01	122.01	123.01	125.01	126.01
1	1	1	1	1	1
9/29/78	9/29/78	9/29/78	9/29/78	9/29/78	10/ 3/78
744.5	744.5	744.5	744.5	744.5	745.0
71	71	71	71	71	45
73	82	82	84	83	79
2500	3000	3000	5000	5000	5000
49.5	60.0	48.0	60.3	40.2	60.3
23.4	34.0	27.2	56.9	38.0	56.7
10.6	14.7	12.6	28.9	21.9	29.4
25.0	25.0	26.0	25.0	38.0	25.0
6.0	3.8	5.5	3.5	9.0	3.0
26.0	38.5	32.0	50.0	26.0	50.0
84	72	81	85	85	80
.0980	.0481	.0596	1.0170	1.3071	.9734
11.42	12.30	11.31	13.91	13.75	14.17
4.43	3.37	4.79	.33	.27	.30
19	17	9	542	559	607
1382	2181	1227	2500	2500	2600
18.59	17.55	18.96	14.61	14.44	14.61
61.1	51.8	59.9	1771.4	1711.1	1701.5
.8	.9	.5	47.4	36.8	53.2
184.7	379.1	199.1	702.8	528.2	655.9
214	223	232	273	267	277
53	55	55	55	55	55
189	190	189	190	189	192
18.0	31.0	26.0	94.0	50.0	96.0
1269	1390	1357	1648	1557	1655

* CORRECTED SAE J8168

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 HONDA 98-CID

FUEL CODE: 7718

TEST NUMBER

DATA SOURCE CODE

TEST DATE

BAROMETER, MMHG

HUMIDITY, GRAINS/LB

TEMPERATURE, F

ENGINE SPEED, RPM

TORQUE, FT-LB

POWER, BHP*

FUEL RATE, LB/HR

IGNITION TIMING, DEG BTDC

MANIFOLD VACUUM, IN HG

THROTTLE ANGLE, DEG

INTAKE MAN. TEMP., F

CONCENTRATIONS, DRY BASIS

CO, %

CO2, %

O2, %

HC, PPMC

NOX, PPM

AIR/FUEL RATIO

EMISSION RATES, G/HR

CO

HC

NOX+

OIL TEMPERATURE, F

OIL PRESSURE, PSI

COOLANT TEMPERATURE, F

EXHAUST PRESSURE, IN. H2O

EXHAUST TEMPERATURE, F

127.01

1

10/ 5/78

748.2

45

73

4300

77.0

62.0

37.7

28.0

2.0

72.0

65

8.4552

9.40

.03

2002

591

11.24

15941.6

189.6

160.6

252

55

192

95.0

1444

* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

HE18.5.A34
no. DOT-TSC-
NHTSA-79-10

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