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*Kenneth J. Kelly, Brent K. Bailey, and Timothy C. Coburn*
*National Renewable Energy Laboratory*

*Leslie Eudy*
*ManTech Environmental Technology, Inc.*

*Peter Lissiuk*
*Environmental Research and Development Corp.*

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## ABSTRACT

The first round of emissions testing of light-duty alternative fuel vehicles placed in the U. S. federal fleet under the provisions of the Alternative Motor Fuels Act was recently completed. This undertaking included 75 Dodge B250 vans, of which 37 were dedicated compressed natural gas models, and 38 were standard gasoline controls. Data were collected on regulated exhaust emissions using the federal test procedures, and on a number of other quantities, through a statistically controlled program of investigation. Fuel economy results were also recorded. All test vehicles were operated in routine federal service activities under normal working conditions, adhering as closely as possible to Chrysler's prescribed maintenance schedules.

The data analysis conducted thus far indicates that the compressed natural gas vehicles exhibit notably lower regulated exhaust emissions, on average, than their gasoline counterparts, and that these values are well within U.S. Environmental Protection Agency standards. In addition, lower levels of toxic constituents are emitted by the compressed natural gas vehicles relative to their gasoline counterparts, and they produce lower levels of ozone precursors as well—both characteristics that are highly desirable in contemporary transportation fuels. The compressed natural gas vehicles obtain slightly lower fuel economy than their gasoline counterparts on an energy equivalent basis.

**To promote the use of alternative fuels** and development of an alternative fuel vehicle (AFV) industry, the Alternative Motor Fuels Act (AMFA) of 1988 requires the U.S. federal fleet to include as many AFVs as practicable. The Energy Policy Act (EPACT) of 1992 tightened the requirements for the federal fleet, requiring new vehicle purchases to be comprised of an increasing percentage of AFVs, up to a maximum of 75%, by 1999. The U.S. Department of Energy is responsible for tracking and reporting the performance of these vehicles on an annual basis to facilitate ongoing evaluation of AFV technology, and for assessing the viability of AFVs in commercial and private applications. Performance measures include driver acceptance, fuel economy, operational cost, cost and level of maintenance, and emissions output.

The most extensive effort of its kind, the AMFA evaluation program targets three alternative fuels—methanol, ethanol, and compressed natural gas (CNG)—and encompasses several different types of vehicles, makes, and models operated in a number of federal service applications at various sites around the country. Light-duty passenger cars, vans, and trucks are included, along with school buses, transit buses, and heavy-duty trucks. The earliest AMFA vehicles have been in service since 1991.

One of the objectives of the AMFA light-duty test program is to compare the emissions of AFVs in actual service to those of otherwise identical vehicles operating on conventional fuel. Detection of emissions deterioration as a result of age and use is of particular interest. In all cases, reformulated gasoline (RFG) is used as the basis of comparison in laboratory tests.

This paper specifically addresses the emissions performance of light-duty federal fleet AFVs operating on CNG. The information reported here covers emissions test results from 75 Dodge RAM B250 vans, 37 of which are dedicated CNG models, with the remaining 38 being standard gasoline versions (controls). The data represents results solely from Round 1 of a three-round testing program (hence, emissions deterioration is not specifically addressed).

## TEST VEHICLES

As depicted in Figure 1, the test vehicles are 1992 and 1994 model year Dodge B250 full-size, 15-passenger vans. General vehicle characteristics are summarized in Table 1.

Both the CNG and gasoline models are configured with 5.2-liter V-8 engines, multi-point fuel injection systems, and 4-speed automatic transmissions. The CNG model is reported by Chrysler to be certified as a low emission vehicle (LEV) by virtue of its having been equipped with a special natural gas catalyst for low emissions.

The primary difference in the physical characteristics of the two vehicles is fuel capacity. The gasoline model is equipped with a 35-gallon fuel tank (a 22-gallon tank is standard), whereas the CNG model carries three or four fuel cylinders, yielding an onboard fuel capacity of 11.1 equivalent gallons for the three-cylinder configuration, and 15.7 equivalent gallons for the four-cylinder configuration. As a result, curb weight is increased, and driving range is decreased, for the CNG model.

## TEST PROCEDURES

The emissions testing program itself was designed to provide the most accurate and precise measurements possible using the EPA's federal test procedure (FTP) [1]. For the CNG vehicles, the regimen included the collection of exhaust emissions using the FTP, evaporative emissions using a simplified version of the EPA's sealed housing evaporative determination (SHED) for leakage (both diurnal and hot soak), and speciated exhaust hydrocarbons (toxic compounds and ozone precursors) from a number of vehicles equal to approximately 15% of all the vehicles tested for exhaust emissions by one of the labs (in this case, speciation constitutes identification and quantification of the non-oxygenated exhaust constituents using gas chromatography). ManTech Environmental Technology, Inc. was designated to provide speciation results. The evaporative emissions tests were included because of concerns expressed by some drivers and service technicians that the existence of leaks in the fuel systems of CNG vehicles could result in a hazardous buildup of gases in enclosed parking spaces or maintenance facilities.

For the gasoline vehicles, a similar regimen was followed: collection of both exhaust and evaporative emissions using the FTP, and speciated exhaust hydrocarbons (toxics and ozone precursors) on a number of vehicles equal to approximately 15% of all the vehicles tested for exhaust emissions by one of the labs. Again, ManTech Environmental Technology, Inc. was designated to provide speciation results. Because of potential differences in the characteristics of the fuels on which the individual vehicles actually operate, the test procedures for gasoline vehicles included a fuel-flushing change-out routine to remove fuel carry-over effects similar to the one used in the Auto/Oil program [2].

The emissions test procedures are designed to be essentially identical across laboratories. However, to ensure the full integrity of the data, EPA has conducted an audit of the test procedures and emissions calculations used by the two labs. Although the tests conducted by ManTech Environmental Technology, Inc. obviously yield high-altitude results, it is not possible to statistically distinguish the effect of altitude from differences between labs.

## FUEL COMPOSITION

Uniformly blended fuels are prepared for use in the emissions testing program, and vehicles are tested using the same fuel at each designated mileage level. The CNG is blended by National Specialty Gases, and is designed to represent industry average fuel composition. Table 2 lists the concentrations of various constituents in the gas. California Phase 2 reformulated gasoline (RFG), blended by Phillips Petroleum Company, is used in tests on the control vehicles. The composition of the fuels actually used in the vans during normal day-to-day activities is unknown.

## TEST FLEET CHARACTERISTICS: EXHAUST AND EVAPORATIVE EMISSIONS

Actual vehicle selection resulted in 37 CNG vans and 38 gasoline vans (controls) being chosen for participation in the exhaust and evaporative emissions testing program. Of the 37 CNG vans, 34 (92%) were 1992 models, and 3 were 1994 models. Conversely, of the 38 gasoline controls, 17 (45%) were 1992 models and 21 were 1994 models. Of the 75 total vehicles in the program, 33 (16 CNG models; 17 gasoline models) are in service in the Washington, D.C. metropolitan area; 10 (5 CNG models; 5 gasoline models) are in service in the metropolitan New York City and northern New Jersey areas; and 32 (16 CNG models; 16 gasoline models) are in service in the Denver metropolitan area. ManTech Environmental Technology, Inc. tested all vehicles from Denver, and Environmental Research & Development tested all vehicles from Washington, D.C. and the New York area. Table 3 shows a breakdown of all 75 test vehicles according to type, model year, and service location.

## TEST FLEET CHARACTERISTICS: TOXIC EXHAUST EMISSIONS AND SPECIATED HYDROCARBONS

Actual vehicle selection resulted in two CNG vans and three gasoline vans (controls) being designated for speciation of exhaust hydrocarbons to determine the levels of toxic pollutants and ozone precursors. Unfortunately, for logistical and operational reasons, none are represented in the exhaust/evaporative data set described above.

All vans were 1992 model year vehicles. All five vehicles were in service in the Denver area and were tested by ManTech Environmental Technology, Inc.

## VEHICLE MILEAGE ACCUMULATION AND OTHER DATA SET CHARACTERISTICS

Because the emissions testing program is in continuous operation, results obtained in the first calendar year of operation include measurements on some vehicles at both the initial and second target mileage levels. The series of tests on the vehicles at a particular target mileage level are referred to as rounds. All the results being reported at this time represent the initial measurements taken on the vehicles (Round 1). In particular, the data set comprises results from 86 exhaust emissions tests conducted on 75 vehicles during the period of March 17, 1994, to May 11, 1995. Included in this data set are a small number of replicate and/or repeat test measurements on selected vehicles, although no assessment of laboratory repeatability is reported here.

Evaporative emissions tests were not conducted on all the vehicles during the first year of program operation. Consequently, the Round 1 data set contains results from only 67 evaporative emissions tests conducted on the 75 vehicles. There were four replicates, or repeat, evaporative measurements.

For exhaust and evaporative emissions, Table 4 shows a breakdown, by lab and vehicle type, of the number of vehicles compared to the number of tests, and identifies the number of replicates and/or repeat tests included. For the speciated exhaust hydrocarbons, one test was performed per vehicle. All results are presented here exactly as reported by the labs, without any values having been edited or removed.

Obviously, for logistical reasons, not all vehicles can be tested at exactly the target mileage levels. The vehicle odometer readings at the time of the initial exhaust tests ranged from a low of 2,121 to a high of 30,493, with an average initial mileage accumulation of 10,047. The vehicle odometer readings associated with the information on speciated hydrocarbons ranged from a low of 5,271 to a high of 10,123, with an average of 8,299.

Table 5 contains a complete breakdown of mileage accumulation, by vehicle type, on vehicles for which exhaust

**Table 4. Comparison of the numbers of vehicles tested and the numbers of tests completed for exhaust and evaporative emissions**

| Vehicle Type | Lab | Vehicles | Exhaust Tests | Evaporative Tests |
|---|---|---|---|---|
| | 1 | 16 | 19 | 7 |
| CNG | 2 | 21 | 23 | 17 |
| | Both | 37 | 42 | 24 |
| | 1 | 16 | 20 | 19 |
| Gasoline | 2 | 22 | 24 | 24 |
| | Both | 38 | 44 | 43 |
| Total | | 75 | 86 | 67 |

Notes: Replicate exhaust tests were conducted on a total of 10 vehicles (5 CNG, 5 gasoline). Replicate evaporative tests were conducted on a total of 4 vehicles (all gasoline).

**Table 5. Comparison of mileage accumulation on all vehicles tested**

| Test | Vehicle Type | Low (miles) | High (miles) | Average (miles) |
|---|---|---|---|---|
| | CNG | 2,121 | 22,272 | 7,964 |
| Exhaust | Gasoline | 3,527 | 30,493 | 12,035 |
| | Both | 2,121 | 30,493 | 10,047 |
| | CNG | 2,121 | 15,091 | 7,945 |
| Evaporative | Gasoline | 3,527 | 30,493 | 12,106 |
| | Both | 2,121 | 30,493 | 10,616 |
| | CNG | 5,271 | 9,514 | 7,393 |
| Speciated Hydrocarbons | Gasoline | 7,287 | 10,123 | 8,903 |
| | Both | 5,271 | 10,123 | 8,299 |

hydrocarbons (NMHC), carbon monoxide (CO), carbon dioxide ($CO_2$), and oxides of nitrogen ($NO_x$). Evaporative emissions are expressed only as total hydrocarbons (THC). Fuel economy values are also provided. Table 6 provides descriptive statistics on each of these quantities.

Speciated hydrocarbons are reported in the Appendix as ozone-forming potential (OFP) and specific reactivity (SR). The tables also include values of the four exhaust constituents, along with an aggregate of the four, designated by the Clean Air Act Amendments of 1990 as mobile source toxics: benzene ($C_6H_6$); 1,3-butadiene ($C_4H_6$); formaldehyde (HCHO); and acetaldehyde ($CH_3CHO$). Table 7 contains average values for each of these quantities.

OFP and SR are calculated using the Carter [3] method, which encompasses the regulatory requirements adopted by the State of California. Using this approach, a maximum incremental reactivity (MIR) value is assigned to individual exhaust constituents. This MIR value represents the predicted impact of the respective constituent on urban atmospheric ozone formation, expressed as milligrams of ozone per milligram of the constituent. OFP for a specific fuel is computed by incorporating the MIR values for all constituents measured in the exhaust from that fuel. SR for a specific fuel is calculated by combining the respective masses of the constituents measured in the exhaust from that fuel, on a per-mile basis, with the corresponding value of OFP. Under

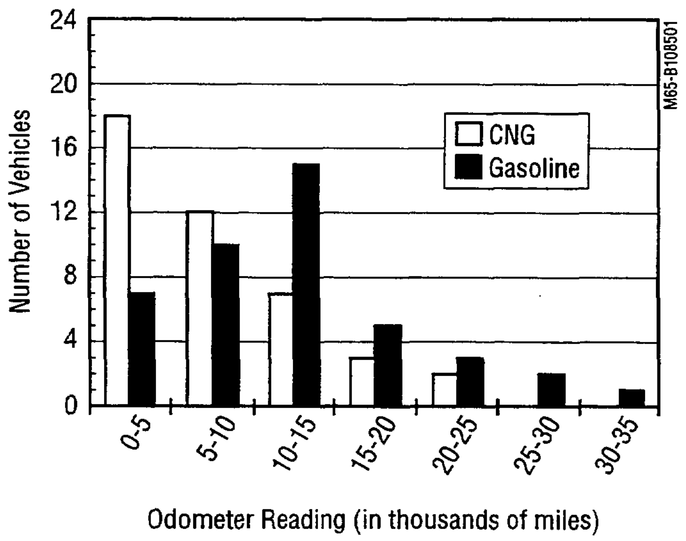

**Figure 2. Round 1 mileage accumulation on two types of vehicles tested for exhaust emissions (includes repeat tests)**

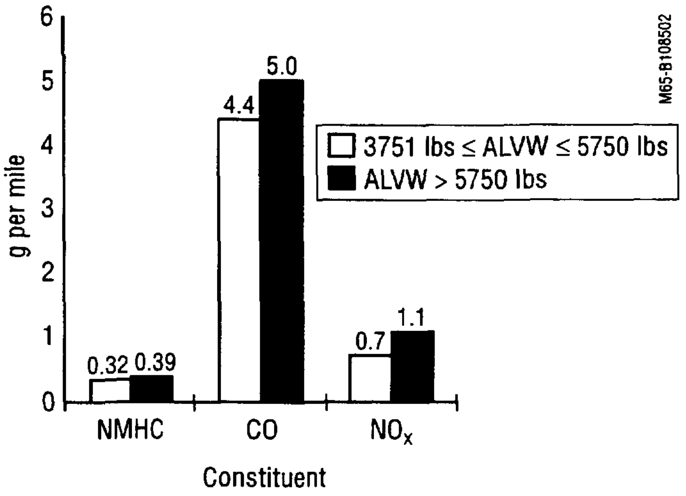

**Figure 3. Federal exhaust emissions standards for heavy light-duty non-diesel vehicles (Tier 1, tailpipe in-use, 50,000 miles)**

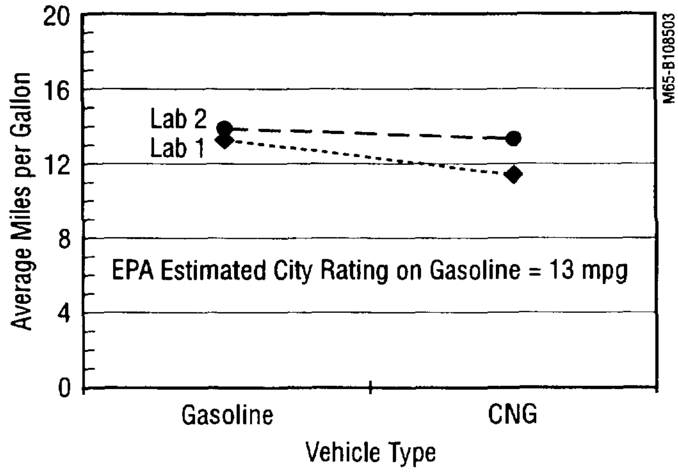

**Figure 4. Comparison of fuel economy for the two types of vehicles, by lab**

On average, the gasoline vans obtained higher fuel economy than the CNG vans, a finding that was repeated in the results reported by both labs. The fuel economy determined for gasoline vans was 13.10 miles per gallon and 13.91 miles per gallon for Labs 1 and 2, respectively, and the fuel economy determined for CNG vans was 11.54 miles per gallon and 13.47 miles per gallon for Labs 1 and 2, respectively. Since the EPA-estimated city rating for Dodge B250 vans on gasoline is 13 miles per gallon, only the average for the CNG vans tested by Lab 1 might be considered outside an acceptable range.

**EXHAUST EMISSIONS** - Comparisons of the CO, $CO_2$, $NO_x$, and NMHC emissions measured by the two labs on the two types of vehicles are presented in Figures 5 through 8, respectively. The corresponding Tier 1 federal standards are shown superimposed on the figures. $CO_2$ is not a regulated component, and therefore, no standards are available for comparison.

Figure 5 compares the CO emissions, stated as average grams per mile, reported by the two labs for the two types of vehicles. The federal Tier 1 standard for CO is 4.4 grams per mile. The figure indicates a considerable difference in the results obtained by the two labs on the two types of vehicles. In the case of the gasoline vans, Lab 1 reported higher average CO emissions (5.83 grams per mile) than Lab 2 (3.76 grams per mile); whereas for the CNG vans, Lab 1 reported lower average CO emissions (1.99 grams per mile) than Lab 2 (3.65 grams per mile). Lab 2 reported only the slightest reduction in CO emissions from CNG vans compared to those from gasoline vans, although its CNG average was dominated by a single van with a very high value. Only the results from Lab 1 for gasoline vans exceed the federal Tier 1 standard of 4.4 grams per mile; and the results from CNG vans tested at both labs are considerably below the standard.

Figure 6 shows the vehicle-type comparison of $CO_2$ emissions reported by the two labs, stated as average grams per mile. The results for Lab 2 are lower than those for Lab 1 for both vehicle types, although both labs reported lower $CO_2$ emissions from the CNG vans (563.54 grams per mile and 500.58 grams per mile for Labs 1 and 2, respectively) than from the gasoline vans (666.85 grams per mile and 617.27 grams per mile for Labs 1 and 2, respectively).

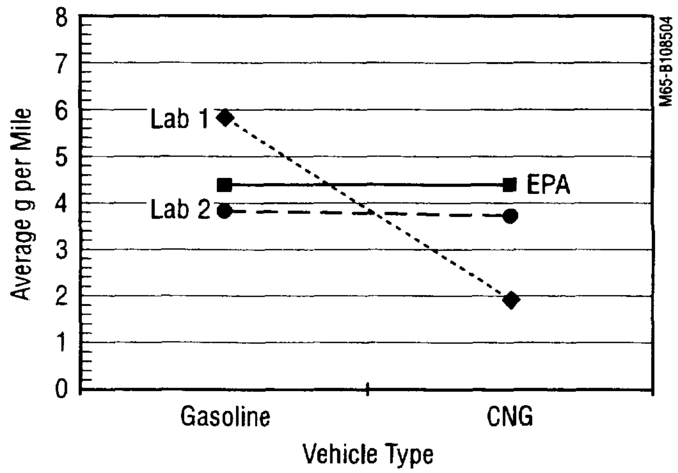

**Figure 5. Comparison of CO emissions from the two types of vehicles, by lab**

Generally speaking, a reduction in $CO_2$ emissions corresponds to an increase in fuel economy. However, as indicated in Figure 4, the CNG vans obtained lower fuel economy while simultaneously emitting lower levels of $CO_2$ than their gasoline counterparts (see Figure 6). This finding may suggest that these particular

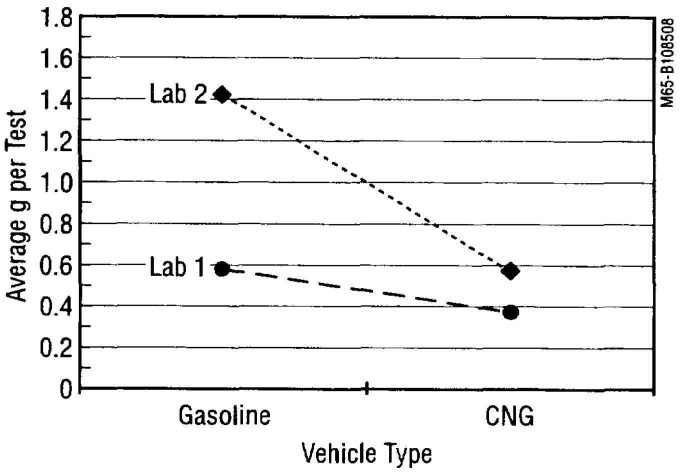

Figure 9. Comparison of evaporative THC measured on the two types of vehicles, by lab

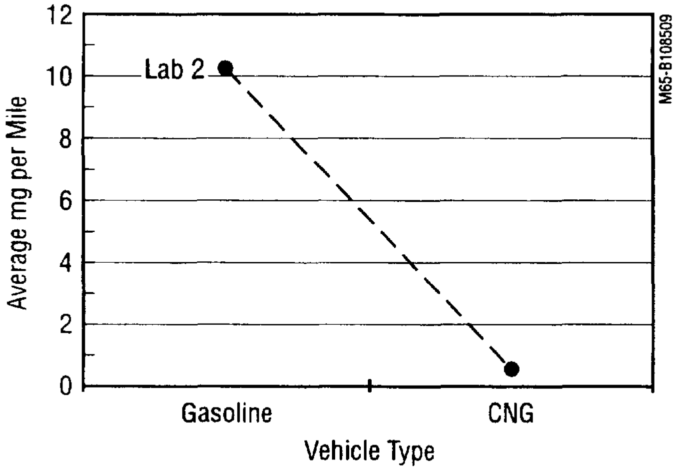

Figure 10. Comparison of $C_6H_6$ emissions from the two types of vehicles

As noted above, the Round 1 toxic emissions data set is a relatively sparse one—only two CNG vehicles and three RFG vehicles are included, with a single test having been performed on each vehicle. Further, one of the two CNG vehicles is known to exhibit an abnormally high emissions profile, which may adversely impact all average results.

In all cases except for formaldehyde, the results show that the levels of toxic compounds emitted from the CNG vans are substantially lower, on average, than those from the gasoline vans (with the caveat that data was obtained from only a small number of vehicles). Similarly, the average of the aggregated toxic emissions for the CNG vans is 7.47 milligrams per mile, while it is 16.31 milligrams per mile for the gasoline vans.

The Clean Air Act Amendments of 1990 specify that reformulated gasoline must produce at least a 15% reduction in aggregated toxic emissions. Assuming the RFG used here satisfies this requirement, the aggregate of the toxic emissions for the CNG vans represents an incremental 54% reduction, on average.

In the case of formaldehyde, the average value reported for the CNG vehicles is higher than the corresponding value reported for the gasoline vehicles. However, the CNG average includes a very high data point obtained on the single suspect van (10.78 milligrams per mile versus 1.78 milligrams per mile). This situation closely parallels the circumstances recently reported by Gabele [4]. In that study, the aggregate toxic emissions from two 1992 Dodge CNG vans averaged 6.25 milligrams per mile, with one of the two also emitting a much higher level of formaldehyde (8.36 milligrams per mile, on average, versus 1.55 milligrams per mile, on average).

In summary, as is the case for evaporative and regulated emissions, CNG vans generally exhibit lower levels of toxic emissions than their gasoline counterparts.

**OZONE PRECURSORS** - Ozone precursor data are reported in terms of OFP and SR. Figures 15 and 16 show the respective comparisons for these two quantities for the two types of vehicles. As in the case of the toxic emissions, the data set for ozone precursors encompasses only a small number of results—a single value obtained on each of the two CNG vans and three gasoline vans.

OFP is reported in average milligrams of ozone per mile, and SR is reported as an average of milligrams of ozone per milligrams of non-methane organic gas (NMOG). There are no federal standards for comparison purposes.

Generally speaking, OFP will be high when SR is high and there is a high overall emissions output. However, for CNG vehicles, OFP can also be low in this situation. Such incongruity is attributable to the fact that NMHC emissions can be extremely low while SR, a calculated quantity, is still quite high. Black and Kleindienst [5], for example, suggest that values of SR from low-emitting CNG vehicles can be higher than those from gasoline vehicles; and that CNG vehicles with high NMHC emissions can exhibit low values of SR because those emissions predominantly consist of compounds such as ethane which have low reactivity.

In the present study, OFP and SR are both substantially lower, on average, for the CNG vans than for their gasoline counterparts. Average OFP for the gasoline vans is 1149.41 milligrams of ozone per mile, whereas for the CNG vans it is 294.05 milligrams

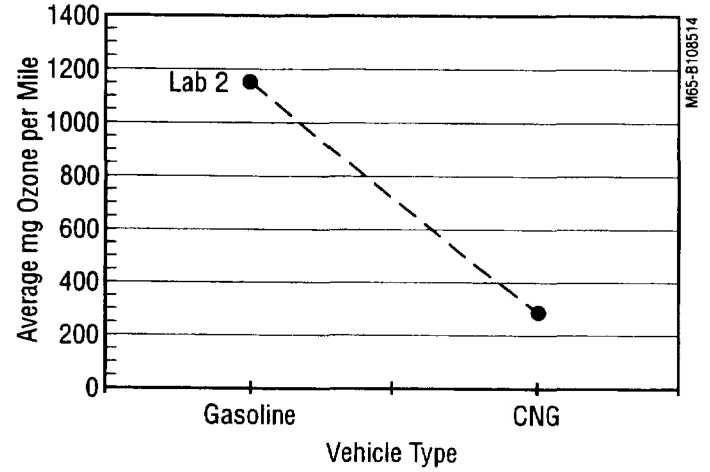

**Figure 15. Comparison of OFP calculated for the two types of vehicles**

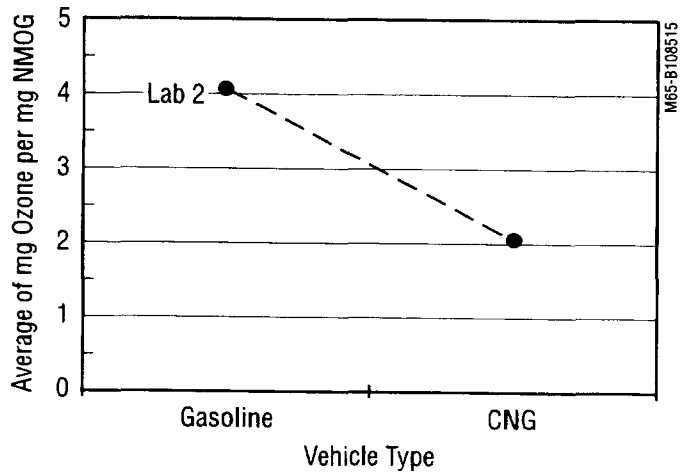

**Figure 16. Comparison of SR calculated for the two types of vehicles**

## SUMMARY OF RESULTS

For each of the quantities discussed above, Table 8 shows the percent change in the average results reported for the CNG vans relative to their gasoline counterparts. An individual tabulation is presented for both labs. Note again that the results for toxic pollutants and ozone precursors are associated with a different set of vehicles than the results for fuel economy, exhaust emissions, and evaporative emissions.

**Table 8. Percent change in average emissions and fuel economy for CNG vehicles relative to gasoline vehicles**

| | % Change | |
|---|---|---|
| **Quantity** | **Lab 1** | **Lab 2** |
| fuel economy | -11.9 | -3.2 |
| NMHC | -83.3 | -76.9 |
| CO | -65.9 | -2.9 |
| $NO_x$ | -30.8 | -31.4 |
| $CO_2$ | -15.5 | -18.9 |
| THC | -35.6 | -59.9 |
| OFP | -74.4 | * |
| SR | -50.0 | * |
| $C_6H_6$ | -96.0 | * |
| $C_4H_6$ | -94.8 | * |
| HCHO | 48.0 | * |
| $CH_3CHO$ | -61.8 | * |
| *No Measurements | | |

Overall, the Round 1 results from the federal emissions testing program indicate that the dedicated CNG vans exhibit notably lower regulated exhaust emissions profiles than their gasoline counterparts, with all constituents well within EPA standards. These vehicles also emit moderately lower amounts of $CO_2$, on average, than the gasoline vehicles. On the other hand, energy equivalent fuel economy is also lower, on average, for the CNG vans than for the gasoline vans.

There is some evaporative emissions leakage associated with the CNG fuel systems, but the mass is no more than would typically be expected from evaporative emissions in a corresponding gasoline vehicle. Any such leakage primarily consists of methane, a non-reactive and non-toxic compound which arises from many sources and is naturally released into the atmosphere. This finding serves to mitigate the safety concerns raised about the CNG fuel system technology.

The CNG vans from which the speciated exhaust emissions profile was developed exhibit substantially lower OFP and SR than their gasoline counterparts. In addition, with the caveat that the formaldehyde results are discounted (see the discussion above), these vans also emit levels of toxic pollutants that are substantially lower than those of their gasoline counterparts. The reduced levels of ozone precursors and toxic pollutants are both highly desirable characteristics of contemporary transportation fuels; and the findings of lower reactivity and lesser amounts of toxics are additional mitigating factors relative to concerns about CNG vehicle safety.

Most vehicles in this study will continue to be monitored to determine if there is any deterioration in emissions levels as the equipment ages. Future reports will discuss the effects of mileage accumulation. Further, statistical analyses are ongoing to evaluate other factors, such as laboratory differences, which may affect interpretations of the data. Some of the statistical techniques suggested by Painter and Rutherford [6] form the basis for these ongoing analysis efforts.

# APPENDIX A:

## Data Set Listings

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DV203CR | DV | 1992 | MAN | 7/15/94 | 22245 | CNG | 13.412 | 0.394 | 506.8935 | 0.0354 | 1.6684 | • |
| DV203CR | DV | 1992 | MAN | 7/17/94 | 22272 | CNG | 13.5854 | 0.6207 | 499.834 | 0.067 | 1.433 | • |
| DV205CR | DV | 1992 | MAN | 5/16/94 | 10107 | CNG | 13.1203 | 2.1215 | 515.0817 | 0.1488 | 0.2565 | • |
| DV205CR | DV | 1992 | MAN | 5/18/94 | 10141 | CNG | 13.0257 | 1.3145 | 519.9444 | 0.0849 | 0.3631 | • |
| DV208CR | DV | 1992 | MAN | 6/15/94 | 4180 | CNG | 13.4482 | 2.2634 | 503.4215 | 0.0257 | 0.2988 | • |
| DV209CR | DV | 1992 | MAN | 6/10/94 | 3607 | CNG | 13.3064 | 2.2416 | 508.8965 | 0.0223 | 0.1724 | • |
| DV210CR | DV | 1992 | MAN | 7/1/94 | 4830 | CNG | 13.7433 | 2.1915 | 492.384 | 0.0531 | 0.2055 | • |
| DV211CR | DV | 1992 | MAN | 3/7/95 | 4342 | CNG | 13.0919 | 7.3207 | 507.2388 | 0.0398 | 0.297 | 0.2892 |
| DV214CR | DV | 1992 | MAN | 3/14/95 | 5790 | CNG | 12.5123 | 3.3715 | 539.2654 | 0.0408 | 0.1449 | 0.5133 |
| DV216CR | DV | 1992 | MAN | 6/2/94 | 19633 | CNG | 13.6543 | 2.1307 | 494.8459 | 0.0558 | 0.4079 | • |
| DV217CR | DV | 1992 | MAN | 4/27/94 | 4253 | CNG | 13.4696 | 1.2116 | 503.5414 | 0.085 | 0.4094 | • |
| DV217CR | DV | 1992 | MAN | 5/11/94 | 4302 | CNG | 13.149 | 0.8014 | 516.2777 | 0.1215 | 0.5035 | • |
| DV218CR | DV | 1992 | MAN | 3/7/95 | 5647 | CNG | 13.5748 | 2.4929 | 497.8253 | 0.0353 | 0.4935 | • |
| DV219CR | DV | 1992 | MAN | 2/22/95 | 2121 | CNG | 12.8361 | 1.2628 | 529.3326 | 0.023 | 0.0858 | 0.2223 |
| DV204CR | DV | 1992 | MAN | 2/16/95 | 5271 | CNG | 13.3231 | 18.3081 | 479.167 | 0.1836 | 1.3804 | • |
| DV206CR | DV | 1992 | MAN | 4/4/95 | 4522 | CNG | 13.1898 | 4.2485 | 509.888 | 0.037 | 0.1124 | 2.5033 |
| DV207CR | DV | 1992 | MAN | 4/6/95 | 12349 | CNG | 13.7581 | 3.4047 | 490.0819 | 0.0272 | 0.1718 | 0.3067 |
| DV212CR | DV | 1992 | MAN | 3/1/95 | 9514 | CNG | 15.5465 | 0.7192 | 436.6604 | 0.0602 | 0.9169 | 0.0877 |
| DV220CR | DV | 1992 | MAN | 4/11/95 | 7991 | CNG | 13.6469 | 5.2411 | 489.5521 | 0.0504 | 0.7511 | 0.0587 |
| DC201CR | DC | 1992 | ERD | 12/9/94 | 6373 | CNG | 11.47 | 1.6191 | 567.5223 | 0.0504 | 0.2067 | 0.1396 |
| DC202CR | DC | 1992 | ERD | 4/20/94 | 4906 | CNG | 12.17 | 2.2326 | 533.5688 | 0.0258 | 0.3293 | • |
| DC202CR | DC | 1992 | ERD | 4/21/94 | 4925 | CNG | 12.19 | 1.3078 | 535.4055 | 0.0227 | 0.5532 | • |
| DC203CR | DC | 1992 | ERD | 11/15/94 | 4108 | CNG | 11.55 | 1.326 | 563.8011 | 0.067 | 0.633 | 1.4556 |
| DC204CR | DC | 1992 | ERD | 12/6/94 | 15026 | CNG | 11.82 | 3.6231 | 546.9124 | 0.0422 | 0.5234 | 0.5909 |
| DC205CR | DC | 1992 | ERD | 9/1/94 | 3220 | CNG | 11.55 | 2.3676 | 561.8193 | 0.043 | 0.1473 | • |
| DC208CR | DC | 1992 | ERD | 4/12/94 | 4382 | CNG | 12.37 | 1.416 | 527.4893 | 0.0364 | 0.3378 | • |
| DC208CR | DC | 1992 | ERD | 4/13/94 | 4407 | CNG | 12.43 | 1.1212 | 524.709 | 0.0344 | 0.4094 | • |
| DC210CR | DC | 1992 | ERD | 11/29/94 | 9492 | CNG | 11.61 | 0.4693 | 562.3634 | 0.0413 | 1.2035 | 0.2509 |
| DC211CR | DC | 1992 | ERD | 5/13/94 | 5481 | CNG | 11.73 | 1.8766 | 553.9037 | 0.0767 | 0.3722 | • |
| DC212CR | DC | 1992 | ERD | 11/15/94 | 6595 | CNG | 11.11 | 1.5938 | 586.6979 | 0.039 | 0.2991 | 0.0566 |
| DC213CR | DC | 1992 | ERD | 12/8/94 | 9361 | CNG | 11.62 | 0.9947 | 562.2017 | 0.0256 | 0.523 | 0.2844 |
| DC214CR | DC | 1992 | ERD | 12/15/94 | 3207 | CNG | 11.15 | 2.1205 | 582.91 | 0.055 | 0.071 | 1.3672 |
| DC216CR | DC | 1992 | ERD | 12/14/94 | 15091 | CNG | 11.64 | 4.7964 | 553.6522 | 0.1007 | 0.3217 | 0.158 |
| DC220CR | DC | 1992 | ERD | 11/17/94 | 10091 | CNG | 11.53 | 0.8387 | 566.825 | 0.023 | 0.3908 | 0.1409 |
| NJ201CR | NJ | 1992 | ERD | 11/3/94 | 4477 | CNG | 11 | 3.8278 | 583.2373 | 0.06 | 0.8269 | 0.2618 |
| NJ202CR | NJ | 1992 | ERD | 11/7/94 | 13954 | CNG | 11.4 | 2.9097 | 568.1722 | 0.0491 | 0.6302 | 0.1384 |
| NJ203CR | NJ | 1992 | ERD | 11/4/94 | 12458 | CNG | 11.43 | 1.5886 | 569.1654 | 0.0616 | 0.9593 | 0.3544 |
| NY201CR | NY | 1992 | ERD | 10/27/94 | 3951 | CNG | 11.15 | 3.637 | 579.288 | 0.0485 | 0.1366 | 0.8547 |
| NY202CR | NY | 1992 | ERD | 10/28/94 | 7717 | CNG | 11.49 | 1.0538 | 566.9647 | 0.0464 | 0.7234 | 0.085 |
| DC222CR | DC | 1994 | ERD | 11/17/94 | 4771 | CNG | 11.6 | 0.8227 | 562.725 | 0.0495 | 0.9348 | 0.0532 |
| DC223CR | DC | 1994 | ERD | 12/1/94 | 10435 | CNG | 11.51 | 2.6836 | 564.4001 | 0.0429 | 0.528 | 0.1617 |
| DC224CR | DC | 1994 | ERD | 12/2/94 | 6935 | CNG | 11.44 | 0.7064 | 571.2047 | 0.0519 | 1.0336 | 0.1286 |