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DOT-HS-805 813

# PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES

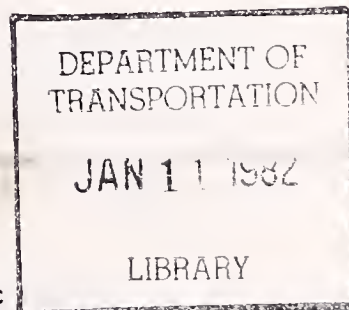
Third Series - Report No. 14  
1978 Buick 196 CID (3.2L), 2V

D.E. Koehler  
W.F. Marshall  
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U.S. DEPARTMENT OF ENERGY  
BARTLESVILLE ENERGY TECHNOLOGY CENTER  
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JUNE 1981  
INTERIM REPORT



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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                      |                                                                                                                                                                |           |
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| 16. Abstract<br><br>Experimental data were obtained in dynamometer tests of a 1978 Buick 196 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 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.

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

Mr. James A. Kidd, Jr. of the U.S. Department of Transportation, Transportation Systems Center, is the technical monitor.

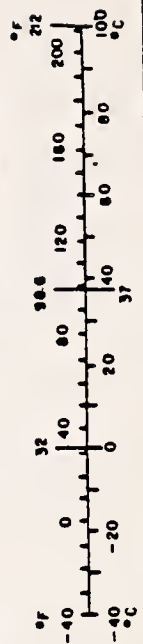
# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

| Symbol                     | When You Know          | Multiply by                | To Find             | Symbol          |
|----------------------------|------------------------|----------------------------|---------------------|-----------------|
| <b>LENGTH</b>              |                        |                            |                     |                 |
| in                         | inches                 | 2.5                        | centimeters         | cm              |
| ft                         | feet                   | 30                         | centimeters         | cm              |
| yd                         | yards                  | 0.9                        | meters              | m               |
| mi                         | miles                  | 1.6                        | kilometers          | km              |
| <b>AREA</b>                |                        |                            |                     |                 |
| in <sup>2</sup>            | square inches          | 6.5                        | square centimeters  | cm <sup>2</sup> |
| ft <sup>2</sup>            | square feet            | 0.09                       | square meters       | m <sup>2</sup>  |
| yd <sup>2</sup>            | square yards           | 0.8                        | square meters       | m <sup>2</sup>  |
| mi <sup>2</sup>            | square miles           | 2.6                        | square kilometers   | km <sup>2</sup> |
|                            | acres                  | 0.4                        | hectares            | ha              |
| <b>MASS (weight)</b>       |                        |                            |                     |                 |
| oz                         | ounces                 | 28                         | grams               | g               |
| lb                         | pounds                 | 0.45                       | kilograms           | kg              |
|                            | short tons (2000 lb)   | 0.9                        | tonnes              | t               |
| <b>VOLUME</b>              |                        |                            |                     |                 |
| tap                        | teaspoons              | 5                          | milliliters         | ml              |
| Tbsp                       | tablespoons            | 15                         | milliliters         | ml              |
| fl oz                      | fluid ounces           | 30                         | milliliters         | ml              |
| c                          | cups                   | 0.24                       | liters              | l               |
| pt                         | pints                  | 0.47                       | liters              | l               |
| qt                         | quarts                 | 0.95                       | liters              | l               |
| gal                        | gallons                | 3.8                        | liters              | l               |
| ft <sup>3</sup>            | cubic feet             | 0.03                       | cubic meters        | m <sup>3</sup>  |
| yd <sup>3</sup>            | cubic yards            | 0.76                       | cubic meters        | m <sup>3</sup>  |
| <b>TEMPERATURE (exact)</b> |                        |                            |                     |                 |
| °F                         | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C              |

\* 1 in = 2.54 exactly. For other exact conversions and more detailed tables, see NBS Monograph 286, Units of Weights and Measures, Price \$2.25. SO Catalog No. C 1.1 10 286.

| Symbol                     | When You Know                     | Multiply by       | To Find                | Symbol          |
|----------------------------|-----------------------------------|-------------------|------------------------|-----------------|
| <b>LENGTH</b>              |                                   |                   |                        |                 |
| mm                         | millimeters                       | 0.04              | inches                 | in              |
| cm                         | centimeters                       | 0.4               | inches                 | in              |
| m                          | meters                            | 3.3               | feet                   | ft              |
| m                          | meters                            | 1.1               | yards                  | yd              |
| km                         | kilometers                        | 0.6               | miles                  | mi              |
| <b>AREA</b>                |                                   |                   |                        |                 |
| cm <sup>2</sup>            | square centimeters                | 0.16              | square inches          | in <sup>2</sup> |
| m <sup>2</sup>             | square meters                     | 1.2               | square yards           | yd <sup>2</sup> |
| km <sup>2</sup>            | square kilometers                 | 0.4               | square miles           | mi <sup>2</sup> |
| ha                         | hectares (10,000 m <sup>2</sup> ) | 2.6               | acres                  |                 |
| <b>MASS (weight)</b>       |                                   |                   |                        |                 |
| g                          | grams                             | 0.035             | ounces                 | oz              |
| kg                         | kilograms                         | 2.2               | pounds                 | lb              |
| t                          | tonnes (1000 kg)                  | 1.1               | short tons             |                 |
| <b>VOLUME</b>              |                                   |                   |                        |                 |
| 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 <sup>3</sup>             | cubic meters                      | 35                | cubic feet             | ft <sup>3</sup> |
| m <sup>3</sup>             | cubic meters                      | 1.3               | cubic yards            | yd <sup>3</sup> |
| <b>TEMPERATURE (exact)</b> |                                   |                   |                        |                 |
| °C                         | Celsius temperature               | 9/5 (then add 32) | Fahrenheit temperature | °F              |



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## 1. INTRODUCTION

This report presents data acquired from tests of a 1978 Buick 196-CID, 2 v engine. Buick uses this particular engine in the 49 state production of the Skylark model, equipped with automatic transmission. Similar versions of this engine are used in other intermediate size Buick automobiles equipped for sale in the 49 states. The results are sufficient to establish steady-state maps for engine performance, fuel consumption, and emission rates (carbon monoxide, unburned hydrocarbon, and oxides of nitrogen) over the entire operating range of the engine.

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

## 2. ENGINE TEST REPORT

The test setup included a complete engine (SAE definition) except that 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.

A new mean-tolerance 1978 Buick 196-CID-V-6 engine was acquired for this series of tests.

The operative emission control systems included exhaust-gas-recirculation (EGR), positive crankcase ventilation, a thermostatically controlled intake air system, and an oxidation catalyst.

Prior to testing, the engine was operated at a variety of speed/load conditions designed to approximate road-load over a 40 hour engine break-in period. Details of engine break-in schedule are outlined in Table 1. A single batch of unleaded regular grade gasoline was used throughout the engine break-in and tests; a detailed fuel analysis is given in Table 2.

Engine tests began on November 29, 1977 and ended on December 14, 1977. The engine was tested while operating at the following steady-state modes:

Speeds: 1,000; 1,300; 1,600; 2,000; 2,500; 3,000; 3,500;  
and 3,800 rpm

Loads: 0, 10, 25, 40, 60, 75, 90, 100 pct of full load  
(repeated at 0, 25, 40, 60, 75 pct of full load)

The following data were recorded for each test point:

Test number

Data source code (1 = before catalyst, 2 = after catalyst)

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  
 CO, pct -- Beckman NDIR  
 CO<sub>2</sub>, pct -- Beckman NDIR  
 O<sub>2</sub>, pct -- Beckman polarographic detector  
 HC, ppmC -- Custom-built heated flame ionization detector  
 NO<sub>x</sub>, ppm -- Thermo-Electron chemiluminescent detector  
 Oil temperature, °F  
 Exhaust temperature, °F  
 Exhaust temperature, °F  
 Exhaust pressure, in H<sub>2</sub>O  
 Intake manifold temperature, °F

The following equations were used in calculating power, air-fuel (A/F) ratio, absolute humidity, and mass emission rates of carbon monoxide (CO), unburned hydrocarbons (HC), and oxides of nitrogen (NO<sub>x</sub>):

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  $\text{NO}_x$  mass emission rate to a standard humidity of 75 grains moisture per pound dry air.

4. Hydrogen concentration in raw exhaust (percent):

$$H_2 = \frac{x(\text{CO}) (\text{CO} + \text{CO}_2)}{2(\text{CO} + 3\text{CO}_2)}$$

where CO = Carbon monoxide concentration (percent)  
 $\text{CO}_2$  = Carbon dioxide concentration (percent)  
 $x$  = Fuel hydrogen/carbon atomic ratio

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

$$\frac{(\text{CO}) (\text{H}_2\text{O})}{(\text{CO}_2) (\text{H}_2)} = 3$$

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

$$C_w = 1 + \frac{(x/2) (\text{CO} + \text{CO}_2) - H_2}{100}$$

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):

$$\text{AF} = \frac{68.9994}{\text{MW}_{\text{fuel}}} \left[ \frac{(1 + \frac{x}{2} - y) (\text{CO}) + (2 + \frac{x}{2} - y) (\text{CO}_2) + 2(\text{O}_2) + \frac{\text{NO}_x}{10^4} - H_2}{\text{CO} + \text{CO}_2 + C_w (\text{HC}/10^4)} \right]$$

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  
 $= 12.01115 + 1.00797x + 15.9994y$

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

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

$MW_{CO}$  = Molecular weight of CO (28.10155)

$M_f$  = Fuel rate in lb/hour

$\%HC$  = HC(ppmC)/ $10^4$

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

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

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

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

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

$MW_{NO_x}$  = 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 (ft-lb)

t = Air temperature (°F)

### 3. DISCUSSION OF TEST RESULTS

The maximum measured torque equaled that specified by the manufacturer (155 ft lb at 2,000 RPM), but was found at slightly less than 2,000 RPM. The maximum measured power also equaled that specified by the manufacturer (95 BHP at 3,800 RPM), but was found at a slightly higher speed than 3,800 RPM.

The fuel consumption characteristics of the engine show a nearly linear relationship with power except for operation near WOT (Figure 1).

The air-fuel (A/F) ratio was maintained slightly lean of stoichiometric for all engine speed/load combinations considered, except those at wide-open-throttle. The lean A/F control and oxidation catalyst were effective in reducing emissions of CO and HC (Figures 2 and 3). The NO<sub>x</sub> emission rates were found to increase with increasing power output, up to about 90 percent of full load for each engine speed considered. The A/F enrichment associated with power output higher than the 90 percent level caused reductions in the NO<sub>x</sub> emission rate (Figure 4).

#### 4. CLOSURE

The experimental work to obtain performance data for the Buick 196-CID engine has been completed, and the data are presented in the Tables accompanying this report.

TABLE 1. ENGINE BREAK-IN SCHEDULE

| Simulated Vehicle<br>Speed<br>(mph) | Engine Speed<br>(RPM) | Manifold Vacuum<br>(in Hg) | Fraction<br>Time in<br>Mode |
|-------------------------------------|-----------------------|----------------------------|-----------------------------|
| 0                                   | 850                   | 17                         | 1/10                        |
| 20                                  | 1000                  | 13                         | "                           |
| 30                                  | 1400                  | 12                         | "                           |
| 40                                  | 1600                  | 11.5                       | "                           |
| 50                                  | 1800                  | 7.5                        | "                           |
| 60                                  | 2000                  | 5                          | "                           |
| 25                                  | 1200                  | 13                         | "                           |
| 35                                  | 1500                  | 11.5                       | "                           |
| 45                                  | 1700                  | 9                          | "                           |
| 55                                  | 1900                  | 5                          | 1/10                        |

Mileage per cycle = 90

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

TABLE 2. 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 |

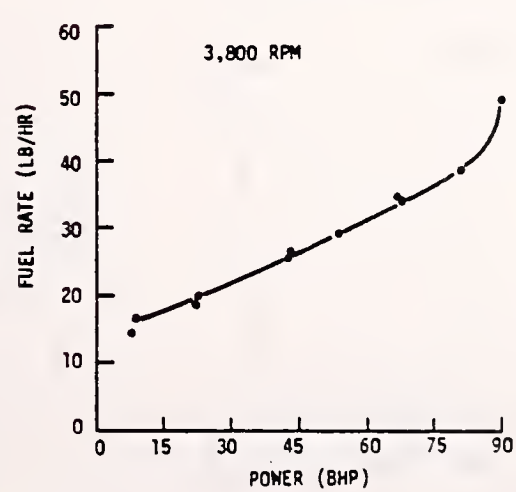
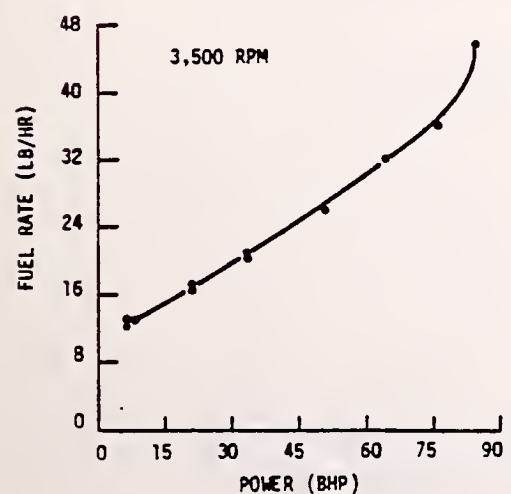
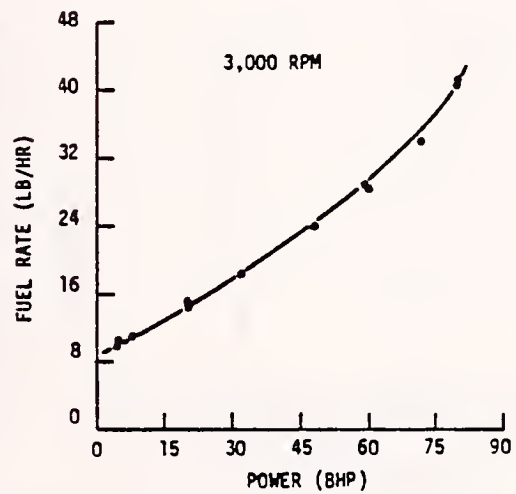
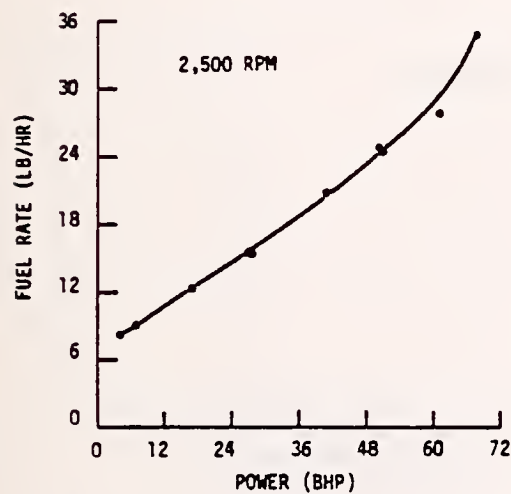
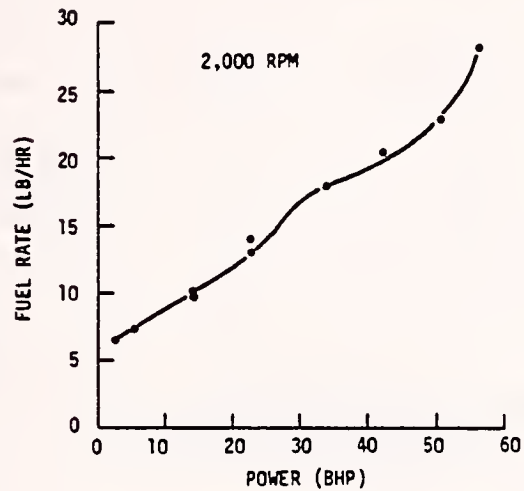
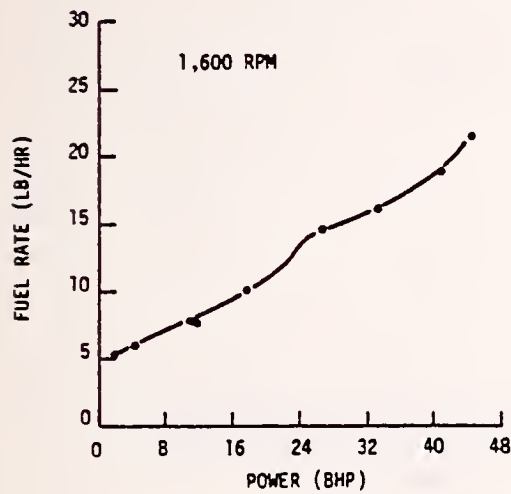
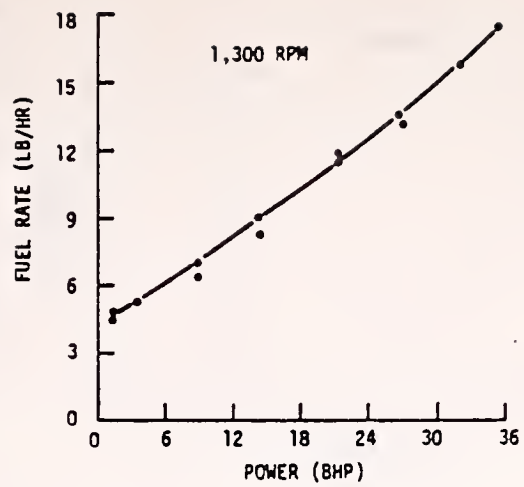
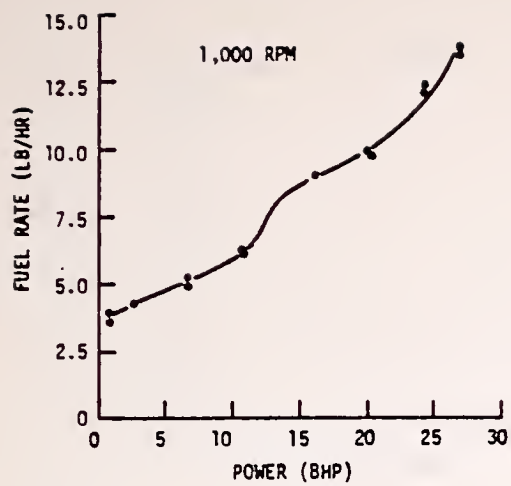


FIGURE 1. FUEL RATE VS POWER

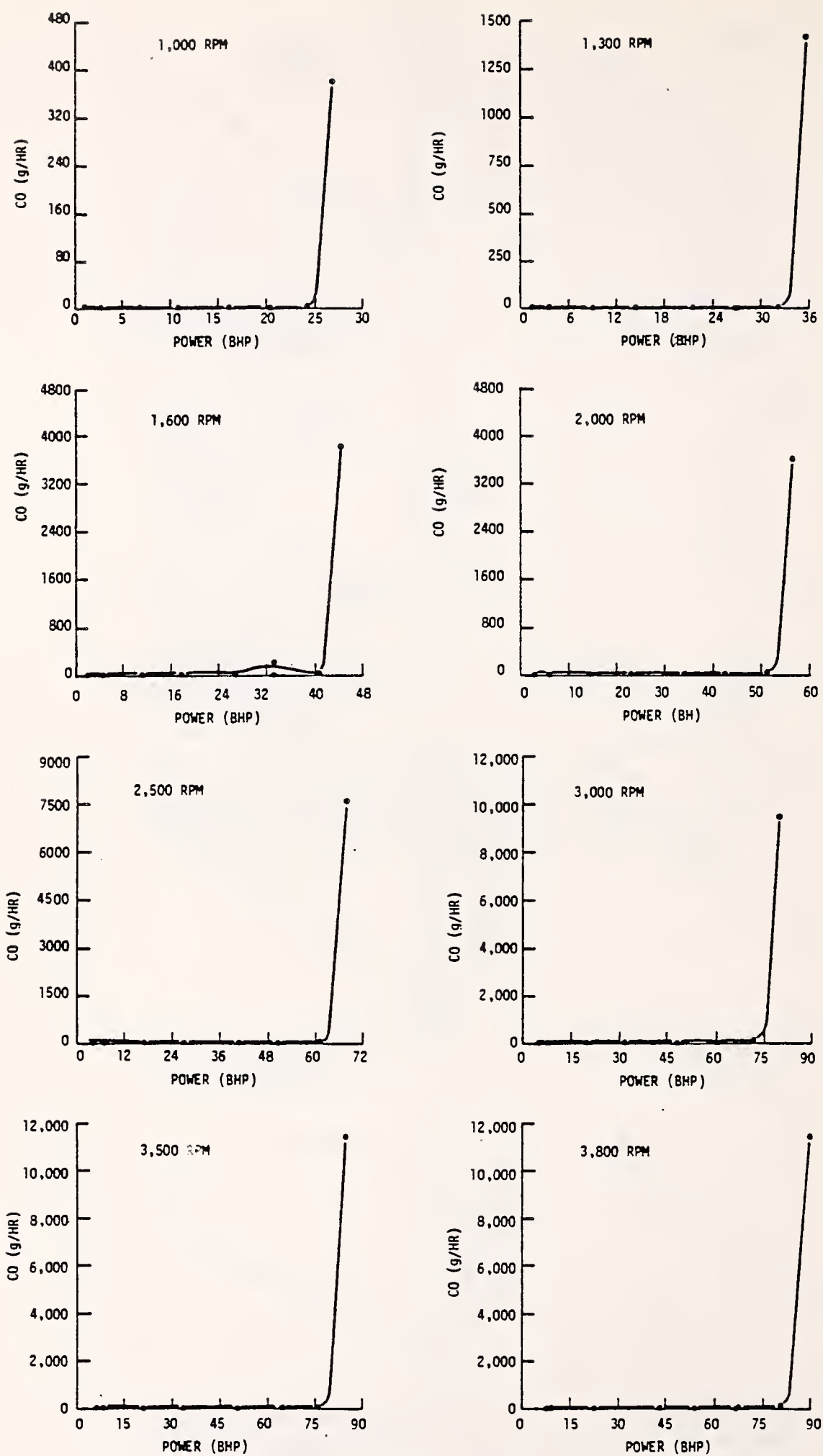


FIGURE 2. CARBON MONOXIDE EMISSIONS VS POWER

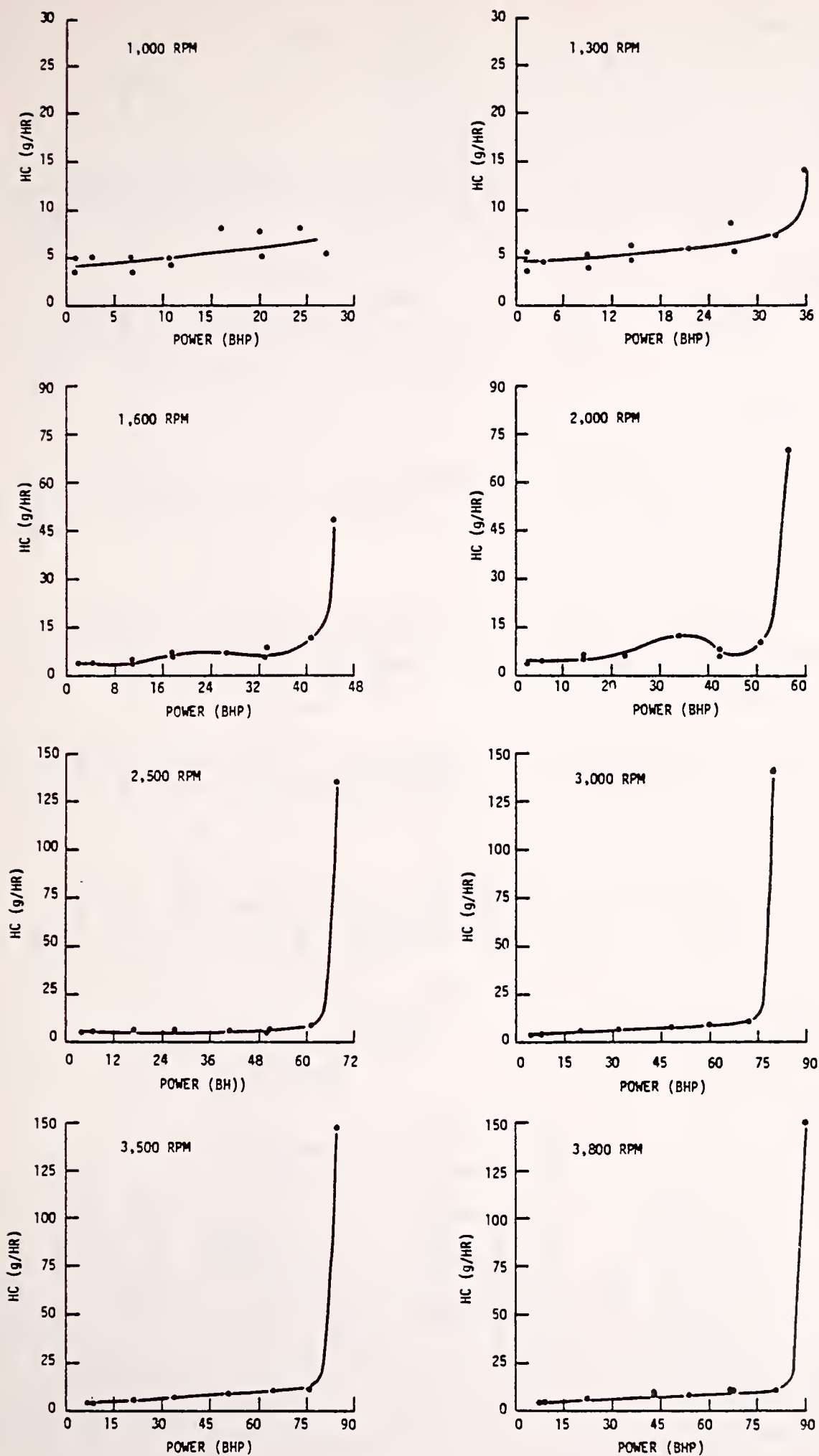


FIGURE 3. HYDROCARBON EMISSIONS VS POWER

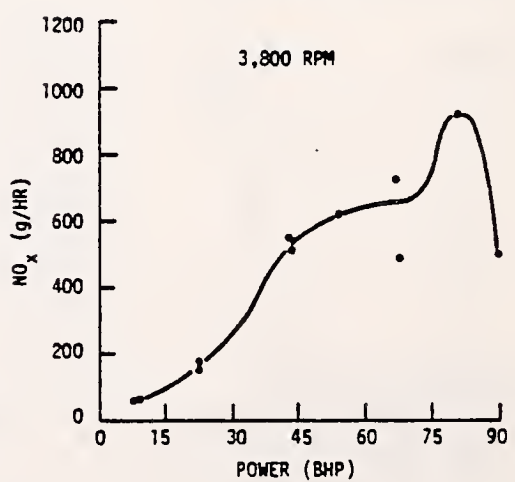
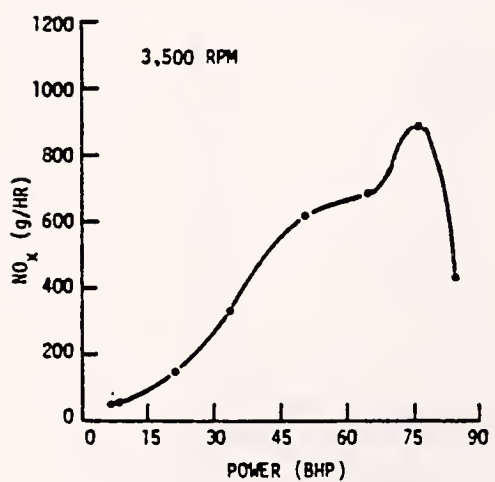
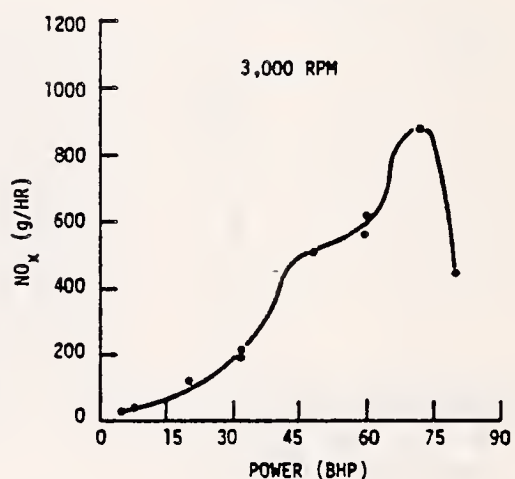
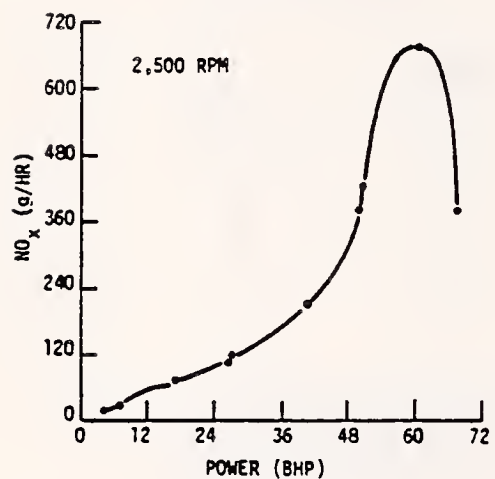
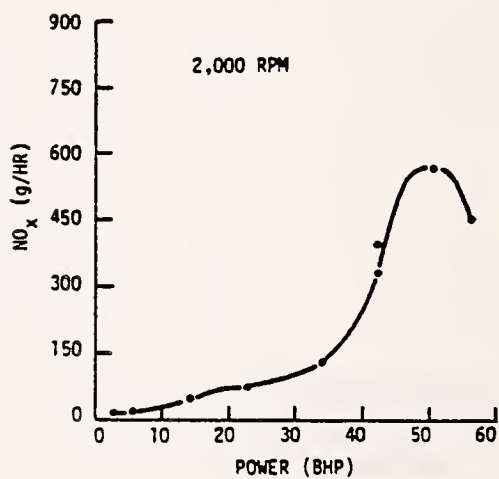
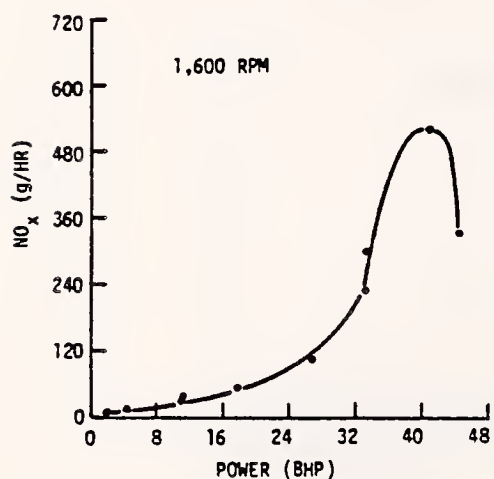
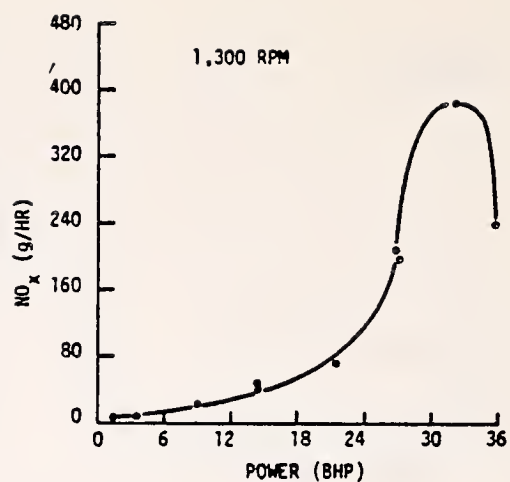
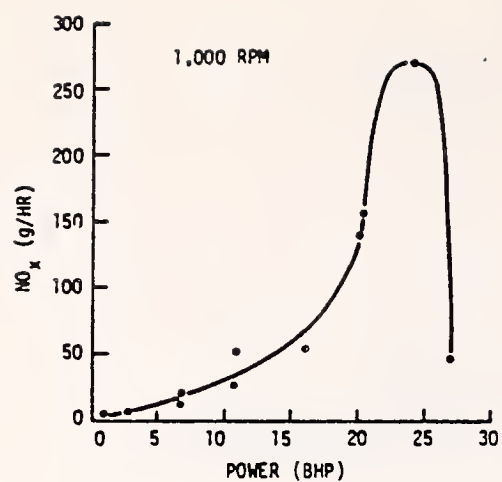


FIGURE 4. OXIDES OF NITROGEN EMISSIONS VS POWER

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 1.01     | 1.02     | 2.01     | 2.02     | 3.01     | 3.02     |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 |
| BAROMETER, MMHG           | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 38       | 38       | 38       | 38       |
| TEMPERATURE, F            | 77       | 77       | 79       | 79       | 79       | 79       |
| ENGINE SPEED, RPM         | 750      | 750      | 750      | 750      | 750      | 750      |
| TORQUE, FT-LB             | 4.1      | 4.1      | 15.0     | 15.0     | 30.0     | 30.0     |
| POWER, BHP*               | .6       | .6       | 2.1      | 2.1      | 4.2      | 4.2      |
| FUEL RATE, LB/HR          | 2.8      | 2.8      | 3.2      | 3.1      | 3.8      | 3.9      |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | 17.3     | 17.5     | 16.0     | 16.0     | 14.0     | 14.0     |
| THROTTLE ANGLE, DEG       | 0.0      | 0.0      | 1.0      | 1.0      | 2.0      | 2.0      |
| INTAKE MAN. TEMP., F      | 146      | 146      | 140      | 140      | 132      | 132      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .1506    | .0014    | .1218    | .0017    | .0985    | .0022    |
| CO2, %                    | 13.07    | 13.96    | 13.29    | 13.89    | 13.54    | 13.97    |
| O2, %                     | 2.01     | 1.26     | 1.89     | 1.11     | 1.63     | 1.13     |
| HC, PPM                   | 8848     | 457      | 5114     | 525      | 2790     | 400      |
| NOX, PPM                  | 12       | 57       | 72       | 85       | 200      | 180      |

AIR/FUEL RATIO 15.21 15.65 15.55 15.54 15.64 15.57

EMISSION RATES, G/HR

|                           |      |     |      |     |      |     |
|---------------------------|------|-----|------|-----|------|-----|
| CO                        | 27.1 | .3  | 25.3 | .3  | 24.3 | .5  |
| HC                        | 80.0 | 4.2 | 53.3 | 5.4 | 34.6 | 5.0 |
| NOX+                      | .3   | 1.4 | 2.1  | 2.4 | 6.9  | 6.3 |
| OIL TEMPERATURE, F        |      |     |      |     |      |     |
| OIL TEMPERATURE, F        | 194  | 194 | 197  | 197 | 197  | 197 |
| OIL PRESSURE, PSI         | 15   | 15  | 15   | 15  | 16   | 16  |
| COOLANT TEMPERATURE, F    | 191  | 191 | 190  | 190 | 191  | 191 |
| EXHAUST PRESSURE, IN. H2O | 0.0  | 1.0 | 0.0  | 1.0 | 0.0  | 1.0 |
| EXHAUST TEMPERATURE, F    | 548  | 549 | 567  | 559 | 604  | 501 |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 4.01     | 4.02     | 5.01     | 5.02     | 6.01     | 6.02     |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 11/29/77 | 11/29/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 |
| BAROMETER, MMHG           | 752.5    | 752.5    | 744.8    | 744.8    | 744.8    | 744.8    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 23       | 23       | 23       | 23       |
| TEMPERATURE, F            | 81       | 81       | 76       | 76       | 78       | 78       |
| ENGINE SPEED, RPM         | 650      | 650      | 1000     | 1000     | 1000     | 1000     |
| TORQUE, FT-LB             | 13.9     | 13.9     | 144.6    | 144.6    | 130.1    | 130.1    |
| POWER, BHP*               | 1.7      | 1.7      | 27.0     | 27.0     | 24.3     | 24.3     |
| FUEL RATE, LB/HR          | 2.7      | 2.7      | 13.7     | 13.4     | 12.3     | 12.0     |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | 16.0     | 16.0     | .5       | .5       | .5       | .5       |
| THROTTLE ANGLE, DEG       | 0.0      | 0.0      | 75.0     | 75.0     | 60.0     | 60.0     |
| INTAKE MAN. TEMP., F      | 144      | 144      | 141      | 141      | 130      | 130      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 1170     | 0002     | 2.2488   | .4632    | .0771    | .0015    |
| CO2, %                    | 13.57    | 13.89    | 12.90    | 14.40    | 12.83    | 13.23    |
| O2, %                     | 1.64     | 1.21     | .59      | .11      | 2.19     | 1.70     |
| HC, PPMC                  | 5354     | 628      | 2565     | 133      | 1903     | 198      |
| NOX, PPM                  | 53       | 68       | 2505     | 437      | 2586     | 2495     |
| AIR/FUEL RATIO            | 15.33    | 15.60    | 14.04    | 14.68    | 16.30    | 16.14    |

EMISSION RATES, G/HR

|                           |      |     |        |       |       |       |
|---------------------------|------|-----|--------|-------|-------|-------|
| CO                        | 20.0 | 0   | 1809.3 | 378.0 | 65.4  | 1.2   |
| HC                        | 45.9 | 5.6 | 103.6  | 5.5   | 81.0  | 8.1   |
| NOX+                      | 1.3  | 1.7 | 266.3  | 47.1  | 269.5 | 268.6 |
| OIL TEMPERATURE, F        | 196  | 196 | 220    | 220   | 221   | 221   |
| OIL PRESSURE, PSI         | 14   | 14  | 18     | 18    | 25    | 25    |
| COOLANT TEMPERATURE, F    | 191  | 191 | 192    | 192   | 189   | 189   |
| EXHAUST PRESSURE, IN. H2O | 0.0  | 1.0 | 10.0   | 3.0   | 9.0   | 3.0   |
| EXHAUST TEMPERATURE, F    | 517  | 462 | 1014   | 969   | 957   | 890   |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 7.01     | 7.02     | 8.01     | 8.02     | 9.01     | 9.02     |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 |
| BAROMETER, MMHG           | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    |
| HUMIDITY, GRAINS/LB       | 40       | 40       | 40       | 40       | 40       | 40       |
| TEMPERATURE, F            | 84       | 84       | 88       | 86       | 81       | 81       |
| ENGINE SPEED, RPM         | 1000     | 1000     | 1000     | 1000     | 1000     | 1000     |
| TORQUE, FT-LB             | 108.5    | 108.5    | 86.8     | 86.8     | 57.8     | 57.8     |
| POWER, BHP*               | 20.1     | 20.1     | 16.1     | 16.1     | 10.7     | 10.7     |
| FUEL RATE, LB/HR          | 9.9      | 9.8      | 8.9      | 9.0      | 6.2      | 6.2      |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 15.0     | 15.0     | 25.0     | 25.0     |
| MANIFOLD VACUUM, IN HG    | 2.0      | 2.0      | 3.5      | 3.5      | 10.0     | 10.0     |
| THROTTLE ANGLE, DEG       | 16.2     | 16.2     | 11.5     | 11.5     | 7.0      | 7.0      |
| INTAKE MAN. TEMP., F      | 145      | 145      | 154      | 154      | 157      | 157      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0700    | .0014    | .0773    | .0014    | .0086    | .0014    |
| CO2, %                    | 12.80    | 13.00    | 13.00    | 13.10    | 13.05    | 13.29    |
| O2, %                     | 3.00     | 2.75     | 3.00     | 2.75     | 2.63     | 2.23     |
| HC, PPM                   | 2262     | 227      | 1926     | 261      | 2493     | 240      |
| NOX, PPM                  | 1650     | 1450     | 700      | 613      | 570      | 440      |

AIR/FUEL RATIO 16.83 16.91 16.80 16.86 16.49 16.44

# EMISSION RATES, G/HR

|                           |       |       |      |      |      |      |
|---------------------------|-------|-------|------|------|------|------|
| CO                        | 47.6  | 1.0   | 47.1 | .9   | 3.6  | .6   |
| HC                        | 77.3  | 7.7   | 58.9 | 8.1  | 52.9 | 5.0  |
| NOX+                      | 158.3 | 139.1 | 60.1 | 53.6 | 34.0 | 26.0 |
| OIL TEMPERATURE, F        | 215   | 215   | 217  | 217  | 214  | 214  |
| OIL PRESSURE, PSI         | 18    | 18    | 18   | 18   | 20   | 20   |
| COOLANT TEMPERATURE, F    | 190   | 190   | 190  | 190  | 190  | 190  |
| EXHAUST PRESSURE, IN. H2O | 4.0   | 2.0   | 3.0  | 1.0  | 0.0  | 1.0  |
| EXHAUST TEMPERATURE, F    | 908   | 851   | 895  | 807  | 805  | 757  |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

## ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 10.01    | 10.02    | 11.01    | 11.02    | 12.01    | 12.02    |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 |
| BAROMETER, MMHG           | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    |
| HUMIDITY, GRAINS/LB       | 40       | 40       | 40       | 40       | 40       | 40       |
| TEMPERATURE, F            | 81       | 81       | 82       | 82       | 81       | 81       |
| ENGINE SPEED, RPM         | 1000     | 1000     | 1000     | 1000     | 1000     | 1000     |
| TORQUE, FT-LB             | 36.0     | 36.0     | 14.5     | 14.5     | 5.0      | 5.0      |
| POWER, BHP*               | 6.7      | 6.7      | 2.7      | 2.7      | .9       | .9       |
| FUEL RATE, LB/HR          | 5.2      | 5.1      | 4.2      | 4.3      | 3.8      | 3.9      |
| IGNITION TIMING, DEG BTDC | 27.0     | 27.0     | 20.0     | 20.0     | 15.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | 14.5     | 13.5     | 16.5     | 16.5     | 17.0     | 17.0     |
| THROTTLE ANGLE, DEG       | 4.0      | 4.0      | 2.3      | 2.3      | 2.0      | 2.0      |
| INTAKE MAN. TEMP., F      | 150      | 150      | 152      | 152      | 154      | 154      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0893    | .0014    | .1362    | .0014    | .1602    | .0014    |
| CO2, %                    | 12.81    | 13.11    | 12.40    | 12.89    | 12.35    | 13.30    |
| O2, %                     | 2.31     | 2.03     | 2.71     | 2.21     | 2.61     | 1.65     |
| HC, PPM                   | 2715     | 289      | 3720     | 339      | 8791     | 369      |
| NOX, PPM                  | 270      | 235      | 103      | 128      | 93       | 93       |
| AIR/FUEL RATIO            | 16.19    | 16.30    | 16.38    | 16.46    | 15.68    | 15.99    |

## EMISSION RATES, G/HR

|                           |      |      |      |     |       |     |
|---------------------------|------|------|------|-----|-------|-----|
| CO                        | 31.6 | .5   | 40.2 | .4  | 41.3  | .4  |
| HC                        | 48.2 | 5.1  | 55.1 | 5.1 | 113.9 | 4.9 |
| NOX+                      | 13.5 | 11.6 | 4.3  | 5.4 | 3.4   | 3.4 |
| OIL TEMPERATURE, F        | 211  | 211  | 207  | 207 | 206   | 206 |
| OIL PRESSURE, PSI         | 20   | 20   | 21   | 21  | 21    | 21  |
| COOLANT TEMPERATURE, F    | 190  | 190  | 190  | 190 | 190   | 190 |
| EXHAUST PRESSURE, IN. H2O | 0.0  | 1.0  | 0.0  | 1.0 | 0.0   | 1.0 |
| EXHAUST TEMPERATURE, F    | 734  | 669  | 674  | 614 | 655   | 620 |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 13.01    | 13.02    | 14.01    | 14.02    | 15.01    | 15.02    |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 11/29/77 | 11/29/77 |
| BAROMETER, MMHG           | 744.8    | 744.8    | 744.8    | 744.8    | 752.5    | 752.5    |
| HUMIDITY, GRAINS/LB       | 23       | 23       | 23       | 23       | 40       | 40       |
| TEMPERATURE, F            | 79       | 79       | 79       | 79       | 84       | 84       |
| ENGINE SPEED, RPM         | 1300     | 1300     | 1300     | 1300     | 1300     | 1300     |
| TORQUE, FT-LB             | 147.8    | 147.8    | 133.0    | 133.0    | 110.8    | 110.8    |
| POWER, BHP*               | 35.8     | 35.8     | 32.2     | 32.2     | 26.7     | 26.7     |
| FUEL RATE, LB/HR          | 17.4     | 17.4     | 15.7     | 15.6     | 13.6     | 13.5     |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | .5       | .5       | .5       | .5       | 2.0      | 2.0      |
| THROTTLE ANGLE, DEG       | 75.0     | 75.0     | 61.0     | 61.0     | 20.0     | 20.0     |
| INTAKE MAN. TEMP., F      | 128      | 128      | 129      | 129      | 148      | 148      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 1.9065   | 1.3602   | .1078    | .0014    | .1031    | .0016    |
| CO2, %                    | 13.13    | 13.80    | 13.15    | 13.43    | 13.00    | 13.20    |
| O2, %                     | .61      | .09      | 2.19     | 1.90     | 2.38     | 2.25     |
| HC, PPMC                  | 1816     | 269      | 1184     | 138      | 1473     | 187      |
| NOX, PPM                  | 2603     | 1748     | 2771     | 2759     | 1650     | 1600     |

AIR/FUEL RATIO

|       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|
| 14.27 | 14.31 | 16.34 | 16.28 | 16.42 | 16.52 |
|-------|-------|-------|-------|-------|-------|

EMISSION RATES, G/HR

|      |        |        |       |       |       |       |
|------|--------|--------|-------|-------|-------|-------|
| CO   | 1966.1 | 1410.1 | 114.3 | 1.5   | 95.4  | 1.5   |
| HC   | 94.0   | 14.0   | 63.0  | 7.3   | 68.5  | 8.6   |
| NOX+ | 354.6  | 239.4  | 388.0 | 382.9 | 215.4 | 207.6 |

OIL TEMPERATURE, F

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 226 | 226 | 232 | 232 | 230 | 230 |
|-----|-----|-----|-----|-----|-----|

OIL PRESSURE, PSI

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 24 | 24 | 24 | 24 | 25 | 25 |
|----|----|----|----|----|----|

COOLANT TEMPERATURE, F

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 191 | 191 | 191 | 191 | 194 | 194 |
|-----|-----|-----|-----|-----|-----|

EXHAUST PRESSURE, IN. H2O

|      |     |      |     |      |     |
|------|-----|------|-----|------|-----|
| 16.0 | 6.0 | 15.0 | 3.0 | 11.0 | 3.0 |
|------|-----|------|-----|------|-----|

EXHAUST TEMPERATURE, F

|      |     |      |     |      |     |
|------|-----|------|-----|------|-----|
| 1083 | 951 | 1096 | 994 | 1057 | 966 |
|------|-----|------|-----|------|-----|

\* CORRECTED SAE J8168

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6  
FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 16.01    | 16.02    | 17.01    | 17.02    | 18.01    | 18.02    |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 |
| BAROMETER, MMHG           | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    | 752.5    |
| HUMIDITY, GRAINS/LB       | 40       | 40       | 40       | 40       | 40       | 40       |
| TEMPERATURE, F            | 80       | 80       | 79       | 79       | 62       | 62       |
| ENGINE SPEED, RPM         | 1300     | 1300     | 1300     | 1300     | 1300     | 1300     |
| TORQUE, FT-LB             | 88.7     | 88.7     | 59.1     | 59.1     | 37.0     | 37.0     |
| POWER, BHP*               | 21.4     | 21.4     | 14.3     | 14.3     | 8.9      | 8.9      |
| FUEL RATE, LB/HR          | 11.8     | 11.5     | 9.0      | 9.0      | 7.0      | 6.9      |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 26.0     | 26.0     | 30.0     | 30.0     |
| MANIFOLD VACUUM, IN HG    | 3.5      | 3.5      | 10.5     | 10.5     | 13.0     | 13.0     |
| THROTTLE ANGLE, DEG       | 15.0     | 15.0     | 7.0      | 7.0      | 5.0      | 5.0      |
| INTAKE MAN. TEMP., F      | 152      | 152      | 166      | 166      | 147      | 147      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 1031     | 10018    | 1170     | 10014    | 1170     | 10013    |
| CO2, %                    | 13.20    | 13.50    | 13.20    | 13.50    | 13.13    | 13.55    |
| O2, %                     | 2.25     | 2.13     | 2.00     | 1.75     | 2.17     | 1.73     |
| HC, PPM                   | 1533     | 154      | 2157     | 205      | 2496     | 228      |
| NOX, PPM                  | 700      | 650      | 600      | 550      | 340      | 350      |
| AIR/FUEL RATIO            | 16.26    | 16.36    | 15.99    | 16.08    | 16.07    | 16.05    |

# EMISSION RATES, G/HR

|                           |      |      |      |      |      |      |
|---------------------------|------|------|------|------|------|------|
| CO                        | 81.6 | 1.4  | 70.6 | .8   | 55.2 | .6   |
| HC                        | 60.9 | 5.9  | 65.3 | 6.2  | 59.1 | 5.3  |
| NOX+                      | 78.2 | 70.6 | 51.1 | 46.5 | 22.6 | 22.8 |
| OIL TEMPERATURE, F        | 202  | 202  | 217  | 217  | 217  | 217  |
| OIL PRESSURE, PSI         | 28   | 28   | 26   | 26   | 26   | 26   |
| COOLANT TEMPERATURE, F    | 192  | 192  | 191  | 191  | 191  | 191  |
| EXHAUST PRESSURE, IN. H2O | 5.0  | 1.0  | 1.0  | 1.0  | 0.0  | 1.0  |
| EXHAUST TEMPERATURE, F    | 989  | 804  | 906  | 835  | 840  | 769  |

\* CORRECTED SAE J8168  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

| TEST NUMBER               | 19.01    | 19.02    | 20.01    | 20.02    | 21.01    | 21.02    |
|---------------------------|----------|----------|----------|----------|----------|----------|
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 11/29/77 | 11/29/77 | 11/29/77 | 11/29/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MMHG           | 752.5    | 752.5    | 752.5    | 752.5    | 741.9    | 741.9    |
| HUMIDITY, GRAINS/LB       | 40       | 40       | 40       | 40       | 62       | 62       |
| TEMPERATURE, F            | 61       | 61       | 60       | 60       | 82       | 82       |
| ENGINE SPEED, RPM         | 1300     | 1300     | 1300     | 1300     | 1600     | 1600     |
| TORQUE, FT-LB             | 14.7     | 14.7     | 6.0      | 6.0      | 146.8    | 146.8    |
| POWER, BHP*               | 3.5      | 3.5      | 1.4      | 1.4      | 44.4     | 44.4     |
| FUEL RATE, LB/HR          | 5.2      | 5.2      | 4.8      | 4.7      | 21.4     | 21.4     |
| IGNITION TIMING, DEG BTDC | 26.0     | 26.0     | 23.0     | 23.0     | 15.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | 17.0     | 17.0     | 18.0     | 18.0     | .5       | .5       |
| THROTTLE ANGLE, DEG       | 3.0      | 3.0      | 2.5      | 2.5      | 75.0     | 75.0     |
| INTAKE MAN. TEMP., F      | 141      | 141      | 137      | 137      | 134      | 134      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .1482    | .0013    | .1698    | .0013    | 2.0921   | 1.8908   |
| CO2, %                    | 12.97    | 13.43    | 12.26    | 13.01    | 12.89    | 13.29    |
| O2, %                     | 2.29     | 1.85     | 2.98     | 2.37     | .44      | .17      |
| HC, PPMC                  | 3173     | 256      | 6419     | 340      | 2303     | 762      |
| NOX, PPM                  | 93       | 110      | 50       | 83       | 1981     | 1695     |
| AIR/FUEL RATIO            | 16.07    | 16.14    | 16.24    | 16.56    | 14.01    | 14.07    |
| EMISSION RATES, G/HR      |          |          |          |          |          |          |
| CO                        | 52.0     | .5       | 56.2     | .4       | 2660.5   | 2391.6   |
| HC                        | 55.9     | 4.5      | 106.6    | 5.5      | 147.1    | 48.4     |
| NOX+                      | 4.6      | 5.4      | 2.3      | 3.8      | 390.5    | 332.3    |
| OIL TEMPERATURE, F        | 213      | 213      | 210      | 210      | 223      | 223      |
| OIL PRESSURE, PSI         | 26       | 26       | 28       | 28       | 30       | 30       |
| COOLANT TEMPERATURE, F    | 191      | 191      | 191      | 191      | 193      | 193      |
| EXHAUST PRESSURE, IN. H2O | 0.0      | 1.0      | 0.0      | 1.0      | 19.0     | 3.0      |
| EXHAUST TEMPERATURE, F    | 776      | 703      | 748      | 665      | 1149     | 1026     |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

## ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 22.01    | 22.02    | 23.01    | 23.02    | 24.01    | 24.02    |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MMHG           | 741.9    | 741.9    | 741.9    | 741.9    | 741.9    | 741.9    |
| HUMIDITY, GRAINS/LB       | 62       | 62       | 62       | 62       | 62       | 62       |
| TEMPERATURE, F            | 79       | 79       | 81       | 81       | 84       | 84       |
| ENGINE SPEED, RPM         | 1600     | 1600     | 1600     | 1600     | 1600     | 1600     |
| TORQUE, FT-LB             | 135.0    | 135.0    | 110.1    | 110.1    | 88.1     | 88.1     |
| POWER, BHP*               | 40.8     | 40.8     | 33.3     | 33.3     | 26.7     | 26.7     |
| FUEL RATE, LB/HR          | 18.8     | 18.9     | 16.0     | 16.0     | 14.6     | 14.5     |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 16.0     | 16.0     | 16.0     | 16.0     |
| MANIFOLD VACUUM, IN HG    | .5       | .5       | 2.0      | 2.0      | 3.5      | 3.5      |
| THROTTLE ANGLE, DEG       | 61.0     | 61.0     | 23.5     | 23.5     | 18.1     | 18.1     |
| INTAKE MAN. TEMP., F      | 145      | 145      | 157      | 157      | 182      | 182      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 1178     | .0013    | 1081     | 1200     | 1146     | .0010    |
| CO2, %                    | 13.33    | 13.52    | 12.66    | 13.01    | 13.06    | 13.38    |
| O2, %                     | 1.80     | 1.56     | 2.46     | 2.30     | 1.94     | 1.79     |
| HC, PPM                   | 1271     | 184      | 1078     | 153      | 1118     | 145      |
| NOX, PPM                  | 2600     | 2651     | 1803     | 1753     | 688      | 682      |
| AIR/FUEL RATIO            | 16.01    | 16.02    | 16.58    | 16.52    | 16.09    | 16.13    |

## EMISSION RATES, G/HR

|                           |       |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|-------|
| CO                        | 147.6 | 1.6   | 121.4 | 131.5 | 113.4 | 1.0   |
| HC                        | 80.0  | 11.6  | 60.8  | 8.4   | 55.6  | 7.1   |
| NOX+                      | 505.2 | 518.2 | 313.8 | 297.8 | 105.6 | 103.5 |
| OIL TEMPERATURE, F        | 241   | 241   | 236   | 236   | 234   | 234   |
| OIL PRESSURE, PSI         | 27    | 27    | 27    | 27    | 28    | 28    |
| COOLANT TEMPERATURE, F    | 191   | 191   | 192   | 192   | 192   | 192   |
| EXHAUST PRESSURE, IN. H2O | 22.0  | 4.0   | 18.0  | 4.0   | 11.0  | 1.0   |
| EXHAUST TEMPERATURE, F    | 1173  | 1070  | 1145  | 1022  | 1146  | 1017  |

\* CORRECTED SAE J8168

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

| TEST NUMBER               | 25.01    | 25.02    | 26.01    | 26.02    | 27.01    | 27.02    |
|---------------------------|----------|----------|----------|----------|----------|----------|
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MMHG           | 741.9    | 741.9    | 741.9    | 741.9    | 741.9    | 741.9    |
| HUMIDITY, GRAINS/LB       | 62       | 62       | 62       | 62       | 62       | 62       |
| TEMPERATURE, F            | 91       | 91       | 81       | 81       | 86       | 86       |
| ENGINE SPEED, RPM         | 1600     | 1600     | 1600     | 1600     | 1600     | 1600     |
| TORQUE, FT-LB             | 58.7     | 58.7     | 36.7     | 36.7     | 14.7     | 14.7     |
| POWER, BHP*               | 17.8     | 17.8     | 11.1     | 11.1     | 4.4      | 4.4      |
| FUEL RATE, LB/HR          | 10.1     | 10.1     | 7.8      | 7.6      | 5.9      | 6.0      |
| IGNITION TIMING, DEG BTDC | 28.0     | 28.0     | 33.0     | 33.0     | 32.0     | 32.0     |
| MANIFOLD VACUUM, IN HG    | 10.0     | 10.0     | 14.0     | 14.0     | 19.0     | 19.0     |
| THROTTLE ANGLE, DEG       | 9.0      | 9.0      | 6.0      | 6.0      | 3.5      | 3.5      |
| INTAKE MAN. TEMP., F      | 196      | 196      | 155      | 155      | 165      | 165      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 1102     | 1010     | 1387     | 1009     | 2023     | 10010    |
| CO2, %                    | 13.06    | 13.34    | 13.17    | 13.92    | 13.50    | 14.04    |
| O2, %                     | 2.10     | 1.80     | 2.22     | 1.58     | 2.01     | 1.39     |
| HC, PPMC                  | 1814     | 173      | 2294     | 151      | 2050     | 209      |
| NOX, PPM                  | 498      | 503      | 388      | 451      | 251      | 259      |
| AIR/FUEL RATIO            | 16.12    | 16.13    | 16.12    | 15.92    | 15.93    | 15.77    |
| EMISSION RATES, G/HR      |          |          |          |          |          |          |
| CO                        | 75.5     | 7        | 71.7     | 4        | 77.2     | 4        |
| HC                        | 62.4     | 5.9      | 59.6     | 3.7      | 39.3     | 4.0      |
| NOX+                      | 52.9     | 53.4     | 31.1     | 34.6     | 14.9     | 15.4     |
| OIL TEMPERATURE, F        | 230      | 230      | 198      | 198      | 219      | 219      |
| OIL PRESSURE, PSI         | 29       | 29       | 32       | 32       | 30       | 30       |
| COOLANT TEMPERATURE, F    | 191      | 191      | 190      | 190      | 191      | 191      |
| EXHAUST PRESSURE, IN. H2O | 2.0      | 0.0      | 0.0      | 0.0      | 0.0      | 1.0      |
| EXHAUST TEMPERATURE, F    | 997      | 916      | 883      | 729      | 802      | 688      |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 28.01    | 28.02    | 29.01    | 29.02    | 30.01    | 30.02    |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MMHG           | 741.9    | 741.9    | 742.3    | 742.3    | 742.3    | 742.3    |
| HUMIDITY, GRAINS/LB       | 62       | 62       | 36       | 36       | 36       | 36       |
| TEMPERATURE, F            | 86       | 86       | 89       | 89       | 90       | 90       |
| ENGINE SPEED, RPM         | 1600     | 1600     | 2000     | 2000     | 2000     | 2000     |
| TORQUE, FT-LB             | 6.6      | 6.6      | 149.9    | 149.9    | 134.9    | 134.9    |
| POWER, BHP*               | 2.0      | 2.0      | 56.3     | 56.3     | 50.7     | 50.7     |
| FUEL RATE, LB/HR          | 5.2      | 5.3      | 28.1     | 28.1     | 22.8     | 22.9     |
| IGNITION TIMING, DEG BTDC | 32.0     | 32.0     | 18.0     | 18.0     | 17.0     | 17.0     |
| MANIFOLD VACUUM, IN HG    | 19.0     | 19.0     | .5       | .5       | .5       | .5       |
| THROTTLE ANGLE, DEG       | 3.0      | 3.0      | 75.0     | 75.0     | 60.0     | 60.0     |
| INTAKE MAN. TEMP., F      | 166      | 166      | 140      | 140      | 154      | 154      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 1678     | .0010    | 2.2058   | 2.2529   | .1285    | .0013    |
| CO2, %                    | 12.86    | 13.32    | 13.39    | 13.49    | 13.56    | 13.55    |
| O2, %                     | 2.81     | 2.37     | .37      | .15      | 1.72     | 1.84     |
| HC, PPHC                  | 2230     | 206      | 1941     | 866      | 977      | 133      |
| NOX, PPM                  | 141      | 162      | 2448     | 2029     | 2680     | 2663     |
| AIR/FUEL RATIO            | 16.57    | 16.54    | 13.99    | 13.93    | 15.97    | 16.22    |

# EMISSION RATES, G/HR

|                           |      |     |        |        |       |       |
|---------------------------|------|-----|--------|--------|-------|-------|
| CO                        | 59.4 | .4  | 3540.8 | 3614.8 | 192.0 | 2.0   |
| HC                        | 39.6 | 3.7 | 156.5  | 69.8   | 73.3  | 10.2  |
| NOX+                      | 7.7  | 9.0 | 547.5  | 453.6  | 557.8 | 564.5 |
| OIL TEMPERATURE, F        | 218  | 218 | 230    | 230    | 248   | 248   |
| OIL PRESSURE, PSI         | 30   | 30  | 32     | 32     | 29    | 29    |
| COOLANT TEMPERATURE, F    | 191  | 191 | 193    | 193    | 193   | 193   |
| EXHAUST PRESSURE, IN. H2O | 0.0  | 1.0 | 31.0   | 9.0    | 31.0  | 12.0  |
| EXHAUST TEMPERATURE, F    | 795  | 665 | 1228   | 1088   | 1293  | 1133  |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 31.01    | 31.02    | 32.01    | 32.02    | 33.01    | 33.02    |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MMHG           | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    |
| HUMIDITY, GRAINS/LB       | 36       | 36       | 36       | 36       | 36       | 36       |
| TEMPERATURE, F            | 91       | 91       | 77       | 77       | 80       | 80       |
| ENGINE SPEED, RPM         | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     |
| TORQUE, FT-LB             | 112.4    | 112.4    | 89.9     | 89.9     | 60.1     | 60.1     |
| POWER, BHP*               | 42.2     | 42.2     | 33.8     | 33.8     | 22.6     | 22.6     |
| FUEL RATE, LB/HR          | 20.3     | 20.3     | 17.8     | 17.9     | 13.8     | 14.0     |
| IGNITION TIMING, DEG BTDC | 17.0     | 17.0     | 19.0     | 19.0     | 28.0     | 28.0     |
| MANIFOLD VACUUM, IN HG    | 2.0      | 2.0      | 4.0      | 4.0      | 9.0      | 9.0      |
| THROTTLE ANGLE, DEG       | 29.0     | 29.0     | 21.0     | 21.0     | 12.5     | 12.5     |
| INTAKE MAN. TEMP., F      | 164      | 164      | 189      | 189      | 211      | 211      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 1128     | 1001     | 1211     | 1001     | 1276     | 10009    |
| CO2, %                    | 12.96    | 13.33    | 13.40    | 13.68    | 13.46    | 13.54    |
| O2, %                     | 2.59     | 2.25     | 2.15     | 1.99     | 2.16     | 2.09     |
| HC, PPM                   | 740      | 120      | 892      | 208      | 1439     | 130      |
| NOX, PPM                  | 2057     | 2061     | 762      | 773      | 538      | 556      |

AIR/FUEL RATIO

16.68 16.53 16.23 16.24 16.16 16.33

EMISSION RATES, G/HR

|                           |       |       |       |       |       |      |
|---------------------------|-------|-------|-------|-------|-------|------|
| CO                        | 157.1 | 1.5   | 143.1 | 1.2   | 115.9 | .8   |
| HC                        | 51.8  | 8.2   | 52.9  | 12.3  | 65.6  | 6.1  |
| NOX+                      | 399.3 | 394.2 | 125.4 | 126.8 | 68.1  | 72.2 |
| OIL TEMPERATURE, F        | 246   | 246   | 242   | 242   | 238   | 238  |
| OIL PRESSURE, PSI         | 30    | 30    | 30    | 30    | 30    | 30   |
| COOLANT TEMPERATURE, F    | 191   | 191   | 191   | 191   | 191   | 191  |
| EXHAUST PRESSURE, IN. H2O | 29.0  | 8.0   | 20.0  | 4.0   | 9.0   | 1.0  |
| EXHAUST TEMPERATURE, F    | 1231  | 1110  | 1218  | 1088  | 1103  | 991  |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 34.01    | 34.02    | 35.01    | 35.02    | 36.01    | 36.02    |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MMHG           | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    |
| HUMIDITY, GRAINS/LB       | 36       | 36       | 36       | 36       | 36       | 36       |
| TEMPERATURE, F            | 74       | 74       | 69       | 69       | 67       | 67       |
| ENGINE SPEED, RPM         | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     |
| TORQUE, FT-LB             | 37.5     | 37.5     | 14.9     | 14.9     | 6.6      | 6.6      |
| POWER, BHP*               | 14.1     | 14.1     | 5.6      | 5.6      | 2.5      | 2.5      |
| FUEL RATE, LB/HR          | 10.0     | 9.8      | 7.2      | 7.2      | 6.4      | 6.4      |
| IGNITION TIMING, DEG BTDC | 38.0     | 38.0     | 38.0     | 38.0     | 36.5     | 36.5     |
| MANIFOLD VACUUM, IN HG    | 14.5     | 14.5     | 18.0     | 18.0     | 20.0     | 20.0     |
| THROTTLE ANGLE, DEG       | 7.5      | 7.5      | 5.0      | 5.0      | 4.0      | 4.0      |
| INTAKE MAN. TEMP., F      | 199      | 199      | 177      | 177      | 171      | 171      |

CONCENTRATIONS, DRY BASIS

|          |       |       |       |       |       |       |
|----------|-------|-------|-------|-------|-------|-------|
| CO, %    | .4380 | .0022 | .3218 | .0010 | .3820 | .0030 |
| CO2, %   | 13.75 | 14.33 | 13.20 | 13.86 | 13.31 | 14.13 |
| O2, %    | 1.22  | .78   | 1.98  | 1.50  | 1.65  | .87   |
| HC, PPMC | 2194  | 203   | 2460  | 187   | 2249  | 181   |
| NOX, PPM | 594   | 520   | 256   | 276   | 196   | 181   |

AIR/FUEL RATIO

|       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|
| 15.24 | 15.34 | 15.81 | 15.86 | 15.56 | 15.40 |
|-------|-------|-------|-------|-------|-------|

EMISSION RATES, G/HR

|      |       |      |       |      |       |      |
|------|-------|------|-------|------|-------|------|
| CO   | 275.6 | 1.4  | 151.9 | .5   | 159.6 | 1.2  |
| HC   | 69.4  | 6.3  | 58.3  | 4.4  | 47.2  | 3.7  |
| NOX+ | 52.1  | 44.7 | 16.9  | 18.0 | 11.4  | 10.3 |

OIL TEMPERATURE, F

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 233 | 233 | 226 | 226 | 223 | 223 |
|-----|-----|-----|-----|-----|-----|

OIL PRESSURE, PSI

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 30 | 30 | 32 | 32 | 32 | 32 |
|----|----|----|----|----|----|

COOLANT TEMPERATURE, F

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 190 | 190 | 189 | 189 | 189 | 189 |
|-----|-----|-----|-----|-----|-----|

EXHAUST PRESSURE, IN. H2O

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 2.0 | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 |
|-----|-----|-----|-----|-----|-----|

EXHAUST TEMPERATURE, F

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 975 | 910 | 870 | 786 | 836 | 724 |
|-----|-----|-----|-----|-----|-----|

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 37.01    | 37.02    | 38.02    | 39.01    | 39.02    | 40.01    |
| DATA SOURCE CODE          | 1        | 2        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MNHG           | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    |
| HUMIDITY, GRAINS/LB       | 31       | 31       | 31       | 31       | 31       | 31       |
| TEMPERATURE, F            | 73       | 73       | 71       | 74       | 74       | 77       |
| ENGINE SPEED, RPM         | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     |
| TORQUE, FT-LB             | 145.6    | 145.6    | 131.0    | 109.2    | 109.2    | 87.4     |
| POWER, BHP*               | 67.9     | 67.9     | 61.1     | 50.9     | 50.9     | 40.8     |
| FUEL RATE, LB/HR          | 34.6     | 34.9     | 27.8     | 24.5     | 24.5     | 20.7     |
| IGNITION TIMING, DEG BTDC | 20.0     | 20.0     | 21.0     | 22.0     | 22.0     | 27.0     |
| MANIFOLD VACUUM, IN HG    | 1.5      | 1.5      | 1.5      | 3.0      | 3.0      | 5.5      |
| THRÖTLE ANGLE, DEG        | 75.0     | 75.0     | 45.0     | 29.0     | 29.0     | 22.0     |
| INTAKE MAN. TEMP., F      | 124      | 124      | 147      | 173      | 173      | 194      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 4.0873   | 3.9356   | .0013    | .1105    | .0011    | .1280    |
| CO2, %                    | 12.28    | 12.35    | 13.53    | 13.44    | 13.29    | 12.88    |
| O2, %                     | .21      | .12      | 1.80     | 1.97     | 1.88     | 2.55     |
| HC, PPMC                  | 1839     | 1402     | 90       | 648      | 79       | 914      |
| NOX, PPM                  | 1758     | 1449     | 2645     | 1939     | 1864     | 1093     |

AIR/FUEL RATIO 13.12 13.15 16.20 16.18 16.26 16.59

EMISSION RATES, G/HR

|                           |        |        |       |       |       |       |
|---------------------------|--------|--------|-------|-------|-------|-------|
| CO                        | 7713.1 | 7553.2 | 2.4   | 179.3 | 1.8   | 182.7 |
| HC                        | 174.3  | 135.1  | 8.3   | 52.8  | 6.6   | 65.5  |
| NOX+                      | 452.5  | 379.2  | 668.6 | 429.1 | 423.4 | 212.8 |
| OIL TEMPERATURE, F        | 218    | 218    | 257   | 252   | 252   | 249   |
| OIL PRESSURE, PSI         | 35     | 35     | 30    | 30    | 30    | 30    |
| COOLANT TEMPERATURE, F    | 193    | 193    | 192   | 193   | 193   | 193   |
| EXHAUST PRESSURE, IN. H2O | 49.0   | 19.0   | 19.0  | 38.0  | 38.0  | 27.0  |
| EXHAUST TEMPERATURE, F    | 1232   | 1048   | 1184  | 1282  | 1151  | 1212  |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7712

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 40.02    | 41.01    | 41.02    | 42.01    | 42.02    | 43.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 |
| BAROMETER, MMHG           | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    | 742.3    |
| HUMIDITY, GRAINS/LB       | 31       | 31       | 31       | 31       | 31       | 31       |
| TEMPERATURE, F            | 77       | 77       | 77       | 73       | 73       | 71       |
| ENGINE SPEED, RPM         | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     |
| TORQUE, FT-LB             | 87.4     | 58.3     | 58.3     | 36.4     | 36.4     | 14.6     |
| POWER, BHP*               | 40.8     | 27.2     | 27.2     | 17.0     | 17.0     | 6.8      |
| FUEL RATE, LB/HR          | 20.8     | 15.6     | 15.3     | 12.1     | 12.2     | 9.0      |
| IGNITION TIMING, DEG BTDC | 27.0     | 35.0     | 35.0     | 41.0     | 41.0     | 41.0     |
| MANIFOLD VACUUM, IN HG    | 5.5      | 10.5     | 10.5     | 14.5     | 14.5     | 19.0     |
| THROTTLE ANGLE, DEG       | 22.0     | 13.5     | 13.5     | 10.0     | 10.0     | 6.5      |
| INTAKE MAN. TEMP., F      | 194      | 202      | 202      | 188      | 188      | 176      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0010    | .1261    | .0010    | .1619    | .0010    | .4097    |
| CO2, %                    | 13.11    | 13.20    | 13.41    | 13.12    | 13.43    | 13.25    |
| O2, %                     | 2.26     | 2.05     | 1.75     | 2.04     | 1.74     | 1.48     |
| HC, PPMC                  | 86       | 1447     | 134      | 1620     | 153      | 1954     |
| NOX, PPN                  | 1079     | 858      | 851      | 638      | 661      | 336      |
| AIR/FUEL RATIO            | 16.53    | 16.12    | 16.11    | 16.07    | 16.09    | 15.47    |

EMISSION RATES, G/HR

|                           |       |       |       |       |      |       |
|---------------------------|-------|-------|-------|-------|------|-------|
| CO                        | 1.4   | 131.6 | 1.0   | 131.7 | .8   | 240.7 |
| HC                        | 6.2   | 75.8  | 6.9   | 66.2  | 6.3  | 57.7  |
| NOX+                      | 210.3 | 122.1 | 119.8 | 70.8  | 73.8 | 26.9  |
| OIL TEMPERATURE, F        | 249   | 246   | 246   | 241   | 241  | 236   |
| OIL PRESSURE, PSI         | 30    | 32    | 32    | 32    | 32   | 32    |
| COOLANT TEMPERATURE, F    | 193   | 191   | 191   | 191   | 191  | 190   |
| EXHAUST PRESSURE, IN. H2O | 27.0  | 11.0  | 2.0   | 5.0   | 0.0  | 2.0   |
| EXHAUST TEMPERATURE, F    | 1109  | 1117  | 1047  | 1057  | 952  | 976   |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 43.02    | 44.01    | 44.02    | 45.01    | 45.02    | 46.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 1/77 | 12/ 1/77 | 12/ 1/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 |
| BAROMETER, MMHG           | 742.3    | 742.3    | 742.3    | 738.8    | 738.8    | 738.8    |
| HUMIDITY, GRAINS/LB       | 31       | 31       | 31       | 49       | 49       | 49       |
| TEMPERATURE, F            | 71       | 70       | 70       | 77       | 77       | 69       |
| ENGINE SPEED, RPM         | 2500     | 2500     | 2500     | 3000     | 3000     | 3000     |
| TORQUE, FT-LB             | 14.6     | 8.5      | 8.5      | 141.5    | 141.5    | 127.4    |
| POWER, BHP*               | 6.8      | 4.0      | 4.0      | 80.0     | 80.0     | 72.0     |
| FUEL RATE, LB/HR          | 9.0      | 8.2      | 8.1      | 40.8     | 41.3     | 34.1     |
| IGNITION TIMING, DEG BTDC | 41.0     | 41.0     | 41.0     | 26.0     | 26.0     | 26.0     |
| MANIFOLD VACUUM, IN HG    | 19.0     | 20.0     | 20.0     | 2.0      | 2.0      | 2.0      |
| THROTTLE ANGLE, DEG       | 6.5      | 5.5      | 5.5      | 75.0     | 75.0     | 48.5     |
| INTAKE MAN. TEMP., F      | 176      | 173      | 173      | 139      | 139      | 150      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0018    | .4614    | .0020    | 4.6707   | 4.1235   | .1466    |
| CO2, %                    | 13.84    | 13.16    | 13.80    | 11.63    | 12.04    | 13.93    |
| O2, %                     | .97      | 1.50     | 1.06     | .20      | .17      | .76      |
| HC, PPHC                  | 189      | 1969     | 196      | 1702     | 1220     | 680      |
| NOX, PPM                  | 330      | 273      | 245      | 1377     | 1328     | 2726     |

AIR/FUEL RATIO

15.49 15.45 15.55 12.84 13.10 15.29

EMISSION RATES, G/HR

|                           |      |       |      |         |        |       |
|---------------------------|------|-------|------|---------|--------|-------|
| CO                        | 1.1  | 246.8 | 1.1  | 10457.5 | 9438.1 | 319.4 |
| HC                        | 5.6  | 52.9  | 5.2  | 191.3   | 140.2  | 74.5  |
| NOX+                      | 26.4 | 19.9  | 17.8 | 452.2   | 445.8  | 871.3 |
| OIL TEMPERATURE, F        | 236  | 233   | 233  | 244     | 244    | 273   |
| OIL PRESSURE, PSI         | 32   | 32    | 32   | 32      | 32     | 30    |
| COOLANT TEMPERATURE, F    | 190  | 191   | 191  | 195     | 195    | 195   |
| EXHAUST PRESSURE, IN. H2O | 0.0  | 0.0   | 1.0  | 70.0    | 35.0   | 74.0  |
| EXHAUST TEMPERATURE, F    | 893  | 911   | 654  | 1272    | 1152   | 1349  |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6  
FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 46.02    | 47.01    | 47.02    | 48.01    | 48.02    | 49.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 |
| BAROMETER, MMHG           | 738.8    | 738.8    | 738.8    | 738.8    | 738.8    | 736.8    |
| HUMIDITY, GRAINS/LB       | 49       | 49       | 49       | 49       | 49       | 36       |
| TEMPERATURE, F            | 69       | 74       | 74       | 82       | 82       | 75       |
| ENGINE SPEED, RPM         | 3000     | 3000     | 3000     | 3000     | 3000     | 3000     |
| TORQUE, FT-LB             | 127.4    | 106.2    | 106.2    | 85.0     | 85.0     | 56.6     |
| POWER, BHP*               | 72.0     | 60.0     | 60.0     | 48.1     | 48.1     | 32.0     |
| FUEL RATE, LB/HR          | 33.8     | 28.4     | 28.4     | 24.1     | 24.0     | 18.3     |
| IGNITION TIMING, DEG BTDC | 26.0     | 26.0     | 26.0     | 34.0     | 34.0     | 40.0     |
| MANIFOLD VACUUM, IN HG    | 2.0      | 3.5      | 3.5      | 6.5      | 6.5      | 11.0     |
| THROTTLE ANGLE, DEG       | 48.5     | 30.0     | 30.0     | 22.5     | 22.5     | 15.2     |
| INTAKE MAN. TEMP., F      | 150      | 183      | 183      | 194      | 194      | 180      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0016    | .1094    | .0014    | .1120    | .0013    | .1390    |
| CO2, %                    | 14.09    | 13.49    | 13.66    | 13.09    | 13.31    | 12.94    |
| O2, %                     | .52      | 1.46     | 1.30     | 1.94     | 1.70     | 2.00     |
| HC, PPMC                  | 93       | 890      | 90       | 1135     | 93       | 1484     |
| NOX, PPM                  | 2747     | 2226     | 2239     | 2112     | 2113     | 1231     |
| AIR/FUEL RATIO            | 15.26    | 15.79    | 15.82    | 16.14    | 16.13    | 16.11    |

|                           |       |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|-------|
| EMISSION RATES, G/HR      |       |       |       |       |       |       |
| CO                        | 3.5   | 204.8 | 2.6   | 182.9 | 2.1   | 173.5 |
| HC                        | 10.2  | 83.7  | 8.5   | 93.1  | 7.6   | 93.1  |
| NOX+                      | 873.5 | 611.2 | 617.1 | 505.9 | 504.9 | 213.5 |
| OIL TEMPERATURE, F        | 273   | 265   | 265   | 262   | 262   | 242   |
| OIL PRESSURE, PSI         | 30    | 30    | 30    | 31    | 31    | 34    |
| COOLANT TEMPERATURE, F    | 195   | 194   | 194   | 194   | 194   | 194   |
| EXHAUST PRESSURE, IN. H2O | 36.0  | 53.0  | 22.0  | 37.0  | 14.0  | 18.0  |
| EXHAUST TEMPERATURE, F    | 1253  | 1309  | 1209  | 1223  | 1138  | 1151  |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

| TEST NUMBER               | 49.02    | 50.01    | 50.02    | 51.01    | 51.02    | 52.01    |
|---------------------------|----------|----------|----------|----------|----------|----------|
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 |
| BAROMETER, MMHG           | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    |
| HUMIDITY, GRAINS/LB       | 36       | 36       | 36       | 36       | 36       | 36       |
| TEMPERATURE, F            | 75       | 74       | 74       | 69       | 69       | 70       |
| ENGINE SPEED, RPM         | 3000     | 3000     | 3000     | 3000     | 3000     | 3000     |
| TORQUE, FT-LB             | 56.6     | 35.4     | 35.4     | 14.2     | 14.2     | 8.6      |
| POWER, BHP*               | 32.0     | 20.0     | 20.0     | 8.0      | 8.0      | 4.9      |
| FUEL RATE, LB/HR          | 18.3     | 14.5     | 14.4     | 11.0     | 11.1     | 10.1     |
| IGNITION TIMING, DEG BTDC | 40.0     | 46.0     | 46.0     | 46.0     | 46.0     | 46.0     |
| MANIFOLD VACUUM, IN HG    | 11.0     | 15.0     | 15.0     | 18.5     | 18.5     | 19.5     |
| THROTTLE ANGLE, DEG       | 15.2     | 11.5     | 11.5     | 8.0      | 8.0      | 7.0      |
| INTAKE MAN. TEMP., F      | 180      | 183      | 183      | 176      | 176      | 175      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0011    | .1823    | .0012    | .4261    | .0050    | .4761    |
| CO2, %                    | 13.16    | 12.95    | 13.29    | 13.26    | 13.82    | 13.18    |
| O2, %                     | 1.80     | 1.83     | 1.61     | 1.25     | .73      | 1.25     |
| HC, PPMC                  | 94       | 1381     | 107      | 1461     | 108      | 1445     |
| NOX, PPM                  | 1237     | 896      | 877      | 460      | 404      | 359      |
| AIR/FUEL RATIO            | 16.19    | 15.95    | 16.02    | 15.35    | 15.33    | 15.33    |
| EMISSION RATES, G/HR      |          |          |          |          |          |          |
| CO                        | 1.4      | 179.7    | 1.2      | 306.5    | 3.6      | 315.1    |
| HC                        | 5.9      | 68.4     | 5.3      | 52.8     | 3.9      | 48.0     |
| NOX+                      | 216.1    | 122.7    | 119.3    | 46.0     | 40.8     | 33.0     |
| OIL TEMPERATURE, F        | 242      | 250      | 250      | 247      | 247      | 245      |
| OIL PRESSURE, PSI         | 34       | 34       | 34       | 34       | 34       | 34       |
| COOLANT TEMPERATURE, F    | 194      | 193      | 193      | 193      | 193      | 193      |
| EXHAUST PRESSURE, IN. H2O | 5.0      | 9.0      | 1.0      | 3.0      | 0.0      | 1.0      |
| EXHAUST TEMPERATURE, F    | 1040     | 1116     | 1009     | 1053     | 954      | 1011     |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 52.02    | 53.01    | 53.02    | 54.01    | 54.02    | 55.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 |
| BAROMETER, MMHG           | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    |
| HUMIDITY, GRAINS/LB       | 36       | 36       | 36       | 36       | 36       | 36       |
| TEMPERATURE, F            | 70       | 78       | 78       | 75       | 75       | 84       |
| ENGINE SPEED, RPM         | 3000     | 3500     | 3500     | 3500     | 3500     | 3500     |
| TORQUE, FT-LB             | 8.6      | 127.8    | 127.8    | 115.0    | 115.0    | 98.0     |
| POWER, BHP*               | 4.9      | 84.3     | 84.3     | 75.9     | 75.9     | 64.7     |
| FUEL RATE, LB/HR          | 10.1     | 45.8     | 45.7     | 36.1     | 36.1     | 32.1     |
| IGNITION TIMING, DEG BTDC | 46.0     | 29.0     | 29.0     | 29.0     | 29.0     | 33.0     |
| MANIFOLD VACUUM, IN HG    | 19.5     | 2.5      | 2.5      | 3.0      | 3.0      | 5.2      |
| THROTTLE ANGLE, DEG       | 7.0      | 75.0     | 75.0     | 41.0     | 41.0     | 29.0     |
| INTAKE MAN. TEMP., F      | 175      | 144      | 144      | 167      | 167      | 190      |

CONCENTRATIONS, DRY BASIS

|          |       |        |        |       |       |       |
|----------|-------|--------|--------|-------|-------|-------|
| CO, %    | .0067 | 4.7040 | 4.3933 | .1151 | .0018 | .2945 |
| CO2, %   | 13.99 | 11.33  | 11.43  | 13.91 | 14.11 | 13.53 |
| O2, %    | .60   | .19    | .10    | .41   | .26   | .68   |
| HC, PPMC | 114   | 1761   | 1132   | 810   | 96    | 1539  |
| NOX, PPM | 299   | 1425   | 1203   | 2738  | 2767  | 2603  |

AIR/FUEL RATIO

|       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|
| 15.22 | 12.79 | 12.89 | 15.05 | 15.08 | 15.08 |
|-------|-------|-------|-------|-------|-------|

EMISSION RATES, G/HR

|      |      |         |         |       |       |       |
|------|------|---------|---------|-------|-------|-------|
| CO   | 4.4  | 12008.0 | 11379.5 | 266.3 | 4.2   | 610.4 |
| HC   | 3.7  | 225.8   | 147.2   | 94.1  | 11.1  | 160.2 |
| NOX+ | 27.1 | 505.2   | 433.0   | 879.9 | 886.7 | 749.4 |

|                           |     |      |      |      |      |      |
|---------------------------|-----|------|------|------|------|------|
| OIL TEMPERATURE, F        | 243 | 263  | 263  | 284  | 284  | 277  |
| OIL PRESSURE, PSI         | 34  | 32   | 32   | 30   | 30   | 30   |
| COOLANT TEMPERATURE, F    | 193 | 194  | 194  | 194  | 194  | 194  |
| EXHAUST PRESSURE, IN. H2O | 0.0 | 90.0 | 48.0 | 85.0 | 44.0 | 62.0 |
| EXHAUST TEMPERATURE, F    | 935 | 1305 | 1190 | 1377 | 1285 | 1314 |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 55.02    | 56.01    | 56.02    | 57.01    | 57.02    | 58.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 |
| BAROMETER, MNHG           | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    |
| HUMIDITY, GRAINS/LB       | 36       | 36       | 36       | 36       | 36       | 36       |
| TEMPERATURE, F            | 84       | 85       | 85       | 83       | 83       | 75       |
| ENGINE SPEED, RPM         | 3500     | 3500     | 3500     | 3500     | 3500     | 3500     |
| TORQUE, FT-LB             | 98.0     | 76.7     | 76.7     | 51.1     | 51.1     | 32.0     |
| POWER, BHP*               | 64.7     | 50.6     | 50.6     | 33.7     | 33.7     | 21.1     |
| FUEL RATE, LB/HR          | 32.0     | 26.1     | 26.0     | 20.4     | 20.4     | 16.7     |
| IGNITION TIMING, DEG BTDC | 33.0     | 40.0     | 40.0     | 47.0     | 47.0     | 48.0     |
| MANIFOLD VACUUM, IN HG    | 5.2      | 8.0      | 8.0      | 11.5     | 11.5     | 15.0     |
| THROTTLE ANGLE, DEG       | 29.0     | 22.5     | 22.5     | 17.0     | 17.0     | 13.0     |
| INTAKE MAN. TEMP., F      | 190      | 199      | 199      | 196      | 196      | 187      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0050    | .1215    | .0014    | .1464    | .0013    | .2115    |
| CO2, %                    | 13.95    | 13.08    | 13.25    | 12.95    | 13.09    | 13.22    |
| O2, %                     | .37      | 1.56     | 1.37     | 1.87     | 1.70     | 1.72     |
| HC, PPHC                  | 104      | 1168     | 98       | 1147     | 100      | 1338     |
| NOX, PPM                  | 2385     | 2530     | 2498     | 1854     | 1713     | 932      |
| AIR:FUEL RATIO            | 15.14    | 15.86    | 15.91    | 16.07    | 16.13    | 15.84    |

# EMISSION RATES, G/HR

|                           |       |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|-------|
| CO                        | 10.3  | 214.7 | 2.5   | 204.4 | 1.8   | 234.5 |
| HC                        | 10.8  | 103.7 | 8.7   | 80.4  | 7.1   | 74.5  |
| NOX+                      | 684.6 | 621.0 | 614.8 | 359.5 | 334.2 | 143.6 |
| OIL TEMPERATURE, F        | 277   | 278   | 278   | 271   | 271   | 254   |
| OIL PRESSURE, PSI         | 30    | 30    | 30    | 31    | 31    | 35    |
| COOLANT TEMPERATURE, F    | 194   | 194   | 194   | 193   | 193   | 192   |
| EXHAUST PRESSURE, IN. H2O | 32.0  | 46.0  | 21.0  | 26.0  | 11.0  | 12.0  |
| EXHAUST TEMPERATURE, F    | 1265  | 1256  | 1190  | 1217  | 1113  | 1179  |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 58.02    | 59.01    | 59.02    | 60.01    | 60.02    | 61.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 |
| BAROMETER, MMHG           | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    |
| HUMIDITY, GRAINS/LB       | 36       | 36       | 36       | 36       | 36       | 36       |
| TEMPERATURE, F            | 75       | 73       | 73       | 73       | 73       | 77       |
| ENGINE SPEED, RPM         | 3500     | 3500     | 3500     | 3500     | 3500     | 3800     |
| TORQUE, FT-LB             | 32.0     | 12.8     | 12.8     | 9.9      | 9.9      | 125.0    |
| POWER, BHP*               | 21.1     | 8.4      | 8.4      | 6.5      | 6.5      | 89.6     |
| FUEL RATE, LB/HR          | 16.6     | 12.9     | 12.9     | 12.3     | 12.3     | 48.4     |
| IGNITION TIMING, DEG BTDC | 48.0     | 48.0     | 48.0     | 48.0     | 48.0     | 27.0     |
| MANIFOLD VACUUM, IN HG    | 15.0     | 17.6     | 17.6     | 18.5     | 18.5     | 2.5      |
| THROTTLE ANGLE, DEG       | 13.0     | 10.0     | 10.0     | 9.0      | 9.0      | 75.0     |
| INTAKE MAN. TEMP., F      | 187      | 186      | 186      | 186      | 186      | 145      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0013    | .2564    | .0012    | .2756    | .0012    | 4.2674   |
| CO2, %                    | 13.55    | 13.24    | 13.57    | 13.20    | 13.58    | 11.78    |
| O2, %                     | 1.45     | 1.81     | 1.54     | 1.77     | 1.52     | .21      |
| HC, PPM                   | 96       | 941      | 80       | 928      | 87       | 1680     |
| NOX, PPM                  | 926      | 434      | 452      | 385      | 388      | 1682     |
| AIR/FUEL RATIO            | 15.88    | 15.91    | 15.93    | 15.87    | 15.92    | 13.01    |

EMISSION RATES, G/HR

|                           |       |       |      |       |      |         |
|---------------------------|-------|-------|------|-------|------|---------|
| CO                        | 1.4   | 220.0 | 1.0  | 225.5 | 1.0  | 11495.4 |
| HC                        | 5.3   | 40.6  | 3.5  | 38.1  | 3.6  | 227.2   |
| NOX+                      | 142.0 | 51.7  | 53.8 | 43.8  | 44.1 | 629.6   |
| OIL TEMPERATURE, F        | 254   | 256   | 256  | 255   | 255  | 278     |
| OIL PRESSURE, PSI         | 35    | 34    | 34   | 34    | 34   | 31      |
| COOLANT TEMPERATURE, F    | 192   | 193   | 193  | 192   | 192  | 194     |
| EXHAUST PRESSURE, IN. H2O | 3.0   | 6.0   | 1.0  | 4.0   | 1.0  | 100.0   |
| EXHAUST TEMPERATURE, F    | 1039  | 1143  | 1008 | 1134  | 996  | 1344    |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 61.02    | 62.01    | 62.02    | 63.01    | 63.02    | 64.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 2/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 736.8    | 736.8    | 736.8    | 736.8    | 736.8    | 739.0    |
| HUMIDITY, GRAINS/LB       | 36       | 36       | 36       | 36       | 36       | 34       |
| TEMPERATURE, F            | 77       | 70       | 70       | 90       | 90       | 90       |
| ENGINE SPEED, RPM         | 3800     | 3800     | 3800     | 3800     | 3800     | 3800     |
| TORQUE, FT-LB             | 125.0    | 112.5    | 112.5    | 94.0     | 94.0     | 75.0     |
| POWER, BHP*               | 89.6     | 80.6     | 80.6     | 67.4     | 67.4     | 53.7     |
| FUEL RATE, LB/HR          | 48.9     | 38.7     | 38.7     | 34.0     | 34.1     | 29.3     |
| IGNITION TIMING, DEG BTDC | 27.0     | 28.0     | 28.0     | 33.0     | 33.0     | 40.0     |
| MANIFOLD VACUUM, IN HG    | 2.5      | 3.0      | 3.0      | 5.5      | 5.5      | 8.0      |
| THROTTLE ANGLE, DEG       | 75.0     | 42.3     | 42.3     | 30.0     | 30.0     | 24.0     |
| INTAKE MAN. TEMP., F      | 145      | 165      | 165      | 197      | 197      | 190      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 4.1748   | .1105    | .0020    | .4419    | .0397    | .1514    |
| CO2, %                    | 11.91    | 13.89    | 14.25    | 13.79    | 14.35    | 13.76    |
| O2, %                     | .08      | .41      | .21      | .55      | .16      | 1.34     |
| HC, PPM                   | 1091     | 592      | 84       | 1589     | 93       | 1326     |
| NOX, PPM                  | 1324     | 2724     | 2705     | 2586     | 1640     | 2321     |
| AIR/FUEL RATIO            | 13.02    | 15.08    | 15.04    | 14.91    | 14.95    | 15.62    |

# EMISSION RATES, G/HR

|                           |         |       |       |       |       |       |
|---------------------------|---------|-------|-------|-------|-------|-------|
| CO                        | 11395.0 | 274.8 | 4.9   | 943.7 | 84.9  | 285.6 |
| HC                        | 149.5   | 74.0  | 10.3  | 170.4 | 10.0  | 125.6 |
| NOX+                      | 501.9   | 940.9 | 920.0 | 767.1 | 487.0 | 605.5 |
| OIL TEMPERATURE, F        | 278     | 290   | 290   | 305   | 305   | 277   |
| OIL PRESSURE, PSI         | 31      | 30    | 30    | 30    | 30    | 30    |
| COOLANT TEMPERATURE, F    | 194     | 194   | 194   | 194   | 194   | 193   |
| EXHAUST PRESSURE, IN. H2O | 50.0    | 99.0  | 50.0  | 72.0  | 39.0  | 54.0  |
| EXHAUST TEMPERATURE, F    | 1215    | 1412  | 1324  | 1359  | 1333  | 1297  |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6  
FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 64.02    | 65.01    | 65.02    | 66.01    | 66.02    | 67.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 739.0    | 739.0    | 739.0    | 739.0    | 739.0    | 739.0    |
| HUMIDITY, GRAINS/LB       | 34       | 34       | 34       | 34       | 34       | 34       |
| TEMPERATURE, F            | 90       | 87       | 87       | 78       | 78       | 75       |
| ENGINE SPEED, RPM         | 3800     | 3800     | 3800     | 3800     | 3800     | 3800     |
| TORQUE, FT-LB             | 75.0     | 60.0     | 60.0     | 31.3     | 31.3     | 12.5     |
| POWER, BHP*               | 53.7     | 43.0     | 43.0     | 22.4     | 22.4     | 9.0      |
| FUEL RATE, LB/HR          | 29.3     | 26.6     | 26.5     | 19.8     | 19.9     | 16.6     |
| IGNITION TIMING, DEG BTDC | 40.0     | 43.0     | 43.0     | 47.0     | 47.0     | 47.0     |
| MANIFOLD VACUUM, IN HG    | 8.0      | 10.0     | 10.0     | 14.2     | 14.2     | 17.2     |
| THROTTLE ANGLE, DEG       | 24.0     | 20.0     | 20.0     | 14.2     | 14.2     | 11.2     |
| INTAKE MAN. TEMP., F      | 190      | 198      | 198      | 199      | 199      | 194      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0011    | .1441    | .0011    | .2027    | .0011    | .2449    |
| CO2, %                    | 13.94    | 13.40    | 13.55    | 13.32    | 13.56    | 13.39    |
| O2, %                     | 1.20     | 1.74     | 1.67     | 1.82     | 1.71     | 1.69     |
| HC, PPMC                  | 84       | 1191     | 94       | 1155     | 96       | 733      |
| NOX, PPM                  | 2350     | 2142     | 2089     | 915      | 847      | 414      |
| AIR/FUEL RATIO            | 15.73    | 15.94    | 16.09    | 15.93    | 16.07    | 15.84    |

# EMISSION RATES, G/HR

|                           |       |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|-------|
| CO                        | 2.1   | 253.5 | 1.9   | 265.3 | 1.5   | 267.5 |
| HC                        | 8.0   | 105.2 | 8.3   | 75.9  | 6.4   | 40.2  |
| NOX+                      | 615.3 | 520.7 | 510.8 | 165.6 | 155.3 | 62.6  |
| OIL TEMPERATURE, F        | 277   | 281   | 281   | 275   | 275   | 270   |
| OIL PRESSURE, PSI         | 30    | 30    | 30    | 30    | 30    | 30    |
| COOLANT TEMPERATURE, F    | 193   | 193   | 193   | 192   | 192   | 191   |
| EXHAUST PRESSURE, IN. H2O | 26.0  | 40.0  | 18.0  | 20.0  | 6.0   | 10.0  |
| EXHAUST TEMPERATURE, F    | 1207  | 1269  | 1169  | 1234  | 1100  | 1199  |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 67.02    | 68.01    | 68.02    | 69.01    | 69.02    | 70.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 739.0    | 739.0    | 739.0    | 739.0    | 739.0    | 739.0    |
| HUMIDITY, GRAINS/LB       | 34       | 34       | 34       | 38       | 38       | 38       |
| TEMPERATURE, F            | 75       | 75       | 75       | 60       | 60       | 72       |
| ENGINE SPEED, RPM         | 3800     | 3800     | 3800     | 750      | 750      | 750      |
| TORQUE, FT-LB             | 12.5     | 10.9     | 10.9     | 3.5      | 3.5      | 15.0     |
| POWER, BHP*               | 9.0      | 7.8      | 7.8      | .5       | .5       | 2.1      |
| FUEL RATE, LB/HR          | 16.5     | 16.3     | 16.3     | 2.6      | 2.6      | 3.1      |
| IGNITION TIMING, DEG BTDC | 47.0     | 47.0     | 47.0     | 15.0     | 15.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | 17.2     | 17.2     | 17.2     | 18.0     | 18.0     | 16.6     |
| THROTTLE ANGLE, DEG       | 11.2     | 11.0     | 11.0     | 0.0      | 0.0      | 1.0      |
| INTAKE MAN. TEMP., F      | 194      | 189      | 189      | 163      | 163      | 157      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0011    | .2369    | .0013    | .2589    | .0013    | .3019    |
| CO2, %                    | 13.80    | 13.43    | 13.65    | 13.10    | 13.91    | 13.49    |
| O2, %                     | 1.46     | 1.61     | 1.47     | 1.99     | 1.25     | 1.59     |
| HC, PPMC                  | 75       | 721      | 72       | 5253     | 362      | 3119     |
| NOX, PPM                  | 422      | 409      | 428      | 52       | 49       | 96       |

AIR/FUEL RATIO 15.86 15.78 15.88 15.54 15.66 15.45

# EMISSION RATES, G/HR

|                           |      |       |      |      |     |      |
|---------------------------|------|-------|------|------|-----|------|
| CO                        | 1.2  | 253.4 | 1.4  | 44.1 | .2  | 60.4 |
| HC                        | 4.1  | 38.7  | 3.9  | 44.9 | 3.1 | 31.3 |
| NOX+                      | 62.8 | 60.5  | 63.9 | 1.2  | 1.2 | 2.7  |
| OIL TEMPERATURE, F        | 270  | 269   | 269  | 204  | 204 | 200  |
| OIL PRESSURE, PSI         | 30   | 30    | 30   | 15   | 15  | 15   |
| COOLANT TEMPERATURE, F    | 191  | 192   | 192  | 190  | 190 | 190  |
| EXHAUST PRESSURE, IN. H2O | 2.0  | 10.0  | 1.0  | 0.0  | 1.0 | 0.0  |
| EXHAUST TEMPERATURE, F    | 1062 | 1200  | 1046 | 528  | 529 | 557  |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6  
FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 70.02    | 71.01    | 71.02    | 72.01    | 72.02    | 73.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 739.0    | 739.0    | 739.0    | 739.0    | 739.0    | 741.8    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 38       | 38       | 38       | 38       |
| TEMPERATURE, F            | 72       | 71       | 71       | 72       | 72       | 78       |
| ENGINE SPEED, RPM         | 750      | 750      | 750      | 650      | 650      | 1000     |
| TORQUE, FT-LB             | 15.0     | 30.0     | 30.0     | 14.0     | 14.0     | 108.5    |
| POWER, BHP*               | 2.1      | 4.2      | 4.2      | 1.7      | 1.7      | 20.4     |
| FUEL RATE, LB/HR          | 3.1      | 3.7      | 3.7      | 2.7      | 2.7      | 9.7      |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | 16.6     | 14.5     | 14.5     | 16.3     | 16.3     | 2.0      |
| THROTTLE ANGLE, DEG       | 1.0      | 1.5      | 1.5      | 0.0      | 0.0      | 16.5     |
| INTAKE MAN. TEMP., F      | 157      | 148      | 148      | 155      | 155      | 141      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0087    | .2390    | .0260    | .2401    | .0263    | .0759    |
| CO2, %                    | 13.99    | 13.49    | 14.00    | 13.66    | 14.04    | 12.41    |
| O2, %                     | 1.01     | 1.66     | 1.18     | 1.54     | 1.16     | 2.91     |
| HC, PPMC                  | 472      | 2837     | 752      | 3004     | 786      | 1933     |
| NOX, PPM                  | 72       | 246      | 187      | 88       | 68       | 1787     |
| AIR/FUEL RATIO            | 15.47    | 15.57    | 15.55    | 15.45    | 15.52    | 16.87    |

# EMISSION RATES, G/HR

|                           |     |      |     |      |     |       |
|---------------------------|-----|------|-----|------|-----|-------|
| CO                        | 1.7 | 57.7 | 6.2 | 41.8 | 4.6 | 52.5  |
| HC                        | 4.8 | 34.4 | 9.1 | 26.3 | 6.9 | 67.1  |
| NOX+                      | 2.0 | 8.3  | 6.3 | 2.1  | 1.7 | 173.2 |
| OIL TEMPERATURE, F        | 200 | 200  | 200 | 199  | 199 | 213   |
| OIL PRESSURE, PSI         | 15  | 15   | 15  | 14   | 14  | 20    |
| COOLANT TEMPERATURE, F    | 190 | 191  | 191 | 190  | 190 | 192   |
| EXHAUST PRESSURE, IN. H2O | 1.0 | 0.0  | 1.0 | 0.0  | 1.0 | 3.0   |
| EXHAUST TEMPERATURE, F    | 512 | 583  | 474 | 524  | 453 | 906   |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 73.02    | 74.01    | 74.02    | 75.01    | 75.02    | 76.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 38       | 38       | 38       | 38       |
| TEMPERATURE, F            | 78       | 78       | 78       | 74       | 74       | 73       |
| ENGINE SPEED, RPM         | 1000     | 1000     | 1000     | 1000     | 1000     | 1000     |
| TORQUE, FT-LB             | 108.5    | 57.8     | 57.8     | 36.0     | 36.0     | 4.9      |
| POWER, BHP*               | 20.4     | 10.9     | 10.9     | 6.8      | 6.8      | .9       |
| FUEL RATE, LB/HR          | 9.8      | 6.2      | 6.2      | 4.9      | 4.9      | 3.6      |
| IGNITION TIMING, DEG BTDC | 15.0     | 26.0     | 26.0     | 25.0     | 25.0     | 15.0     |
| MANIFOLD VACUUM, IN HG    | 2.0      | 11.0     | 11.0     | 14.5     | 14.5     | 18.5     |
| THROTTLE ANGLE, DEG       | 16.5     | 4.5      | 4.5      | 3.0      | 3.0      | 1.5      |
| INTAKE MAN. TEMP., F      | 141      | 154      | 154      | 149      | 149      | 157      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0010    | .0756    | .0012    | .0908    | .0012    | .2677    |
| CO2, %                    | 12.74    | 12.89    | 13.14    | 12.67    | 13.16    | 12.35    |
| O2, %                     | 2.56     | 2.28     | 1.92     | 2.45     | 2.11     | 2.51     |
| HC, PPMC                  | 150      | 2738     | 201      | 2486     | 211      | 4285     |
| NOX, PPM                  | 1603     | 935      | 861      | 494      | 428      | 99       |

AIR/FUEL RATIO

16.83 16.20 16.25 16.35 16.37 16.09

EMISSION RATES, G/HR

|      |       |      |      |      |      |      |
|------|-------|------|------|------|------|------|
| CO   | .7    | 32.1 | .5   | 30.7 | .4   | 67.4 |
| HC   | 5.2   | 58.3 | 4.3  | 42.2 | 3.5  | 54.2 |
| NOX† | 155.4 | 55.6 | 51.0 | 23.4 | 20.0 | 3.5  |

OIL TEMPERATURE, F

213 215 215 210 210 207

OIL PRESSURE, PSI

20 20 20 20 20 20

COOLANT TEMPERATURE, F

192 191 191 190 190 190

EXHAUST PRESSURE, IN. H2O

1.0 1.0 1.0 0.0 1.0 0.0

EXHAUST TEMPERATURE, F

807 768 725 694 630 632

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 76.02    | 77.01    | 77.02    | 78.01    | 78.02    | 79.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 38       | 38       | 38       | 38       |
| TEMPERATURE, F            | 73       | 76       | 76       | 78       | 78       | 76       |
| ENGINE SPEED, RPM         | 1000     | 1300     | 1300     | 1300     | 1300     | 1300     |
| TORQUE, FT-LB             | 4.9      | 110.8    | 110.8    | 59.0     | 59.0     | 37.0     |
| POWER, BHP*               | .9       | 27.1     | 27.1     | 14.4     | 14.4     | 9.0      |
| FUEL RATE, LB/HR          | 3.6      | 13.1     | 13.1     | 8.2      | 8.3      | 6.4      |
| IGNITION TIMING, DEG BTDC | 15.0     | 15.0     | 15.0     | 26.0     | 26.0     | 30.0     |
| MANIFOLD VACUUM, IN HG    | 18.5     | 2.0      | 2.0      | 11.0     | 11.0     | 14.0     |
| THROTTLE ANGLE, DEG       | 1.5      | 20.0     | 20.0     | 6.5      | 6.5      | 4.6      |
| INTAKE MAN. TEMP., F      | 157      | 141      | 141      | 166      | 166      | 158      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0011    | .1015    | .0011    | .1839    | .0010    | .1247    |
| CO2, %                    | 13.29    | 12.61    | 13.09    | 13.60    | 13.72    | 13.11    |
| O2, %                     | 1.63     | 2.39     | 2.21     | 1.49     | 1.57     | 2.20     |
| HC, PPMC                  | 282      | 1531     | 125      | 2484     | 176      | 2361     |
| NOX, PPM                  | 117      | 1605     | 1561     | 576      | 536      | 367      |
| AIR/FUEL RATIO            | 15.98    | 16.47    | 16.51    | 15.53    | 15.93    | 16.11    |

# EMISSION RATES, G/HR

|                           |     |       |       |      |      |      |
|---------------------------|-----|-------|-------|------|------|------|
| CO                        | 3   | 93.3  | 1.0   | 97.2 | .5   | 53.6 |
| HC                        | 3.5 | 70.7  | 5.7   | 65.9 | 4.8  | 51.0 |
| NOX+                      | 4.0 | 206.8 | 197.5 | 42.7 | 40.9 | 22.1 |
| OIL TEMPERATURE, F        | 207 | 217   | 217   | 223  | 223  | 218  |
| OIL PRESSURE, PSI         | 20  | 25    | 25    | 25   | 25   | 25   |
| COOLANT TEMPERATURE, F    | 190 | 191   | 191   | 191  | 191  | 190  |
| EXHAUST PRESSURE, IN. H2O | 0.0 | 9.0   | 2.0   | 3.0  | 0.0  | 0.0  |
| EXHAUST TEMPERATURE, F    | 565 | 1039  | 886   | 921  | 870  | 837  |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 79.02    | 80.01    | 80.02    | 81.01    | 81.02    | 82.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 38       | 38       | 38       | 38       |
| TEMPERATURE, F            | 76       | 74       | 74       | 75       | 75       | 77       |
| ENGINE SPEED, RPM         | 1300     | 1300     | 1300     | 1600     | 1600     | 1600     |
| TORQUE, FT-LB             | 37.0     | 5.6      | 5.6      | 110.1    | 110.1    | 58.7     |
| POWER, BHP*               | 9.0      | 1.4      | 1.4      | 33.1     | 33.1     | 17.6     |
| FUEL RATE, LB/HR          | 6.4      | 4.5      | 4.5      | 16.0     | 16.0     | 10.0     |
| IGNITION TIMING, DEG BTDC | 30.0     | 23.0     | 23.0     | 16.0     | 16.0     | 29.0     |
| MANIFOLD VACUUM, IN HG    | 14.0     | 18.5     | 18.5     | 2.3      | 2.3      | 10.5     |
| THROTTLE ANGLE, DEG       | 4.6      | 2.5      | 2.5      | 23.0     | 23.0     | 8.0      |
| INTAKE MAN. TEMP., F      | 158      | 155      | 155      | 149      | 149      | 178      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0010    | .1775    | .0010    | .1102    | .0010    | .1462    |
| CO2, %                    | 13.19    | 12.18    | 12.95    | 13.06    | 13.30    | 13.59    |
| O2, %                     | 2.24     | 3.57     | 2.79     | 2.32     | 2.25     | 1.56     |
| HC, PPMC                  | 177      | 4393     | 228      | 1056     | 98       | 2026     |
| NOX, PPM                  | 348      | 85       | 122      | 1468     | 1492     | 596      |
| AIR/FUEL RATIO            | 16.47    | 16.95    | 16.90    | 16.41    | 16.51    | 15.65    |
| EMISSION RATES, G/HR      |          |          |          |          |          |          |
| CO                        | .4       | 56.0     | .3       | 120.3    | 1.1      | 94.8     |
| HC                        | 3.9      | 69.6     | 3.6      | 57.9     | 5.4      | 66.0     |
| NOX*                      | 21.4     | 3.7      | 5.3      | 224.8    | 227.7    | 54.2     |
| OIL TEMPERATURE, F        | 218      | 212      | 212      | 215      | 215      | 229      |
| OIL PRESSURE, PSI         | 25       | 25       | 25       | 30       | 30       | 30       |
| COOLANT TEMPERATURE, F    | 190      | 190      | 190      | 192      | 192      | 192      |
| EXHAUST PRESSURE, IN. H2O | 0.0      | 0.0      | 1.0      | 14.0     | 5.0      | 3.0      |
| EXHAUST TEMPERATURE, F    | 774      | 762      | 688      | 1140     | 1007     | 974      |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 82.02    | 83.01    | 83.02    | 84.01    | 84.02    | 85.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| SAROMETER, MMHG           | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 38       | 38       | 38       | 38       |
| TEMPERATURE, F            | 77       | 73       | 73       | 71       | 71       | 75       |
| ENGINE SPEED, RPM         | 1600     | 1600     | 1600     | 1600     | 1600     | 2000     |
| TORQUE, FT-LB             | 58.7     | 36.7     | 36.7     | 6.4      | 6.4      | 112.4    |
| POWER, BHP*               | 17.6     | 11.0     | 11.0     | 1.9      | 1.9      | 42.2     |
| FUEL RATE, LB/HR          | 10.1     | 7.8      | 7.7      | 5.2      | 5.2      | 20.3     |
| IGNITION TIMING, DEG BTDC | 29.0     | 34.0     | 34.0     | 29.0     | 29.0     | 18.0     |
| MANIFOLD VACUUM, IN HG    | 10.5     | 15.0     | 15.0     | 19.5     | 19.5     | 2.3      |
| THRUSTLE ANGLE, DEG       | 8.0      | 5.5      | 5.5      | 3.0      | 3.0      | 28.0     |
| INTAKE MAN. TEMP., F      | 178      | 162      | 162      | 163      | 163      | 159      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0010    | .2545    | .0015    | .1752    | .0010    | .1158    |
| CO2, %                    | 13.99    | 13.49    | 14.08    | 12.66    | 13.24    | 12.94    |
| O2, %                     | 1.17     | 1.57     | 1.10     | 2.94     | 2.35     | 2.69     |
| HC, PPM                   | 208      | 2290     | 190      | 2724     | 217      | 728      |
| NOX, PPM                  | 600      | 440      | 411      | 114      | 149      | 1681     |

AIR/FUEL RATIO 15.63 15.57 15.57 16.62 16.53 16.75

EMISSION RATES, G/HR

|                           |      |       |      |      |     |       |
|---------------------------|------|-------|------|------|-----|-------|
| CO                        | .6   | 127.8 | .7   | 62.7 | .4  | 161.7 |
| HC                        | 6.8  | 57.7  | 4.7  | 49.0 | 3.9 | 51.1  |
| NOX+                      | 54.6 | 31.0  | 28.5 | 5.7  | 7.4 | 329.4 |
| OIL TEMPERATURE, F        | 229  | 224   | 224  | 219  | 219 | 236   |
| OIL PRESSURE, PSI         | 30   | 30    | 30   | 30   | 30  | 30    |
| COOLANT TEMPERATURE, F    | 192  | 191   | 191  | 191  | 191 | 191   |
| EXHAUST PRESSURE, IN. H2O | 1.0  | 0.0   | 1.0  | 0.0  | 0.0 | 27.0  |
| EXHAUST TEMPERATURE, F    | 910  | 889   | 800  | 809  | 735 | 1226  |

\* CORRECTED SAE J8168

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6  
FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 85.02    | 86.01    | 86.02    | 87.01    | 87.02    | 88.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 | 12/ 5/77 |
| BAROMETER, MMHG           | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    | 741.8    |
| HUMIDITY, GRAINS/LB       | 38       | 38       | 38       | 38       | 38       | 38       |
| TEMPERATURE, F            | 75       | 78       | 78       | 78       | 78       | 74       |
| ENGINE SPEED, RPM         | 2000     | 2000     | 2000     | 2000     | 2000     | 2000     |
| TORQUE, FT-LB             | 112.4    | 60.1     | 60.1     | 37.5     | 37.5     | 7.3      |
| POWER, BHP*               | 42.2     | 22.6     | 22.6     | 14.1     | 14.1     | 2.7      |
| FUEL RATE, LB/HR          | 20.3     | 13.0     | 12.9     | 9.6      | 9.7      | 6.3      |
| IGNITION TIMING, DEG BTDC | 18.0     | 30.0     | 30.0     | 37.0     | 37.0     | 35.0     |
| MANIFOLD VACUUM, IN HG    | 2.3      | 9.5      | 9.5      | 15.0     | 15.0     | 20.0     |
| THROTTLE ANGLE, DEG       | 28.0     | 11.5     | 11.5     | 7.0      | 7.0      | 4.0      |
| INTAKE MAN. TEMP., F      | 159      | 195      | 195      | 198      | 198      | 191      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0012    | .1246    | .0010    | .2749    | .0013    | .3455    |
| CO2, %                    | 12.98    | 13.20    | 13.47    | 13.64    | 14.10    | 13.46    |
| O2, %                     | 2.59     | 2.20     | 1.87     | 1.42     | 1.06     | 1.76     |
| HC, PPM                   | 85       | 1517     | 142      | 2063     | 173      | 1886     |
| NOX, PPM                  | 1673     | 510      | 558      | 526      | 517      | 196      |

AIR/FUEL RATIO 16.82 16.21 16.18 15.47 15.55 15.69

# EMISSION RATES, G/HR

|                           |       |       |      |       |      |       |
|---------------------------|-------|-------|------|-------|------|-------|
| CO                        | 1.7   | 108.4 | .9   | 169.4 | .8   | 141.4 |
| HC                        | 6.0   | 66.3  | 6.2  | 63.8  | 5.4  | 38.8  |
| NOX+                      | 331.5 | 62.3  | 67.8 | 45.5  | 44.9 | 11.3  |
| OIL TEMPERATURE, F        | 236   | 238   | 238  | 233   | 233  | 229   |
| OIL PRESSURE, PSI         | 30    | 30    | 30   | 30    | 30   | 30    |
| COOLANT TEMPERATURE, F    | 191   | 191   | 191  | 191   | 191  | 190   |
| EXHAUST PRESSURE, IN. H2O | 11.0  | 8.0   | 3.0  | 2.0   | 1.0  | 0.0   |
| EXHAUST TEMPERATURE, F    | 1087  | 1084  | 994  | 979   | 918  | 867   |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 88.02    | 89.01    | 89.02    | 90.01    | 90.02    | 91.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 5/77 | 12/ 7/77 | 12/ 2/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 |
| BAROMETER, MMHG           | 741.8    | 745.5    | 745.5    | 745.5    | 745.5    | 745.5    |
| HUMIDITY, GRAINS/LB       | 38       | 18       | 18       | 18       | 18       | 18       |
| TEMPERATURE, F            | 74       | 65       | 65       | 67       | 67       | 67       |
| ENGINE SPEED, RPM         | 2000     | 2500     | 2500     | 2500     | 2500     | 2500     |
| TORQUE, FT-LB             | 7.3      | 109.2    | 109.2    | 58.3     | 58.3     | 36.4     |
| POWER, BHP*               | 2.7      | 50.4     | 50.4     | 26.9     | 26.9     | 16.8     |
| FUEL RATE, LB/HR          | 6.5      | 24.6     | 24.7     | 15.6     | 15.6     | 12.2     |
| IGNITION TIMING, DEG BTDC | 35.0     | 22.0     | 22.0     | 35.0     | 35.0     | 41.0     |
| MANIFOLD VACUUM, IN HG    | 20.0     | 3.0      | 3.0      | 10.5     | 10.5     | 15.0     |
| THROTTLE ANGLE, DEG       | 4.0      | 29.0     | 29.0     | 13.0     | 13.0     | 10.0     |
| INTAKE MAN. TEMP., F      | 191      | 168      | 168      | 188      | 188      | 173      |

CONCENTRATIONS, DRY BASIS

|          |       |       |       |       |       |       |
|----------|-------|-------|-------|-------|-------|-------|
| CO, %    | .0011 | .1140 | .0012 | .1300 | .0010 | .1544 |
| CO2, %   | 13.96 | 13.14 | 13.28 | 13.20 | 13.46 | 13.15 |
| O2, %    | 1.15  | 2.23  | 2.14  | 2.17  | 1.92  | 2.18  |
| HC, PPMC | 176   | 532   | 66    | 1454  | 121   | 1546  |
| NOX, PPM | 207   | 1754  | 1748  | 807   | 807   | 587   |

AIR/FUEL RATIO 15.61 16.41 16.45 16.20 16.22 16.18

EMISSION RATES, G/HR

|      |      |       |       |       |       |       |
|------|------|-------|-------|-------|-------|-------|
| CO   | .5   | 190.5 | 2.0   | 136.2 | 1.1   | 125.9 |
| HC   | 3.7  | 44.7  | 5.6   | 76.5  | 6.4   | 63.3  |
| NOX+ | 12.1 | 380.9 | 381.1 | 109.8 | 109.9 | 62.2  |

|                           |     |      |      |      |      |      |
|---------------------------|-----|------|------|------|------|------|
| OIL TEMPERATURE, F        | 229 | 254  | 254  | 248  | 248  | 241  |
| OIL PRESSURE, PSI         | 30  | 30   | 30   | 30   | 30   | 30   |
| COOLANT TEMPERATURE, F    | 190 | 193  | 193  | 193  | 193  | 191  |
| EXHAUST PRESSURE, IN. H2O | 0.0 | 40.0 | 18.0 | 13.0 | 4.0  | 4.0  |
| EXHAUST TEMPERATURE, F    | 787 | 1284 | 1165 | 1107 | 1045 | 1050 |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

| TEST NUMBER               | 91.02    | 92.01    | 92.02    | 93.01    | 93.02    | 94.01    |
|---------------------------|----------|----------|----------|----------|----------|----------|
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 7/77 | 12/ 7/77 | 12/ 2/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 |
| BAROMETER, MMHG           | 745.5    | 745.5    | 745.5    | 745.5    | 745.5    | 745.5    |
| HUMIDITY, GRAINS/LB       | 18       | 18       | 18       | 25       | 25       | 25       |
| TEMPERATURE, F            | 67       | 67       | 67       | 68       | 68       | 70       |
| ENGINE SPEED, RPM         | 2500     | 2500     | 2500     | 3000     | 3000     | 3000     |
| TORQUE, FT-LB             | 36.4     | 8.5      | 8.5      | 106.2    | 106.2    | 56.6     |
| POWER, BHP*               | 16.8     | 3.9      | 3.9      | 59.6     | 59.6     | 31.7     |
| FUEL RATE, LB/HR          | 12.2     | 8.2      | 8.2      | 28.8     | 28.9     | 18.6     |
| IGNITION TIMING, DEG 8TDC | 41.0     | 41.0     | 41.0     | 28.0     | 28.0     | 40.0     |
| MANIFOLD VACUUM, IN HG    | 15.0     | 20.0     | 20.0     | 4.5      | 4.5      | 11.0     |
| THROTTLE ANGLE, DEG       | 10.0     | 5.2      | 5.2      | 29.0     | 29.0     | 15.5     |
| INTAKE MAN. TEMP., F      | 173      | 173      | 173      | 172      | 172      | 189      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | 0.011    | 5.142    | 0.015    | 1.112    | 0.014    | 1.312    |
| CO2, %                    | 13.45    | 13.56    | 14.04    | 13.83    | 13.88    | 13.15    |
| O2, %                     | 1.90     | 1.32     | 1.16     | 1.28     | 1.29     | 2.21     |
| HC, PPMC                  | 131      | 1740     | 150      | 1146     | 90       | 1231     |
| NOX, PPM                  | 611      | 248      | 252      | 2266     | 2232     | 1181     |
| AIR/FUEL RATIO            | 16.21    | 15.31    | 15.62    | 15.61    | 15.80    | 16.28    |

# EMISSION RATES, G/HR

|                           |      |       |      |       |       |       |
|---------------------------|------|-------|------|-------|-------|-------|
| CO                        | 9    | 268.4 | 8    | 205.9 | 2.5   | 164.2 |
| HC                        | 5.4  | 45.6  | 4.0  | 106.6 | 8.5   | 77.4  |
| NOX+                      | 64.7 | 16.8  | 17.2 | 559.7 | 560.1 | 197.1 |
| OIL TEMPERATURE, F        | 241  | 236   | 236  | 262   | 262   | 262   |
| OIL PRESSURE, PSI         | 30   | 30    | 30   | 30    | 30    | 30    |
| COOLANT TEMPERATURE, F    | 191  | 191   | 191  | 193   | 193   | 192   |
| EXHAUST PRESSURE, IN. H2O | 0.0  | 1.0   | 0.0  | 52.0  | 25.0  | 20.0  |
| EXHAUST TEMPERATURE, F    | 936  | 922   | 891  | 1297  | 1207  | 1160  |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 94.02    | 95.01    | 95.02    | 96.01    | 96.02    | 97.01    |
| DATA SOURCE CODE          | 2        | 1        | 2        | 1        | 2        | 1        |
| TEST DATE                 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 |
| BAROMETER, MMHG           | 745.5    | 745.5    | 745.5    | 745.5    | 745.5    | 744.8    |
| HUMIDITY, GRAINS/LB       | 25       | 25       | 25       | 25       | 25       | 25       |
| TEMPERATURE, F            | 70       | 70       | 70       | 71       | 71       | 72       |
| ENGINE SPEED, RPM         | 3000     | 3000     | 3000     | 3000     | 3000     | 3500     |
| TORQUE, FT-LB             | 56.6     | 35.4     | 35.4     | 8.6      | 8.6      | 98.0     |
| POWER, BHP*               | 31.7     | 19.9     | 19.9     | 4.8      | 4.8      | 64.1     |
| FUEL RATE, LB/HR          | 18.6     | 14.9     | 15.0     | 10.5     | 10.5     | 32.2     |
| IGNITION TIMING, DEG BTDC | 40.0     | 46.0     | 46.0     | 46.0     | 46.0     | 33.0     |
| MANIFOLD VACUUM, IN HG    | 11.0     | 14.8     | 14.8     | 19.5     | 19.5     | 5.5      |
| THROTTLE ANGLE, DEG       | 15.5     | 12.0     | 12.0     | 7.5      | 7.5      | 28.5     |
| INTAKE MAN. TEMP., F      | 189      | 177      | 177      | 178      | 178      | 168      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .0012    | .1594    | .0012    | .4580    | .0071    | .2076    |
| CO2, %                    | 13.40    | 13.30    | 13.58    | 13.69    | 14.25    | 14.01    |
| O2, %                     | 1.94     | 1.98     | 1.78     | 1.20     | .78      | .92      |
| HC, PPMC                  | 110      | 1263     | 103      | 1319     | 110      | 1468     |
| NOX, PPM                  | 1162     | 901      | 891      | 359      | 311      | 2576     |
| AIR/FUEL RATIO            | 16.26    | 16.06    | 16.12    | 15.30    | 15.35    | 15.28    |

EMISSION RATES, G/HR

|                           |       |       |       |       |      |       |
|---------------------------|-------|-------|-------|-------|------|-------|
| CO                        | 1.5   | 158.3 | 1.2   | 303.0 | 4.7  | 420.5 |
| HC                        | 6.9   | 63.0  | 5.2   | 43.8  | 3.7  | 149.3 |
| NOX+                      | 193.8 | 119.3 | 118.4 | 31.7  | 27.6 | 694.4 |
| OIL TEMPERATURE, F        | 262   | 255   | 255   | 251   | 251  | 263   |
| OIL PRESSURE, PSI         | 30    | 30    | 30    | 30    | 30   | 31    |
| COOLANT TEMPERATURE, F    | 192   | 192   | 192   | 191   | 191  | 193   |
| EXHAUST PRESSURE, IN. H2O | 6.0   | 10.0  | 1.0   | 2.0   | 0.0  | 62.0  |
| EXHAUST TEMPERATURE, F    | 1078  | 1122  | 1012  | 1030  | 959  | 1309  |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6  
FUEL CODE: 7718

|                           |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|
| TEST NUMBER               | 98.01    | 98.02    | 99.01    | 99.02    | 100.01   | 100.02   |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 |
| SARUMETER, MMHG           | 744.8    | 744.8    | 744.8    | 744.8    | 744.8    | 744.8    |
| HUMIDITY, GRAINS/LB       | 25       | 25       | 25       | 25       | 25       | 25       |
| TEMPERATURE, F            | 74       | 74       | 73       | 73       | 74       | 74       |
| ENGINE SPEED, RPM         | 3500     | 3500     | 3500     | 3500     | 3500     | 3500     |
| TORQUE, FT-LB             | 51.1     | 51.1     | 32.0     | 32.0     | 9.9      | 9.9      |
| POWER, BHP*               | 33.4     | 33.4     | 20.9     | 20.9     | 6.5      | 6.5      |
| FUEL RATE, LB/HR          | 20.9     | 20.9     | 17.1     | 17.1     | 12.9     | 12.9     |
| IGNITION TIMING, DEG BTDC | 47.0     | 47.0     | 48.0     | 48.0     | 48.0     | 48.0     |
| MANIFOLD VACUUM, IN HG    | 11.5     | 11.5     | 15.0     | 15.0     | 18.0     | 18.0     |
| THROTTLE ANGLE, DEG       | 17.0     | 17.0     | 13.5     | 13.5     | 10.0     | 10.0     |
| INTAKE MAN. TEMP., F      | 191      | 191      | 187      | 187      | 184      | 184      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .1478    | .0012    | .1825    | .0012    | .2312    | .0012    |
| CO2, %                    | 13.24    | 13.48    | 13.40    | 13.57    | 13.37    | 13.65    |
| O2, %                     | 2.08     | 1.93     | 1.83     | 1.75     | 1.84     | 1.60     |
| HC, PPMC                  | 1089     | 99       | 1155     | 93       | 859      | 101      |
| NOX, PPM                  | 1829     | 1763     | 1016     | 987      | 399      | 421      |
| AIR/FUEL RATIO            | 16.20    | 16.27    | 15.95    | 16.10    | 15.94    | 15.96    |

# EMISSION RATES, G/HR

|                           |       |       |       |       |       |      |
|---------------------------|-------|-------|-------|-------|-------|------|
| CO                        | 206.4 | 1.7   | 206.1 | 1.4   | 197.5 | 1.0  |
| HC                        | 76.4  | 7.0   | 65.5  | 5.3   | 36.9  | 4.3  |
| NOX+                      | 339.9 | 328.8 | 152.7 | 149.2 | 45.3  | 48.0 |
| OIL TEMPERATURE, F        | 277   | 277   | 271   | 271   | 262   | 262  |
| OIL PRESSURE, PSI         | 30    | 30    | 30    | 30    | 30    | 30   |
| COOLANT TEMPERATURE, F    | 193   | 193   | 193   | 193   | 192   | 192  |
| EXHAUST PRESSURE, IN. H2O | 27.0  | 8.0   | 15.0  | 3.0   | 5.0   | 0.0  |
| EXHAUST TEMPERATURE, F    | 1221  | 1108  | 1190  | 1070  | 1147  | 1000 |

\* CORRECTED SAE J816B

+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6

FUEL CODE: 7718

| TEST NUMBER               | 101.01   | 101.02   | 102.01   | 102.02   | 103.01   | 103.02   |
|---------------------------|----------|----------|----------|----------|----------|----------|
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 |
| BAROMETER, MMHG           | 744.8    | 744.8    | 744.8    | 744.8    | 744.8    | 744.8    |
| HUMIDITY, GRAINS/LB       | 25       | 25       | 25       | 25       | 25       | 25       |
| TEMPERATURE, F            | 75       | 75       | 76       | 76       | 76       | 76       |
| ENGINE SPEED, RPM         | 3800     | 3800     | 3800     | 3800     | 3800     | 3800     |
| TORQUE, FT-LB             | 94.0     | 94.0     | 60.0     | 60.0     | 31.3     | 31.3     |
| POWER, BHP*               | 66.7     | 66.7     | 42.6     | 42.6     | 22.2     | 22.2     |
| FUEL RATE, LB/HR          | 34.7     | 34.5     | 25.7     | 25.7     | 18.6     | 18.7     |
| IGNITION TIMING, DEG BTDC | 33.0     | 33.0     | 43.0     | 43.0     | 47.0     | 47.0     |
| MANIFOLD VACUUM, IN HG    | 5.5      | 5.5      | 10.0     | 10.0     | 14.5     | 14.5     |
| THROTTLE ANGLE, DEG       | 30.0     | 30.0     | 20.5     | 20.5     | 15.0     | 15.0     |
| INTAKE MAN. TEMP., F      | 190      | 190      | 187      | 187      | 194      | 194      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |          |          |
| CO, %                     | .2620    | .0062    | .1436    | .0014    | .2050    | .0013    |
| CO2, %                    | 14.06    | 14.48    | 13.57    | 13.81    | 13.46    | 13.72    |
| O2, %                     | .80      | .38      | 1.61     | 1.45     | 1.67     | 1.62     |
| HC, PPMC                  | 1582     | 97       | 1290     | 112      | 1226     | 99       |
| NOX, PPM                  | 2629     | 2529     | 2441     | 2446     | 1147     | 1069     |
| AIR/FUEL RATIO            | 15.17    | 15.14    | 15.84    | 15.92    | 15.81    | 16.00    |

# EMISSION RATES, G/HR

|                           |       |       |       |       |       |       |
|---------------------------|-------|-------|-------|-------|-------|-------|
| CO                        | 566.5 | 13.4  | 241.1 | 2.3   | 249.5 | 1.5   |
| HC                        | 171.8 | 10.5  | 108.7 | 9.5   | 74.9  | 6.1   |
| NOX+                      | 756.6 | 723.6 | 545.3 | 547.3 | 185.8 | 174.9 |
| OIL TEMPERATURE, F        | 279   | 279   | 284   | 284   | 278   | 278   |
| OIL PRESSURE, PSI         | 30    | 30    | 30    | 30    | 30    | 30    |
| COOLANT TEMPERATURE, F    | 193   | 193   | 193   | 193   | 193   | 193   |
| EXHAUST PRESSURE, IN. H2O | 70.0  | 36.0  | 41.0  | 17.0  | 19.0  | 4.0   |
| EXHAUST TEMPERATURE, F    | 1350  | 1297  | 1280  | 1187  | 1233  | 1115  |

\* CORRECTED SAE J816B  
+ CORRECTED FOR HUMIDITY

ENGINE: 1978 BUICK 196 CID, V-6  
FUEL CODE: 7718

|                           |          |          |          |          |
|---------------------------|----------|----------|----------|----------|
| TEST NUMBER               | 104.01   | 104.02   | 105.01   | 105.02   |
| DATA SOURCE CODE          | 1        | 2        | 1        | 2        |
| TEST DATE                 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 | 12/ 7/77 |
| BAROMETER, MMHG           | 744.8    | 744.8    | 744.8    | 744.8    |
| HUMIDITY, GRAINS/LB       | 25       | 25       | 23       | 23       |
| TEMPERATURE, F            | 76       | 76       | 80       | 80       |
| ENGINE SPEED, RPM         | 3800     | 3800     | 4000     | 4000     |
| TORQUE, FT-LB             | 10.9     | 10.9     | 127.4    | 127.4    |
| POWER, BHP*               | 7.7      | 7.7      | 95.0     | 95.0     |
| FUEL RATE, LB/HR          | 14.5     | 14.5     | 52.5     | 52.6     |
| IGNITION TIMING, DEG BTDC | 47.0     | 47.0     | 29.0     | 29.0     |
| MANIFOLD VACUUM, IN HG    | 18.0     | 18.0     | 2.5      | 2.5      |
| THROTTLE ANGLE, DEG       | 11.0     | 11.0     | 75.0     | 75.0     |
| INTAKE MAN. TEMP., F      | 191      | 191      | 128      | 128      |
| CONCENTRATIONS, DRY BASIS |          |          |          |          |
| CO, %                     | 2375     | .0013    | 4.3598   | 4.6540   |
| CO2, %                    | 13.54    | 13.87    | 11.85    | 12.07    |
| O2, %                     | 1.60     | 1.40     | .16      | .10      |
| HC, PPHC                  | 712      | 80       | 1773     | 1368     |
| NOX, PPM                  | 462      | 469      | 1886     | 1700     |
| AIR/FUEL RATIO            | 15.77    | 15.81    | 12.96    | 12.88    |

# EMISSION RATES, G/HR

|                           |       |      |         |         |
|---------------------------|-------|------|---------|---------|
| CO                        | 224.4 | 1.2  | 12625.0 | 13112.3 |
| HC                        | 33.8  | 3.8  | 257.9   | 193.5   |
| NOX+                      | 58.1  | 59.1 | 721.3   | 632.7   |
| OIL TEMPERATURE, F        | 272   | 272  | 288     | 288     |
| OIL PRESSURE, PSI         | 30    | 30   | 29      | 29      |
| COOLANT TEMPERATURE, F    | 192   | 192  | 195     | 195     |
| EXHAUST PRESSURE, IN. H2O | 10.0  | 1.0  | 100.0   | 55.0    |
| EXHAUST TEMPERATURE, F    | 1192  | 1047 | 1379    | 1266    |

\* CORRECTED SAE J8168

+ CORRECTED FOR HUMIDITY



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