Final Report:

The Effect of Fuel Sulfur on NH_3 and Other Emissions from 2000-2001 Model Year Vehicles

CRC Project No. E-60

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Executive Summary

The reduction of fuel sulfur levels in gasoline is considered to be an important factor in attaining present and future vehicle emissions standards and air quality goals. Numerous studies have shown that sulfur reduces the efficiency of the catalytic converter and increases regulated emissions. Although catalysts reduce most emissions, some pollutants, such as ammonia (NH_3), can be formed over the catalyst surface. Since NH_3 is primarily formed on the catalyst surface, it has been suggested that sulfur could inhibit NH_3 formation on the catalyst by inhibiting reaction sites for NH_3 formation, leading to increases in NH_3 emissions as fuel sulfur levels are decreased.

To date, information about the effects on fuel sulfur on emissions such as NH_3 is very limited, especially for low emission vehicles representative of present and future vehicle technologies. For this study, the emissions impact of fuel sulfur and catalyst age was evaluated for 14 vehicles. The 14 vehicles included 12 California-certified Low-Emission Vehicles (LEV) to Super-Ultra-Low-Emission Vehicles (SULEV) vehicles and 2 European vehicles certified to Euro 3 standards. Each vehicle was evaluated with 3 fuels (5, 30, and 150 ppmw sulfur) and using as-received and aged catalysts. Vehicles were tested on each fuel/catalyst configuration over the Federal Test Procedure (FTP) and US06 test cycles. The two European vehicles were also tested over the New European Driving Cycle (NEDC) on each of the fuel/catalyst configurations. For the primary analyses, the European vehicles were excluded from the data set since the European vehicles are certified to different limits and procedures.

In addition to making measurements of bag and modal regulated emissions, a tunable diode laser (TDL) was developed and successfully used to measure engine-out and tailpipe NH_3 in real-time. The TDL offers both the detection limits and the response time necessary to investigate low-level concentrations of NH_3 in vehicle exhaust. Additionally, the TDL has the important advantage that it can make measurements *in-situ* using raw exhaust gases. The combination of these advantages allows the measurement of highly time-resolved NH_3 emissions with sensitivity levels of better than 0.5 ppmv at two standard deviations, or minimum detection limits of roughly 0.5 mg/mi.

For the California-certified vehicles, NH_3 emissions over the FTP were generally lower than those of the regulated emissions. Fleet average FTP NH_3 emissions averaged between 14 and 21 mg/mi depending on the fuel/catalyst combination. Five of the test vehicles had NH_3 emissions below 5 mg/mi for most of the test configurations. Only 4 vehicles had NH_3 emissions over 20 mg/mi when averaged over all test configurations. Measurements of engine-out NH_3 emissions indicated that NH_3 emissions were formed primarily over the catalyst. The highest FTP NH_3 emissions were found during bag 1 of the FTP after catalyst light-off. NH_3 emissions over the US06 were considerably higher than those found for the FTP and were comparable with or greater than those of non-methane hydrocarbons (NMHC) and nitrogen oxides (NO_x) over the US06.

Fuel sulfur effects on fleet average NH_3 were found to be statistically significant over the US06 cycle but not over the FTP. Fleet average NH_3 emissions over the US06 for the 150 ppm fuel were 27% higher than those for the 5 ppm and 12% higher than those for the 30 ppm fuel.

Catalyst aging effects on NH_3 emissions were found to be statistically significant for both the FTP and US06 cycles for NH_3 emissions, with higher emissions for the aged catalyst. Fleet average NH_3 emissions were 50% higher for the aged catalysts over the FTP and 17% higher for the aged catalysts over the US06. The interaction between vehicle and catalyst age effects was found to be statistically significant, however, for both the FTP and US06 cycles.

For the FTP, fleet average NO_x emissions were higher at a statistically significant level for the 150 ppm fuel compared with both the 5 and 30 ppm sulfur fuels, although the interaction between vehicle and fuel effects was also statistically significant. For fleet average NMHC, emissions were higher at statistically significant levels for the 150 ppm fuel compared with the 30 ppm fuel, although the magnitude of this fuel effect was small.

The effects of catalyst age were found to be statistically significant for fleet average CO emissions, with higher emissions observed for the aged catalysts.

Similar to NH_3, the N_2O emissions over the FTP were generally lower than those of the regulated pollutants. The results showed there was a statistically significant increase in N_2O emissions for 150 ppm fuel compared to both the 30 and 5 ppm fuels. This trend is consistent with previous studies that have shown that higher N_2O emissions are generally observed for higher sulfur fuels. The highest N_2O emissions for the FTP were found in bag 1, as the catalyst was warming up to operational temperatures.

The effects of fuel sulfur on both fleet average NMHC and NO_x emissions were found to be statistically significant over the US06 cycle, although the interaction between vehicle and fuel effects was statistically significant for NMHC. A pair-wise comparison showed that fuels with 5, 30 and 150 ppm sulfur were all different from one another at a statistically significant level for both NO_x and NMHC emissions over the US06 cycle. The magnitude of the fuel sulfur effects over the US06 for NMHC and NO_x was also found to be relatively larger than that found for the FTP cycle. For fleet average CO emissions over the US06 cycle, only the differences between the 5 and 150 ppm fuels were found to be statistically significant at the 90% confidence level.

Catalyst effects over the US06 were found to be statistically significant for fleet average NMHC, CO, and NO_x emissions, with higher emissions for the aged catalyst. The vehicle by catalyst interaction was statistically significant, however, for both NMHC and CO emissions.

Fleet average N_2O emissions over the US06 were lower than those obtained over the FTP. N_2O emissions showed trends of higher emissions with increasing fuel sulfur level. Pair-wise comparisons showed that the 5, 30 and 150 ppm fuels were all different from each other for N_2O emissions over the US06 cycle at a statistically significant level.

European Vehicle Results

Overall, the fleet average FTP and US06 results with the inclusion of the European vehicles were very similar to those obtained with just the California-certified vehicles. Over the NEDC cycle, CO, NO_x and NH_3 for the Renault Megane were all found to be higher for the tests conducted on the aged catalyst in comparison with the as-received catalyst. For the VW Bora, fuel sulfur and catalyst effects generally did not have a significant impact on emissions over the NEDC cycle.

1. Introduction

The reduction of fuel sulfur levels in gasoline is considered to be an important factor in attaining future emissions standards and air quality goals. The impact of gasoline sulfur levels has been the subject of numerous studies over the years, and it is well documented that higher sulfur reduces the efficiency of the catalytic converter, resulting in increases in regulated emissions [1-14]. Some of these studies show the effects to be more pronounced, on a percentage basis, for the more advanced ULEV and LEV vehicles [6].

Although catalysts provide reductions for most emissions, from studies as early as the 1970s it was known that other emissions, such as ammonia (NH_3), can be formed over the catalyst surface [15,16]. Recently, there has been increased interest in NH_3 emissions since NH_3 is known to be an important precursor to the formation of secondary particulate matter (PM) and since studies have indicated that NH_3 emission levels may be greater than originally thought [17-19]. One of the important issues regarding NH_3 emissions is the potential effect of changing fuel sulfur levels on the NH_3 emissions found in the tailpipe exhaust. In some early studies, it was suggested that sulfur could inhibit NH_3 formation on the catalyst by deactivating reaction sites for NH_3 formation [20-22]. Some initial chassis dynamometer emissions results were also consistent with these conclusions, showing higher NH_3 emissions for fuels with lower fuel sulfur levels, but for a limited number of tests and only one vehicle [23]. In a more recent study of 10 late model vehicles, NH_3 emissions did not show any consistent trends as a function of fuel sulfur level over the Federal Test Procedure (FTP), but showed lower emissions for higher sulfur levels over the US06 [24]. Other chassis dynamometer measurements on two vehicles, however, showed that decreasing fuel sulfur content resulted in lower NH_3 emissions for one vehicle and had little effect on NH_3 emissions for the second vehicle [25]. To better understand how reduced fuel sulfur levels will affect future NH_3 emissions inventories, it was important to conduct a more comprehensive study and utilize more advanced experimental techniques capable of measuring the low NH_3 emission levels found in late model vehicles.

The objective of this project was to evaluate the impact of different fuel sulfur levels on NH_3 emissions, as well as regulated and N_2O emissions for a fleet of present and future technology gasoline vehicles. For this project, 12 vehicles certified to California's Low Emission Vehicle (LEV) requirements and 2 European vehicles certified to Euro 3 standards were tested on fuels with nominal sulfur levels of 5, 30, and 150 ppmw. The fleet was designed to represent some of the latest technology vehicles currently available in the market. Each vehicle was tested with the as-received catalyst and an aged catalyst. The vehicles were tested using the FTP and US06 cycles. The European vehicles were also tested over the New European Driving Cycle (NEDC). NH_3 emissions were measured using a novel approach, tunable diode laser (TDL) spectroscopy. The TDL offers the detection limits and the response time necessary to investigate low-level concentrations of exhaust gases as well as the ability to make *in-situ* measurements of raw exhaust gases. The results of this study are discussed in the following report.

2. Experimental Procedures

2.1 Test Vehicles

A total of 14 vehicles were recruited and tested for this study. This included 4 low-emission vehicle (LEV), 6 ultra-low-emission vehicle (ULEV) and 2 super-ultra-low-emission vehicle (SULEV) California-certified vehicles and 2 European vehicles certified to Euro 3 standards [26]. The LEV and ULEV vehicles were recruited from a combination of different rental car agencies and private parties. The 2 SULEV vehicles were obtained on loan from a major automobile manufacturer. The European vehicles were obtained on loan from CONCAWE. Table 1 describes the vehicles and shows whether each is certified over the US06. It should be noted that vehicles 5-7 and 10-12 in Table 1 were also used in a separate program to investigate the effects of lubricant sulfur levels and other properties on emissions [27]. Prior to entering the program, all vehicles were inspected using a standard checklist to ensure that they were in sound mechanical and operational condition.

Table 1. Description of Test Vehicles

#	MY	OEM	Model	Certification	US06 Certified	Engine Size	Mileage	Engine Family
1	2001	Ford	Taurus	LEV	No	3.0 L	23,553	1FMXV03.0VF9
2	2001	Chevrolet	Cavalier	LEV	No	2.4 L	22,482	1GMXV02.4022
3	2001	Chevrolet	Silverado	LEV	No	5.3 L	8,380	1GMXA05.3183
4	2000	Jeep	Grand Cherokee	LEV	No	4.7 L	29,571	YCRXT0287231
5	2001	Buick	LeSabre	ULEV	Yes	3.8 L	20,164	1GMXV03.8044
6	2001	Dodge	Neon	ULEV	No	2.0 L	18,634	1CRXV0122V40
7	2001	Toyota	Camry	ULEV	Yes	2.2 L	22,055	1TYXV02.2JJA
8	2001	Chrysler	Sebring	ULEV	No	2.4 L	19,677	1CRXV0148V40
9	2001	Acura	CL	ULEV	No	3.2 L	20,523	1HNXV03.2K88
10	2001	Ford	Windstar	ULEV	No	3.8 L	21,261	1FMXT03.82J*
11	2000	Honda	Accord	SULEV	No	2.3 L	11,958	YHNXV02.3NL5
12	2001	Nissan	Sentra CA	SULEV	Yes	1.8 L	6,592	1NSXV01.852A
13	2000	VW	Bora	Euro 3	No	2.0 L	6,741	APK026895
14	2001	Renault	Megane**	Euro 3	No	2.0 L	5,493	C006106F5RD740

* = 5 or 6, L = liter, ** equipped with a stoichiometric direct–injection gasoline engine

2.2 Fuels and Lubricants

The test matrix for this program involved 3 test fuels with nominal sulfur levels of 5 ppm, 30 ppm, and 150 ppm. The base fuel for these tests was an in-use California Phase 2 gasoline obtained from Chevron with a 5 ppm sulfur level. The properties of this fuel included 14.0 vol% aromatics, and Reid Vapor Pressure (RVP) of 6.7 pounds per square inch (psi), and no oxygenates. A more detailed listing of the fuel properties is provided in Appendix A. The nominal 30 ppm and 150 ppm fuels were obtained by doping the base fuel with a three-component sulfur mixture including dimethyl disulfide, thiophene, and benzothiophene. This mixture has been used in previous studies of fuel sulfur effects [28].

A specially formulated zero-sulfur lubricant was used in this test program to ensure the effects of sulfur from the lubricant would be negligible. This oil had a synthetic base containing ashless, zero-sulfur antiwear and antioxidant additives. The effect of varying oil sulfur levels on regulated emissions was investigated in a separate study using the same zero-sulfur oil as the baseline oil [27].

2.3 Catalyst and Oxygen Sensor Aging

For this program, each vehicle was tested using the original as-received catalyst and a bench aged catalyst system. All catalyst aging was conducted at the Southwest Research Institute (SwRI) in San Antonio, TX. The catalyst systems were obtained new from local dealerships for each of the California-certified vehicles, and were supplied by CONCAWE on a similar basis for the European vehicles. This included the underfloor catalyst(s), any close-coupled catalyst(s), and pre- and post-catalyst oxygen sensors. The catalyst systems were aged for 90 hours (120,000 mile equivalent) using the Rapid Aging Test-A (RAT-A) protocol [29]. Catalysts were configured for the SwRI aging cell at CE-CERT prior to shipment. All catalysts were aged in pairs using a single engine with the RAT-A temperature profile maintained for each catalyst. The aged catalysts for 6 of the test vehicles were used in a companion program to investigate oil sulfur effects [27]. All catalyst systems were aged using a specially formulated ultra-low 0.2 ppmw sulfur gasoline and a zero-sulfur oil [27]. The aging protocol is discussed in greater detail in Appendix B.

2.4 Test Sequence

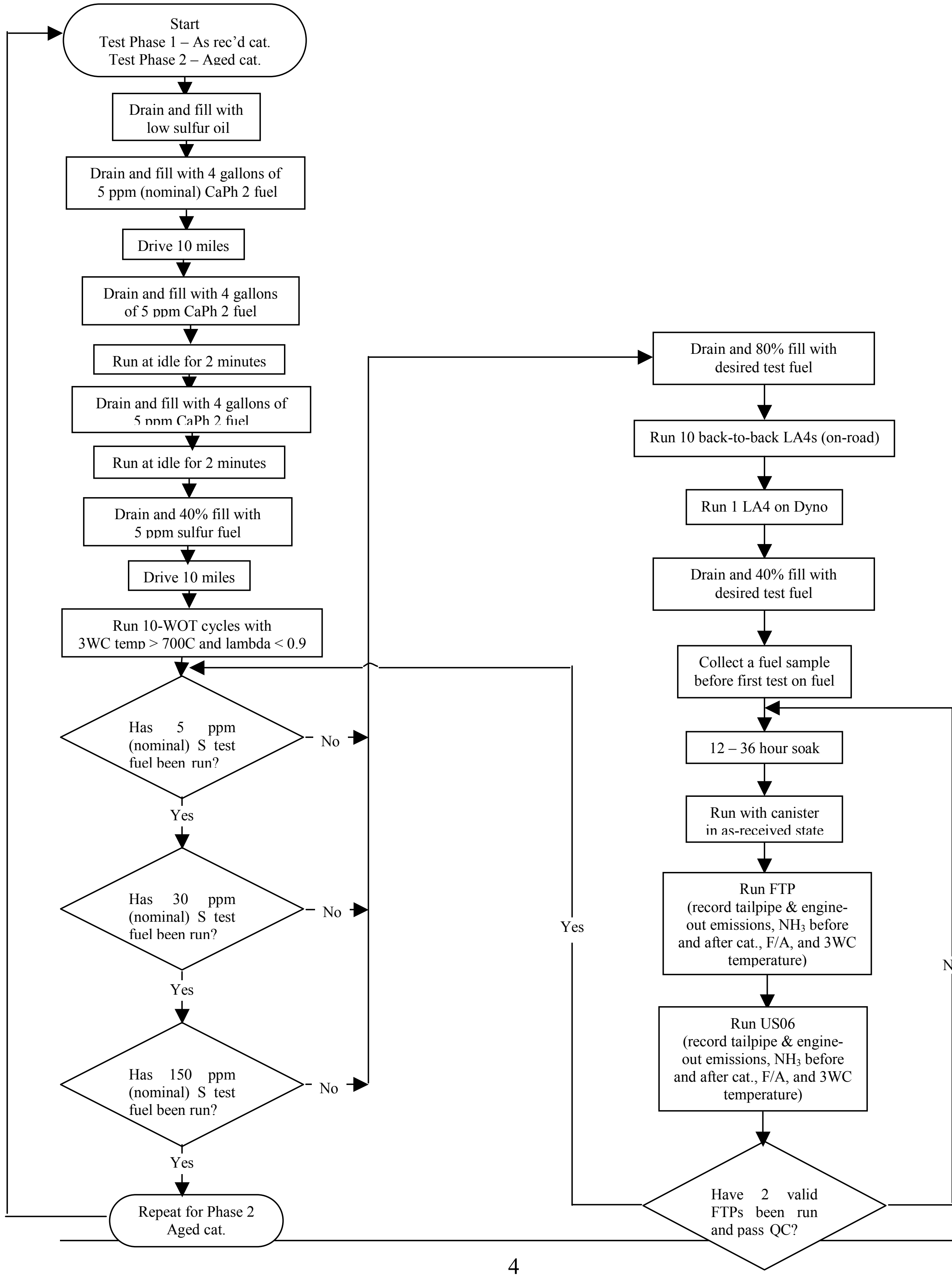
A flow chart for the E-60 project is provided in Figure 1 and is outlined briefly below.

Prior to testing on any of the fuel/catalyst combinations, a sequence including an oil change to the low-sulfur oil and a multiple drain and fill for the fuel was conducted. The multiple drain and fill procedure was used for the fuel to ensure the in-use fuel in the vehicle's tank at the time it was received was fully purged from the system [30]. After completion of the drain and fill sequence, a cycle to remove residual sulfur from the catalyst was run, consisting of 10 wide-open throttle (WOT) events. This cycle is described in greater detail in Appendix C.

The vehicles were conditioned on each test fuel over a period of approximately 10 back-to-back LA4 cycles. This driving was conducted on the surface streets near the Bourns College of Engineering Center for Environmental Research and Technology (CE-CERT) facility. The route was designed to have similar driving conditions to the LA4 including a number of stops and similar speed ranges. After completing the 10 LA4 equivalents on the road, a final LA4 was conducted on the dynamometer. The vehicle was then soaked for a period of 12-36 hours prior to running the emissions test sequence.

The test cycles for this project were the Federal Test Procedure (FTP) and US06 cycles for the California-certified vehicles. The test cycles were run in duplicate with a third test conducted if the emissions between the two FTPs differed by more than the following criteria: HC 33%, NO_x

Figure 1. Flow Chart for CRC Project No. E-60



29%, and CO 70%. The European vehicles were tested over a similar test sequence, although the NEDC cycle was run in place of the FTP cycle and was followed by the US06. Following the NEDC test sequence, duplicate FTPs were also run on the European vehicles at each test matrix point, with a third test run where the testing criteria were exceeded. For 3 of the 168 FTP test sequences and 3 of the 12 NEDC test sequences, triplicate tests were not conducted for vehicles exceeding the test criteria. This was due in part to logistical and other reasons, including the need to return vehicles to their owners. Although these specific paired sequences may have slightly more variability than other pairs, these differences did not have any significant impacts on the overall results.

For each vehicle, the fuels were tested in order of ascending fuel sulfur level, moving sequentially from the 5 ppm level to the 30 ppm level to the 150 ppm sulfur level. This test sequence minimized the possibility of sulfur carry-over from one test to the next. Keeping repeat tests to the minimum necessary to produce reliable results, allowed the maximum number of test vehicles to be evaluated. Although the procedure does not incorporate true long term repeat tests, or randomization of test fuel order, the fact that each fuel was tested on a number of vehicles allows consistent trends to be identified. The statistical analyses of the data should be evaluated bearing these factors in mind.

The vehicles were tested on both the as-received and aged catalysts. In each case, tests on all fuels were completed before changing the catalyst configuration. The order in which the catalyst configurations were tested was determined in part by the logistics of the project. The 6 vehicles tested in the E-61 program were already configured with the aged catalyst and hence were tested on the aged catalysts first [27]. The two European vehicles were also tested on the aged catalyst first so they were configured for return shipment following testing. The remaining vehicles were tested with the as-received catalyst first followed by the aged catalyst.

2.5 Vehicle Emissions Measurements

2.5.1 Regulated Pollutants

All tests were conducted in CE-CERT's Vehicle Emissions Research Laboratory (VERL) equipped with a Burke E. Porter 48-inch single-roll electric dynamometer. For these tests, standard bag measurements were obtained for total hydrocarbons (THC), non-methane hydrocarbons (NMHC), carbon monoxide (CO), nitrogen oxides (NO_x) and carbon dioxide (CO_2). Modal tailpipe and engine-out measurements were also taken for THC, NMHC, NO_x, CO, and CO_2. Bag measurements were conducted with a Pierburg AMA-4000 bench while the pre- and post-catalyst emissions were made with a Pierburg AMA-2000 emissions bench. Both the AMA-4000 and the AMA-2000 emission benches incorporate a separate methane (CH_4) analyzer for the determination of the NMHC.

2.5.2 NH_3 Tunable Diode Laser Measurements

The primary NH_3 measurements were made for both engine-out and tailpipe emissions on a real-time basis using a tunable diode laser infrared absorption spectrometer (TDL). The TDL provides significant advantages over other methodologies in quantifying low levels of NH_3 from vehicle exhaust. Previous studies have used techniques such as citric acid coated filters [31] or Fourier Transform Infrared (FTIR) spectroscopy [23] typically through a dilution tunnel. While these techniques provide some information about the integrated NH_3 emissions from vehicles, the adsorption/desorption of NH_3 to and from surfaces in the lines transferring to the tunnel and the dilution tunnel itself complicate these measurements. The dilution process itself also reduces the NH_3 concentration levels in the tunnel, making it difficult to measure NH_3 from vehicles with low emission rates.

An important step in reducing the adsorption/desorption effects for NH_3 is measurement in the raw exhaust. Both citric acid coated filters and FTIR have disadvantages in this regard. Citric acid coated filters can be used to determine integrated concentrations from the raw exhaust, but over transient cycles, these concentration levels can not be correlated with the exhaust flow rate to enable determination of the mass emission rate. FTIR can be used for raw exhaust measurements, but to obtain comparable detection limits, the FTIR requires a considerably larger sample cell. With the large sample cell and corresponding longer sample residence time, it again becomes more difficult to obtain an accurate concentration vs. time profile that can be correlated with the exhaust flow. This is further illustrated in Section 2.5.3.

TDL has already been applied to measurements of vehicle exhaust for the measurement of other infrared absorbing gases such as CO, CO_2, and formaldehyde (HCHO) [32-33]. The distinction here is that the other measurements were done via extraction and dilution into a multi-path reflective cell at mid-infrared wavelengths, whereas the system constructed and developed for this project employed measurements of the raw exhaust, without modification, in the near infrared wavelength region. TDL spectroscopy offers the specificity, sensitivity and response time necessary to investigate low-level concentrations of exhaust gases. Additionally, the TDL has the important advantage that it can make measurements *in-situ* using raw exhaust gases [34]. The combination of these advantages in the configuration described below allowed the measurement of highly time-resolved engine-out and tailpipe NH_3 emissions with sensitivity levels at two standard deviations of better than 0.5 ppmv, or minimum detection limits of roughly 0.5 mg/mi.

The TDL optics were installed in conjunction with the existing exhaust sampling lines for measuring raw pre- and post-catalyst emissions. This was done by installing a short 2-meter section into the sample line, basically making the TDL sampling system a part of the line. Figure 2 is a picture of the installation. The 2-meter sections were fabricated using 1-inch inner diameter stainless steel tubes that were electroplated with a Ni alloy to passivate the surface. The corresponding sampling cell volume is approximately 1 liter. The sampling system was heated at temperatures between 120 and 130°C to prevent condensation or adsorption in the sampling lines. With a constant sampling rate of 20 liters per minute (lpm), this sampling configuration has a residence time for the sample gas in the cell of just over 2 seconds. Sealed quartz windows were placed at diametrically opposed ends of the section.

The optical system was configured in a monostatic mode with a transmitting/receiving assembly on one side and a retroreflector on the other side. This was done to enhance sensitivity by doubling the effective optical pathlength of the 2-meter section to 4-meters. With the 4-meter pathlength, the signal noise at two times the standard deviation was found to be better than 0.5

ppmv for a 2-second averaging time. The transmitter/receiver assembly contained a variable focal length grin lens with a perforated, off-axis parabolic mirror (OAP) as the collector. The laser beam was sent via fiber optic cable (FC-APC 9 micrometer) that connected to the lens assembly. The divergent beam was then slightly focused so that it was 0.5-inch in diameter when hitting the surface of the retroreflector and continued to expand to 1-inch when returning to the collecting OAP. The beam traveled through the optical center of the OAP where there was a small 1/8-inch diameter perforation. The GaAS detector was placed at the focal point of the OAP and received the raw modulated signal. The subsequent output was returned to the controller via coaxial cable and analyzed employing signal processing techniques.

Figure 2. Configuration of the TDL Sampling System

The single mode laser light for the TDL was created by running an electrical current through a diode crystal to create light with a specific wavelength in the near infrared spectral region. For NH_3, a GaAs diode laser was used to optimize the radiation to a wavelength near 1.512 µm. The GaAs laser can be operated at room temperature. The TDL system employed for the study was a UNISEARCH Associates LasIR. The instrument was configured with a three-way optical beam splitter that sent 45% of the total laser energy to each of the two channels, allowing for the measurement of both engine-out and tailpipe emissions at these levels. The 10% third channel was used to locate and lock the emission wavelength of the laser by passing it through a small cell that contains a high concentration of the target gas (NH_3).

An important characteristic of the tunable diode laser is that the wavelength at which it emits changes very slightly over a small spectral range (1 nm) with the electric current passing through it. This makes it possible to scan across the entire selected absorption line of the target gas as well as the region where the target gas does not absorb. By scanning the absorption feature prior to the target gas absorption, deviations in overall laser intensity can be measured, providing enhanced sensitivity. The TDL performs each such scan in a period of 1/60th of a second. Twotone FM modulation techniques were used to filter out any stray signals and to improve the signal-to-noise resolution. More details on the signal processing for the TDL can be found in Appendix D.

Verification of the TDL accuracy was done using calibration gas levels between 10 and 150 ppmv. A calibration curve is provided in Appendix D. Although some calibration gases are certified from the producer with accuracies of better than ±5%, it has been suggested that accuracies of <10% are difficult to achieve with NH_3 [35]. The calibration gas used for most of the verification tests and daily testing calibrations was certified with an accuracy of ±10%. The TDL readings were compared with measurements obtained from citric acid-coated filters at various positions in the sampling train. The results showed agreement within 10% for an NH_3 calibration gas level of 150 ppm, as shown in Appendix D. Daily test calibrations were conducted *in-situ* by injecting the calibration gas into the raw exhaust stream under idle conditions.

In calibrating the TDL measurements, it was also important to evaluate temperature and pressure effects. This is primarily important for the more aggressive portions of driving cycles such as the US06 where pressures and temperatures can increase in the sampling lines. At higher pressures and temperatures, the TDL lineshape can broaden, affecting the measured intensity. Since the sample cell is of a fixed volume, pressure and temperature also can affect the number of molecules in the sampling cell, which in turn can affect the measured intensity. Plots of the pressure and temperature dependence of the TDL signal over a full range of conditions are provided in Appendix D.

The dual channel capability of the TDL allowed the measurement of engine-out and tailpipe emissions simultaneously. The TDL was configured to provide data once every 2 seconds for both the engine-out and tailpipe emissions. For each channel, data were integrated over a 2-second dwell time, with sampling alternating between engine-out and tailpipe measurements each second. Second-by-second NH_3 concentrations were obtained from the 2-second TDL readings using a linear extrapolation. The concentrations were then converted into mass emissions rates by multiplying by the density of NH_3 and the time-aligned exhaust flow rate. Similar procedures have been used previously in analysis of second-by-second data for regulated pollutants for the development of CE-CERT's Comprehensive Modal Emissions Model (CMEM) [36]. The exhaust flow rate was determined on a second-by-second basis using the CO_2 tracer method. Temperature and pressure corrections were applied to the TDL data based on second-by-second measurements made in the sampling cell.

2.5.3 Fourier Transform Infrared Spectroscopy Measurements

A Fourier Transform Infrared (FTIR) system was also used to measure NH_3 and N_2O emissions. This instrument samples through the dilution tunnel. The instrument collects one set of values every 3 seconds. The absorption cell for the FTIR has a volume of approximately 5 liters and a residence time of approximately 10 seconds. Other pollutants such as formaldehyde, acetaldehyde, benzene, and 1,3-butadiene are also available with the FTIR, but the detection limits for these compounds exceed the diluted concentration levels for the vehicles tested in this program.

A comparison of real-time measurements made using the FTIR and TDL instruments is presented in Figure 3 for bag 1 of an FTP. To compensate for the 3-second sampling time for the FTIR, a 3-second average was applied to the data. The results show that the FTIR measurements are considerably broader than the TDL measurements. Typically, the FTIR measurements underestimate the maximum NH_3 emission rates but have an extended tail after the peak in NH_3 emissions. It should be noted the NH_3 mass emission rates for these two measurements were very similar at 88 mg/mi for the TDL and 84 mg/mi for the FTIR.

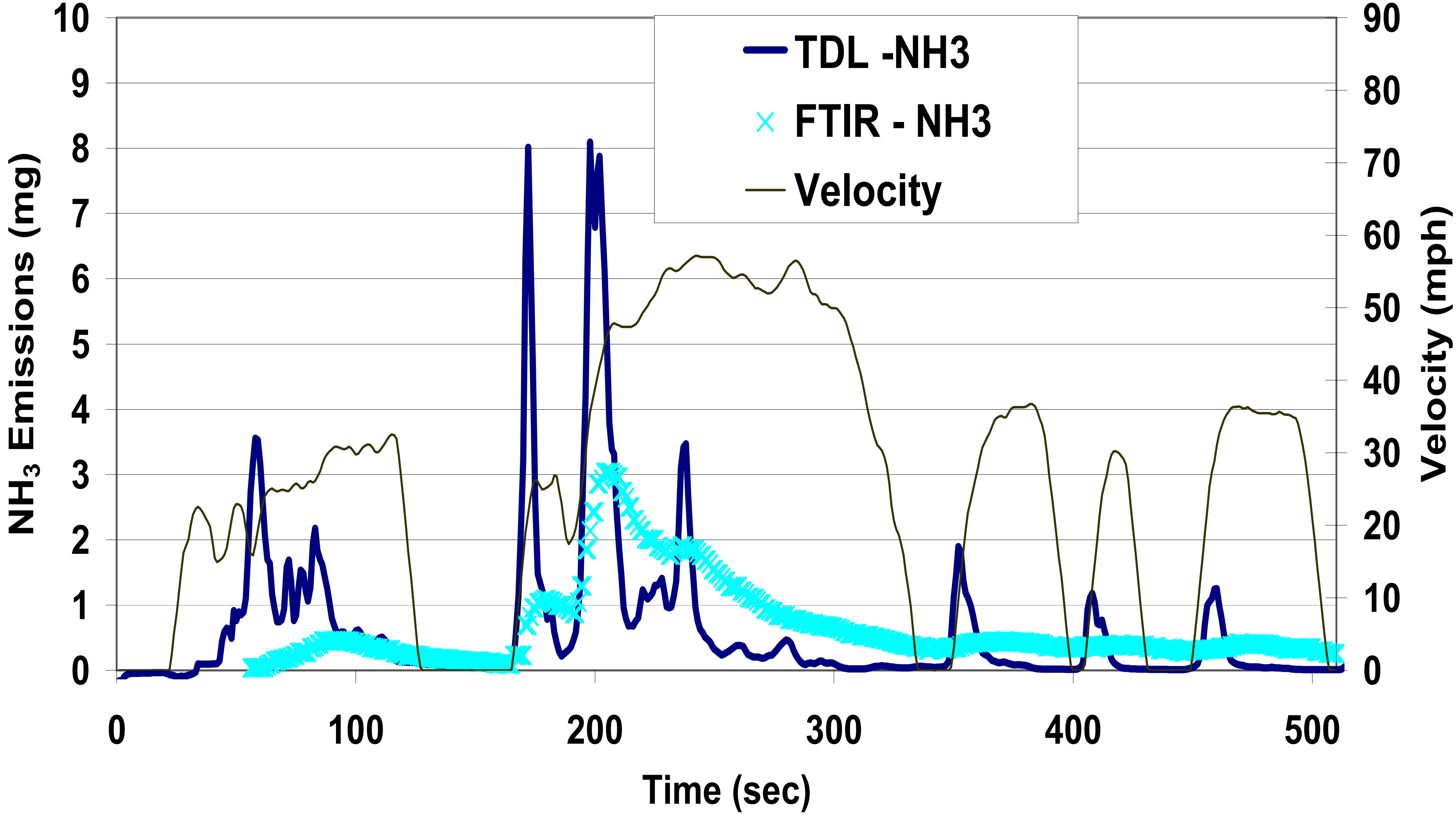
The observed differences in Figure 3 can be attributed to the longer residence time in the FTIR sampling cell as well as adsorption/desorption effects that occur as the sample travels through the dilution tunnel. A well-mixed cell model can be used to mathematically adjust for the differences in the residence times for the two instruments [37]. The FTIR measurements become sharper when the well-mixed cell model is used, but they are still more diffuse than those of the TDL signal and exhibit a tail. Overall, the comparisons between the TDL and FTIR are reasonably good. Some differences can be attributed to differences in the sampling methodologies. For lower-emitting vehicles (i.e., below 10 mg/mi), the FTIR was typically found to underestimate the NH_3 concentration since the peak NH_3 emissions could not be measured as accurately and the emission levels in the tail region fell below the detection limits. For cycles with aggressive driving segments near the end of the test, such as the US06, an additional problem occurs in that the tail cannot be fully quantified prior to the conclusion of the test cycle. It should be noted that since the FTIR is designed to make measurements from the dilution tunnel, the transfer tube was wrapped with a heating pad that was maintained at a temperature of 120ºC. This helps to minimize the loss of ammonia in the transfer tube between the exhaust pipe and the dilution tunnel.

2.6 Statistical Analysis

Analysis of variance (ANOVA) tests were performed for each pollutant to determine the statistical significance of fuel sulfur and catalyst age effects and any corresponding interactions between the design test variables (vehicle, fuel, and catalyst age). The data were analyzed using the average data values for repeat tests on each vehicle/fuel/catalyst combination. The analysis approach used was a 3-way ANOVA using fuel sulfur level and catalyst age as fixed effects and vehicles as a random effect. The ANOVA analyses were conducted using a PC/SAS system from SAS Institute, Inc.

The ANOVA analyses were run using up to four different data set versions. The primary conclusions from the statistical analyses were based on a data set using the natural logarithm of the arithmetic averages for each vehicle/fuel/catalyst combination. For this data set only the California-certified vehicles were used since the European vehicles are certified over the NEDC, as opposed to the FTP. Separate analyses were also conducted using the entire fleet including the European vehicles. From a statistical point of view, analyses using the logarithmic transform of the data were used since previous studies have shown that emissions variance is relatively constant as a percentage of the emission level. In other words, vehicles with higher emission levels will tend to have a higher variability on an absolute basis than those with lower emissions

Figure 3. Comparison of FTIR and TDL NH_3 Measurements



levels. Taking the logarithm of the data helps to provide a more constant variability across the range of the data set. For this data set, outlier tests were also removed based on the Hawkins-Perold test. A similar technique was used in previous Auto/Oil Air Quality Research Programs where similar data sets were investigated [38]. The Hawkins-Perold test was applied to run sets where triplet or quadruplet data were obtained. Using the Hawkins-Perold test, an entire FTP test was rejected as an outlier if at least two of the three composite emissions, i.e., NMHC, CO, and NO_x, for that test fell outside the limits specified by the Hawkins-Perold two-sided test at the probability of p=0.10. This methodology is described in greater detail in ref. 38. On the basis of the Hawkins-Perold test, only 2 FTP and 2 US06 tests were found to be outliers for 2 or more regulated emissions.

The ANOVA analyses were also run using different data sets to ensure the conclusions were consistent. Other data sets examined included a data set using the arithmetic averages for each vehicle/fuel/catalyst combination with the outliers removed, a data set using the arithmetic averages with outliers not removed, and a data set using the natural logarithm of the arithmetic averages with outliers not removed. In most cases, statistically significant effects observed for the base analysis case were also found for the other analysis cases.

The statistical significance of the fuel effects between the 5, 30, and 150 ppm fuel sulfur levels was also examined using pair-wise difference comparisons. The pair-wise comparisons were conducted using a least squares means test with a Tukey adjustment. Pair-wise comparisons that were statistically significant at the 90% confidence level (p=0.10) are included as well as those that were statistically significant at the 95% confidence level (p=0.05). Instances where comparisons are only statistically significant at the 90% confidence level are noted in the text.

In cases where statistically significant interactions were found between different factors, such as vehicle and catalyst, some additional analyses were conducted. In particular, statistically significant interactions between factors such as vehicle and catalyst indicate that the catalyst effects can differ for different vehicles. In such cases, interaction plots were developed showing the catalyst/fuel effects for each of the individual vehicles, as discussed further below. For cases where specific vehicles showed different trends than those of other vehicles, additional ANOVA analyses were sometimes conducted with those vehicles eliminated to determine the sensitivity of the analysis to that particular vehicle.

3. Results

3.1 FTP Emissions Results

The fleet average FTP results for NH_3, NMHC, CO, NO_x and N_2O are presented in Figure 4. This Figure shows the average emission results on each fuel/catalyst combination for each of the 12 California-certified test vehicles. As discussed in section 2.6, the main results and analyses are presented using only the California-certified fleet, since the California-certified and European vehicles are not certified to the same standard. Some additional analyses with the European vehicles included are also provided in Section 3.3.2. The averages in Figure 4 and throughout the results section also exclude tests determined to be outliers by the Hawkins-Perold test. In Figure 4, the CO emissions are divided by 10 to allow the changes for all emissions to be more clearly presented. The TDL NH_3 measurements were used for all analysis of NH_3 emissions since these measurements are more representative of the actual tailpipe NH_3 emissions, as discussed in Section 2.5. The error bars in Figure 4 and other figures presenting fleet average results represent half of the least significant difference, as determined from the statistical analysis. More complete test results are provided in Appendix E. Complete ANOVA analysis results are provided in Appendix F for the FTP.

3.1.1 FTP NH_3 Emissions

The FTP NH_3 emissions results are presented in Table 2 for each of the test fuels and the two catalyst configurations. The individual vehicle results for NH_3 emissions are presented in Figure 5. NH_3 emissions over the FTP were generally lower than those of the regulated pollutants. Fleet average FTP NH_3 emissions averaged between 14 and 21 mg/mi depending on the fuel/catalyst combination. Five of the test vehicles had NH_3 emissions below 5 mg/mi for most of the test configurations, although NH_3 emissions for some of these vehicles were slightly higher for the 150 ppm fuel sulfur with aged catalyst configuration. Only 4 vehicles had NH_3 emissions over 20 mg/mi when averaged over all test configurations.

Table 2. FTP NH_3 Emissions Results (mg/mi)

	Fuel Averages		Catalyst Averages
5	16	**OE**	14*
30	16	**Aged**	21*
150	19		

*: Statistically significant catalyst differences.

The NH_3 emissions for the aged catalysts were found to be 50% higher than those for the as-received catalysts. The difference in NH_3 emissions for the different catalysts was found to be statistically significant (p=0.0212). The vehicle by catalyst interaction was also statistically significant at the 90% confidence level, indicating that there were differences in catalyst age effects for different vehicles. To examine the vehicle by catalyst interaction, an interaction plot of catalyst effects vs. vehicle was developed. The interaction plot is presented in Figure 6 and shows the paired catalyst results for each of the individual vehicles. The interaction plots show that for most vehicles the emissions on the as-received catalyst were either similar to or higher than those for the aged catalyst. For vehicles that are relatively insensitive to catalyst age, some tests and vehicles could have slightly higher emissions for the as-received catalysts due to variability between test runs. Thus, the vehicle by catalyst interaction can be attributed to a subset of vehicles in the fleet whose NH_3 emissions were relatively insensitive to catalyst age or showed a reverse effect. Of these vehicles, the Jeep showed the most significant deviation from the expected trend of higher emissions for the aged catalyst. To evaluate the sensitivity of the ANOVA analyses to the results for the Jeep, an additional ANOVA was conducted with the Jeep results excluded. Interestingly, with the removal of the Jeep, the vehicle by catalyst interaction was no longer statistically significant ($p=0.1672$), while the catalyst effect remained statistically significant ($p=0.0021$).

Fuel effects were not found to be statistically significant over the fleet for NH_3 emissions. This is in contrast with some previous studies that have shown NH_3 emissions can have a tendency to decrease with increasing fuel sulfur levels [20-23]. More recent studies have shown fuel sulfur to have mixed effects on NH_3 emissions over the FTP or other similar cycles, however [24,25].

Since the FTP is composed of individual segments of driving comprising cold start conditions (bag 1), hot stabilized driving (bag 2), and hot start driving (bag 3), separate analyses were conducted for each of the individual bags to examine the differences in driving on fuel sulfur and catalyst effects. NH_3 emissions for individual FTP bags are presented in Figure 7. Interestingly, NH_3 emissions are highest for bag 1, similar to other emissions. A plot of real-time NH_3 emissions, as shown in Figure 8, indicates that the peak in NH_3 emissions does not occur prior to catalyst light-off, but rather immediately after catalyst light-off. The real-time NH_3 emissions plot also shows that NH_3 emissions are transient in nature, with emission peaks corresponding to periods of acceleration.

In general, the data for all three bags show higher emissions for the aged catalysts, similar to the trends observed for the weighted emissions. The average NH_3 results for individual bags for the three test fuels and two catalyst configurations are presented in Table 3. Statistically significant catalyst effects were found for bags 1 and 2, but not for bag 3. The vehicle by catalyst interaction was also found to be statistically significant at the 90% confidence level for bag 1. Fuel sulfur effects were not found to be statistically significant for any of the FTP bags.

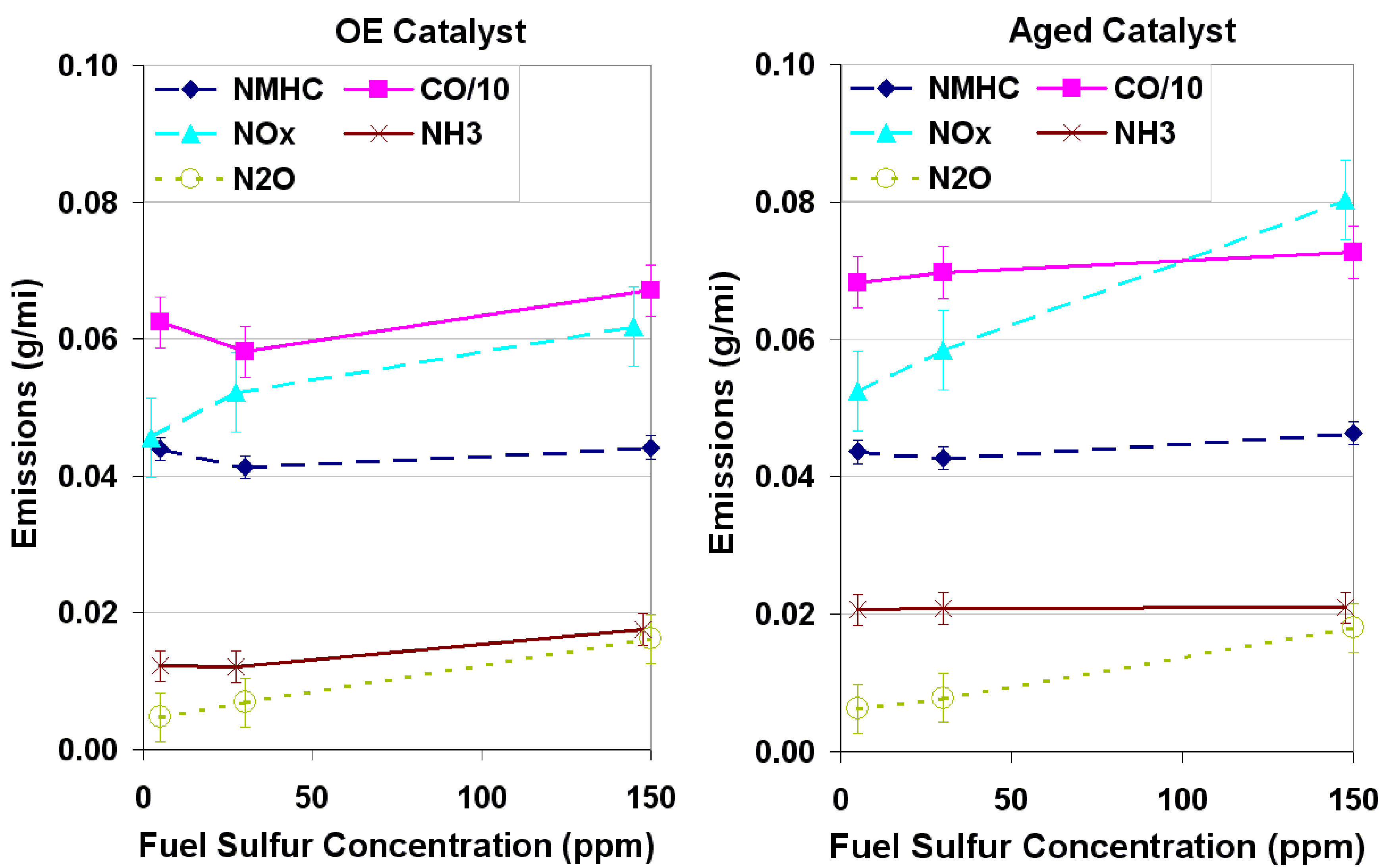
Table 3. FTP NH_3 Emissions for Individual Bags (mg/mi)

Fuel Averages				**Catalyst Averages**			
	Bag 1	Bag 2	Bag 3		Bag 1	Bag 2	Bag 3
5	37	12	9	**OE**	32*	10*	8
30	34	13	10	**Aged**	40*	17*	14
150	38	14	14				

*: Statistically significant catalyst differences.

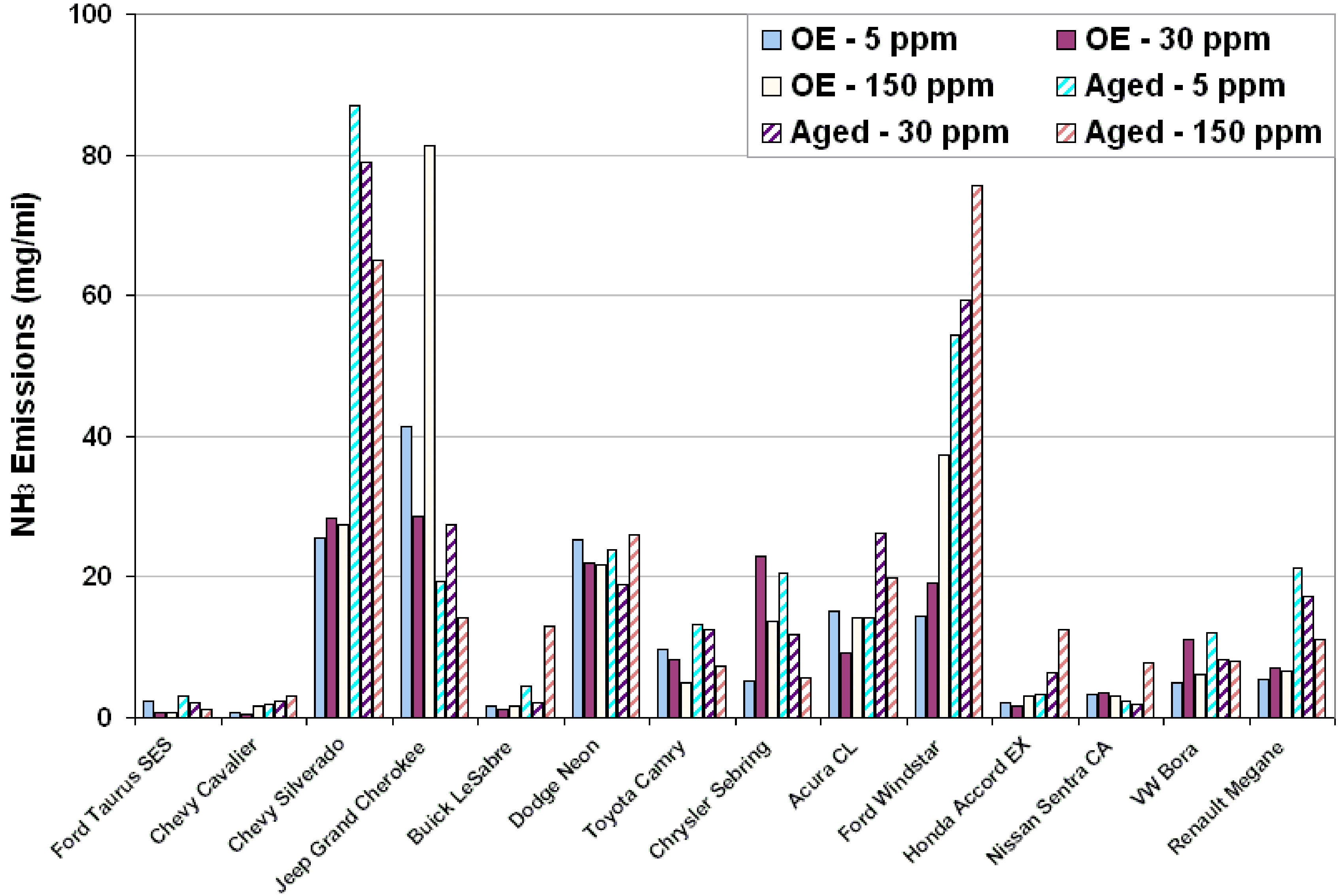
Measurements of engine-out NH_3 emissions were consistent with the idea that NH_3 emissions are formed primarily over the catalyst. Engine-out emissions profiles for a number of vehicles did show a few small peaks, on the order of 2-5 ppm, but the contribution of the peaks was typically below 1 mg/mi. The Toyota Camry did show some higher peaks in NH_3 emissions, but these generally occurred during deceleration. The engine-out mass emission rates for the Toyota were around 5 mg/mi or less. It is possible that NH_3 could build up on surfaces in and around the closed coupled catalyst during other portions of the cycle and subsequently degas during deceleration. It is also possible that some other catalytic surface may be upstream of the closed coupled catalyst. Higher NH_3 emissions were also observed for the Dodge Neon, which had engine-out emissions in the range of 3 to 14 mg/mi. In order to better understand the nature of the engine out emissions observed for the Toyota Camry or Dodge Neon further experimentation would be required. In general, it can be concluded that for most vehicles NH_3 is not formed in appreciable amounts during the combustion process.

Figure 4. Fleet Average FTP Emissions



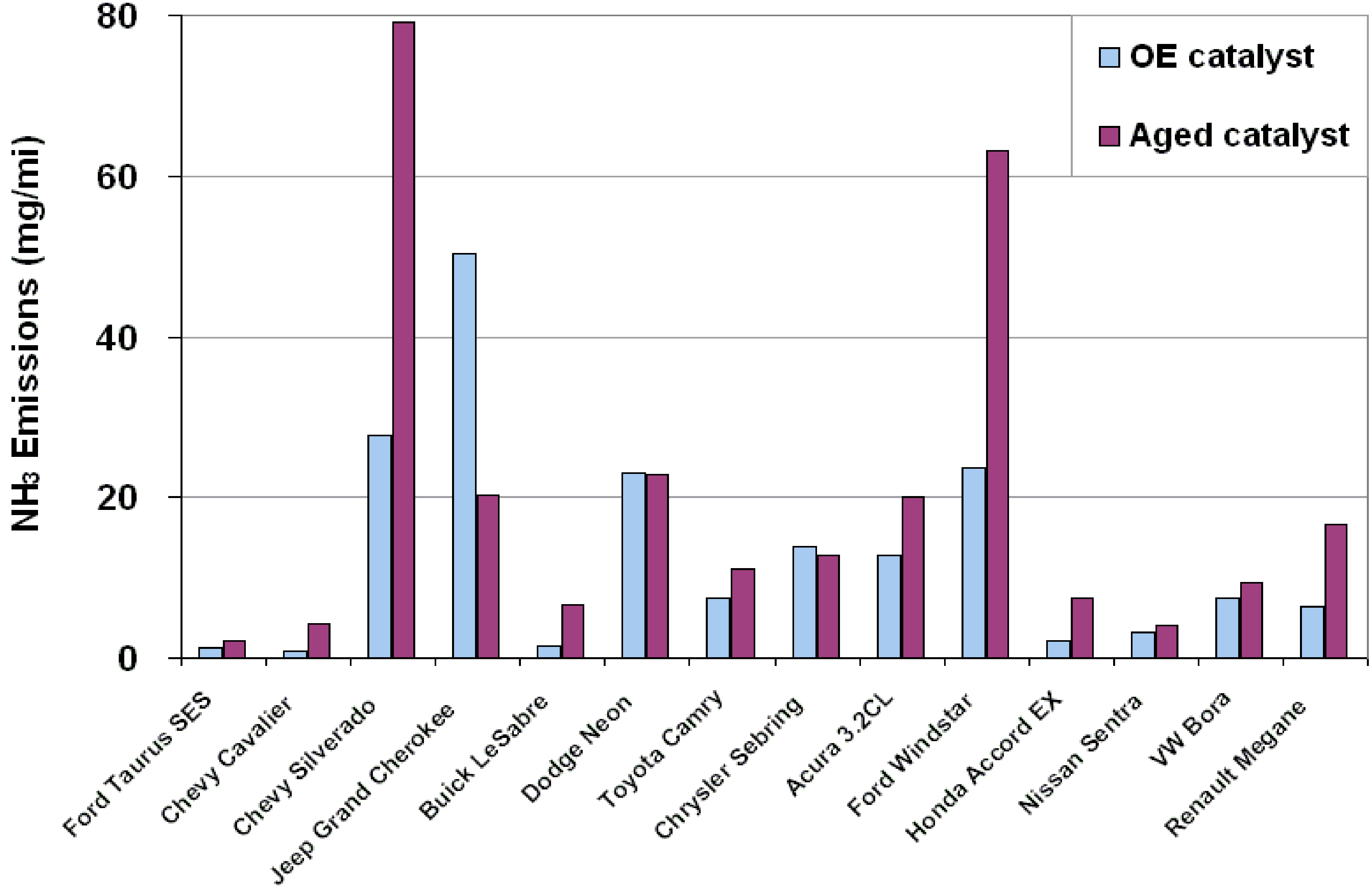
Values are the average of all vehicle/fuel combination for the 12 U.S. vehicles at condition
Error bars represent half of the least significant difference

Figure 5. FTP Individual Vehicle NH_3 Emissions



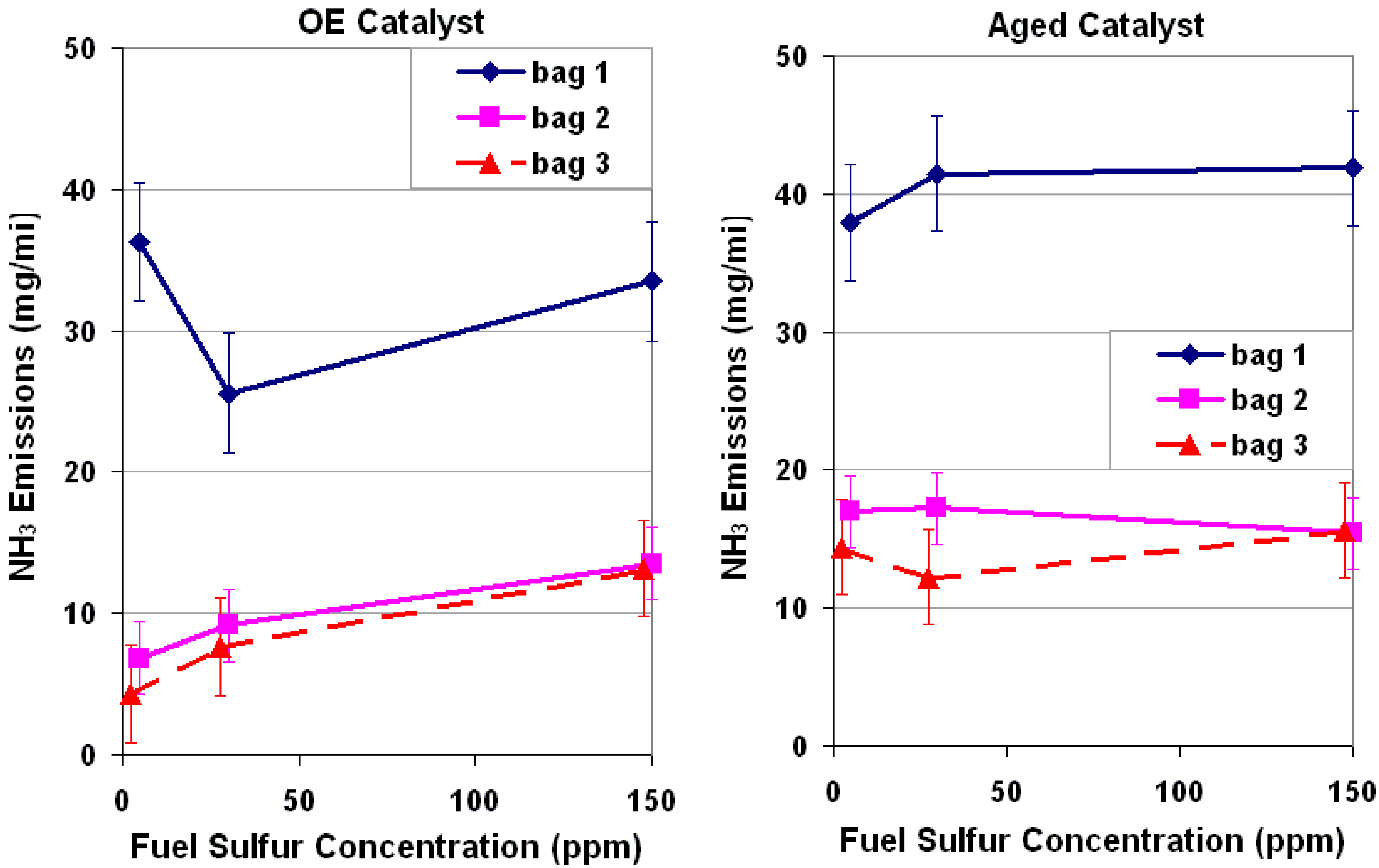
Values are the average of all tests at condition

Figure 6. NH_3 Interaction Plot for Vehicle by Catalyst Effects



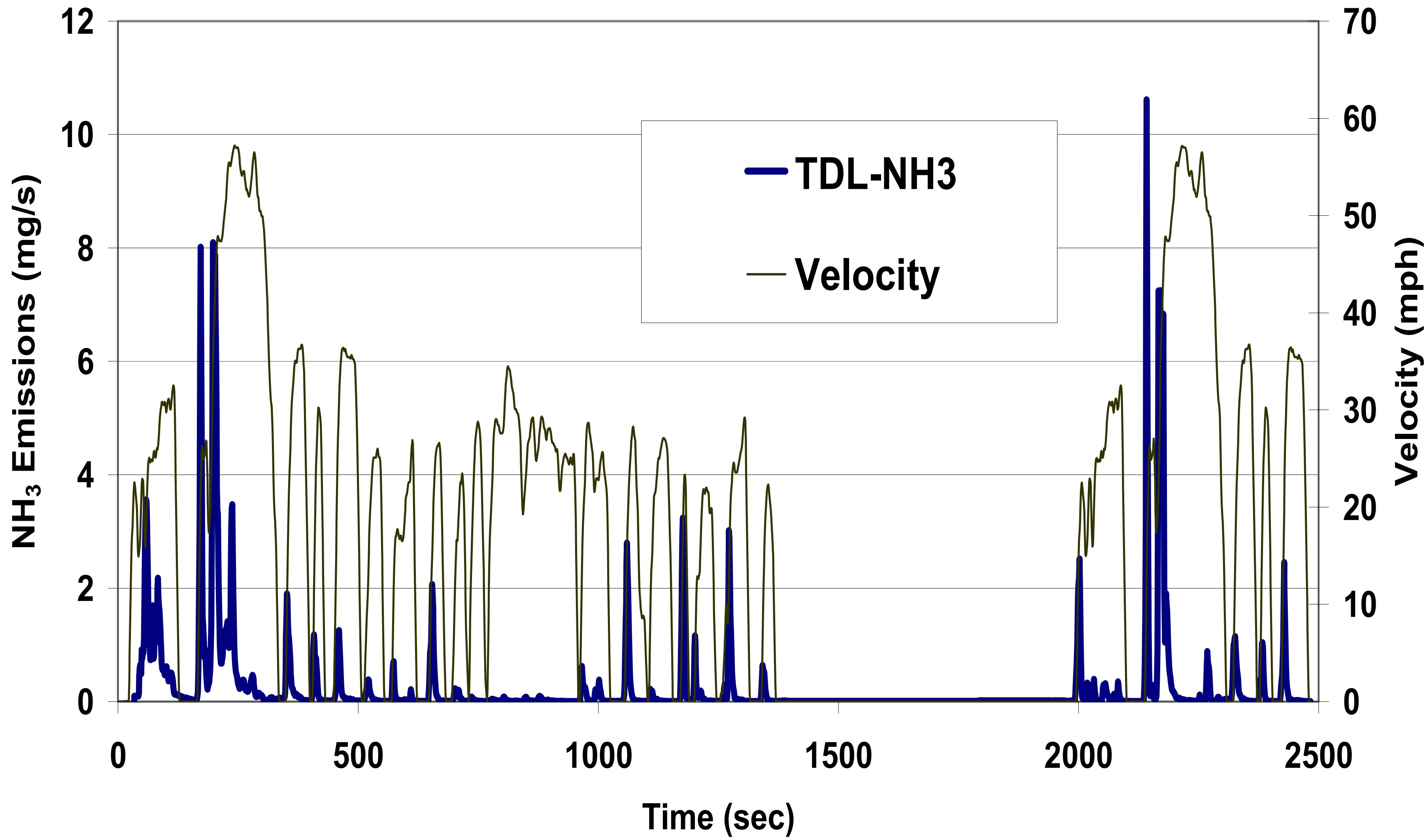
Values are the average of all fuel combinations at the condition

Figure 7. NH_3 Emissions by Bag



Values are the average of all vehicle/fuel combination for the 12 U.S. vehicles at condition
Error bars represent half of the least significant difference

Figure 8. Real-Time NH_3 Emissions over the FTP for a ULEV Light-Duty Truck



3.1.2 FTP NMHC Emissions

FTP NMHC emissions results are presented in Table 4 for each of the test fuels and the two catalyst configurations. Similar results for THC are also provided in Appendix G. Average NMHC emissions for each vehicle at each of the fuel/catalyst test matrix points are presented in Figure 9. Although a statistically significant difference was observed between the fleet average NMHC emissions for the 150 ppm sulfur fuel compared with the 30 ppm fuel, the magnitude of this difference was small. The effects of catalyst age were not statistically significant for the fleet.

Table 4. FTP NMHC Emissions Results (g/mi)

	Fuel Averages		Catalyst Averages
5	0.044	**OE**	0.043
30	0.042[c]	**Aged**	0.044
150	0.045[b]		

b: Statistically significant difference from 30 ppm;
c: Statistically significant difference from 150 ppm;

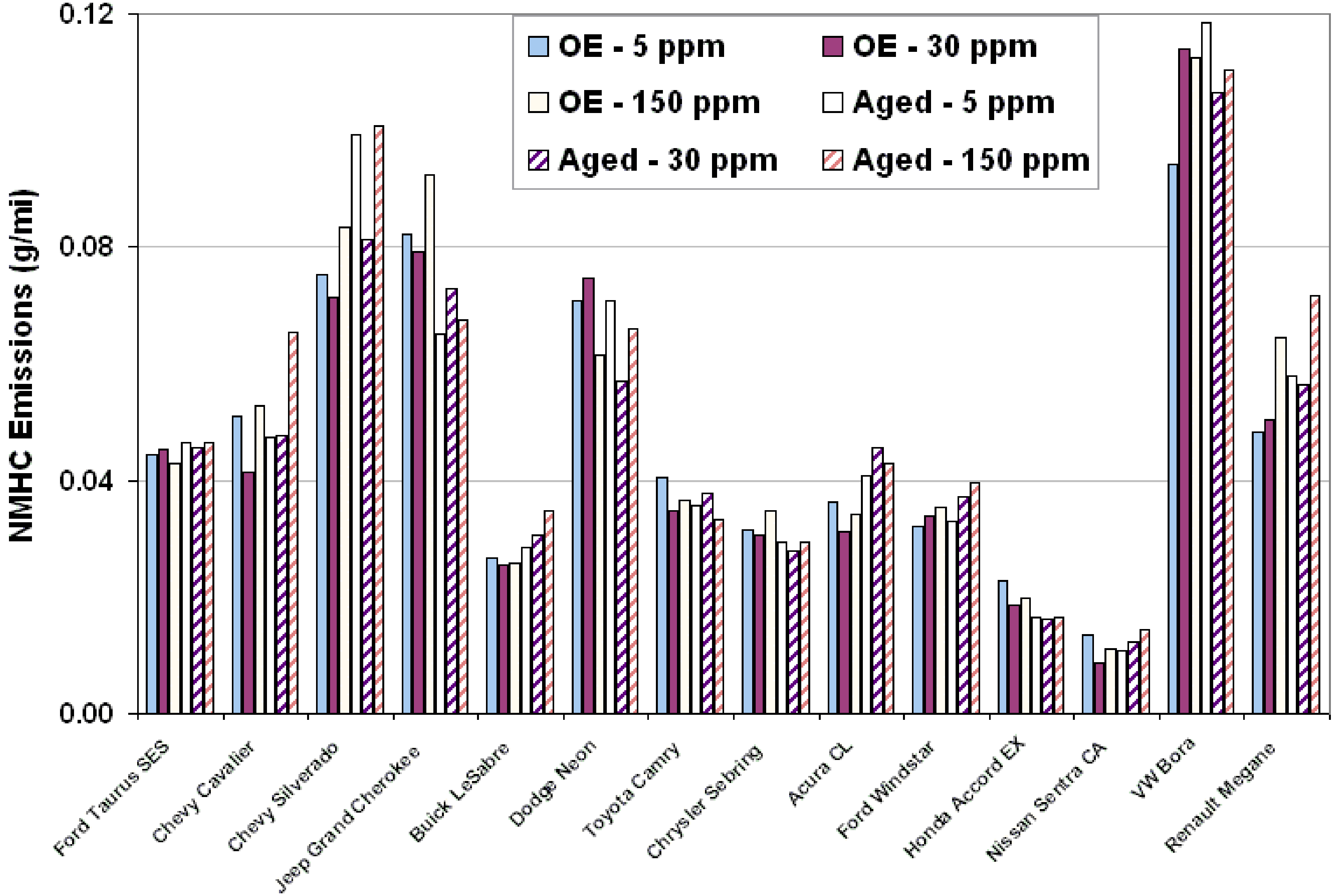
A comparison of NMHC emissions for the different bags is presented in Figure 10. The bag 1 NMHC emissions are divided by 20 to allow the results for all three bags to be presented on the same plot. Table 5 presents the average FTP NMHC emissions by bag for the three test fuels and two catalyst configurations. Some statistically significant fuel differences were found for bag 2 between the 5 and 150 ppm fuels and for bag 3 at the 90% confidence level between the 30 and 150 ppm fuels, but these differences were relatively small in magnitude. Catalyst effects were only found to be statistically significant for bag 3, although again the difference was small on an absolute basis. The vehicle by fuel and vehicle by catalyst interactions were both statistically significant for the bag 3 results.

Table 5. FTP NMHC Emissions Results for Individual Bags (g/mi)

Fuel Averages				Catalyst Averages			
	Bag 1	Bag 2	Bag 3		Bag 1	Bag 2	Bag 3
5	0.189	0.004[c]	0.009	**OE**	0.185	0.005	0.009*
30	0.180	0.004	0.009[c]	**Aged**	0.188	0.004	0.011*
150	0.190	0.005[a]	0.012[b]				

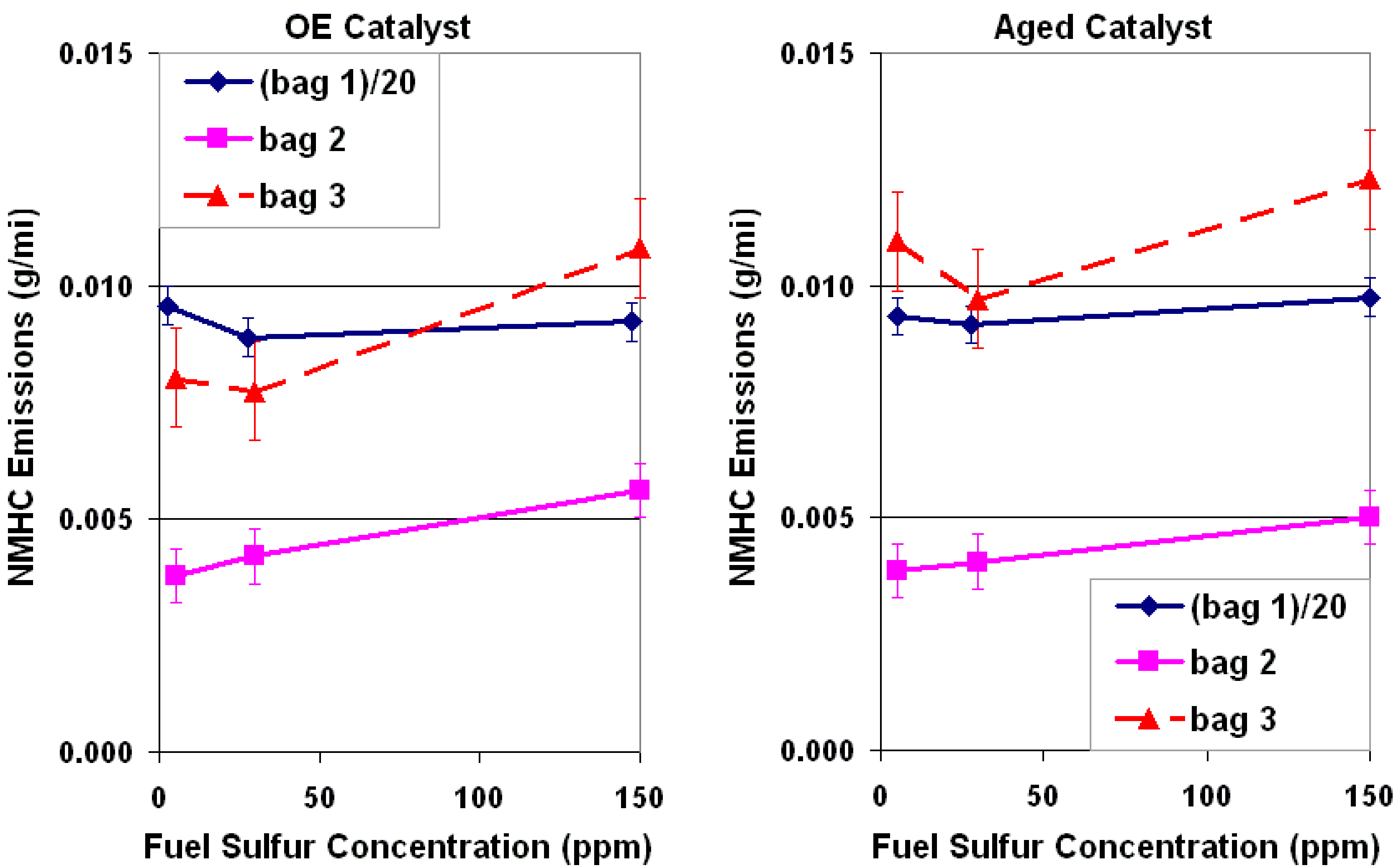
a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;
*: Statistically significant difference between catalysts.

Figure 9. FTP Individual Vehicle NMHC Emissions



Values are the average of all tests at condition

Figure 10. NMHC Emissions by Bag



Values are the average of all vehicle/fuel combination for the 12 U.S. vehicles at condition
Error bars represent half of the least significant difference

3.1.3 FTP CO Emissions

FTP CO emissions are presented in Table 6 for each of the test fuels and the two catalyst configurations. The FTP CO emissions for individual vehicles are shown in Figure 11.

Table 6. FTP CO Emissions Results (g/mi)

	Fuel Averages		Catalyst Averages
5	0.654	**OE**	0.626*
30	0.639	**Aged**	0.702*
150	0.699		

*: Statistically significant differences between catalysts.

On a fleet average basis, CO emissions were approximately 12% higher for the tests conducted on the aged catalysts than on the as-received catalysts. The ANOVA analyses showed that the effects of catalyst age on CO emissions were statistically significant. Fuel effects on CO emissions were not found to be statistically significant for the fleet average.

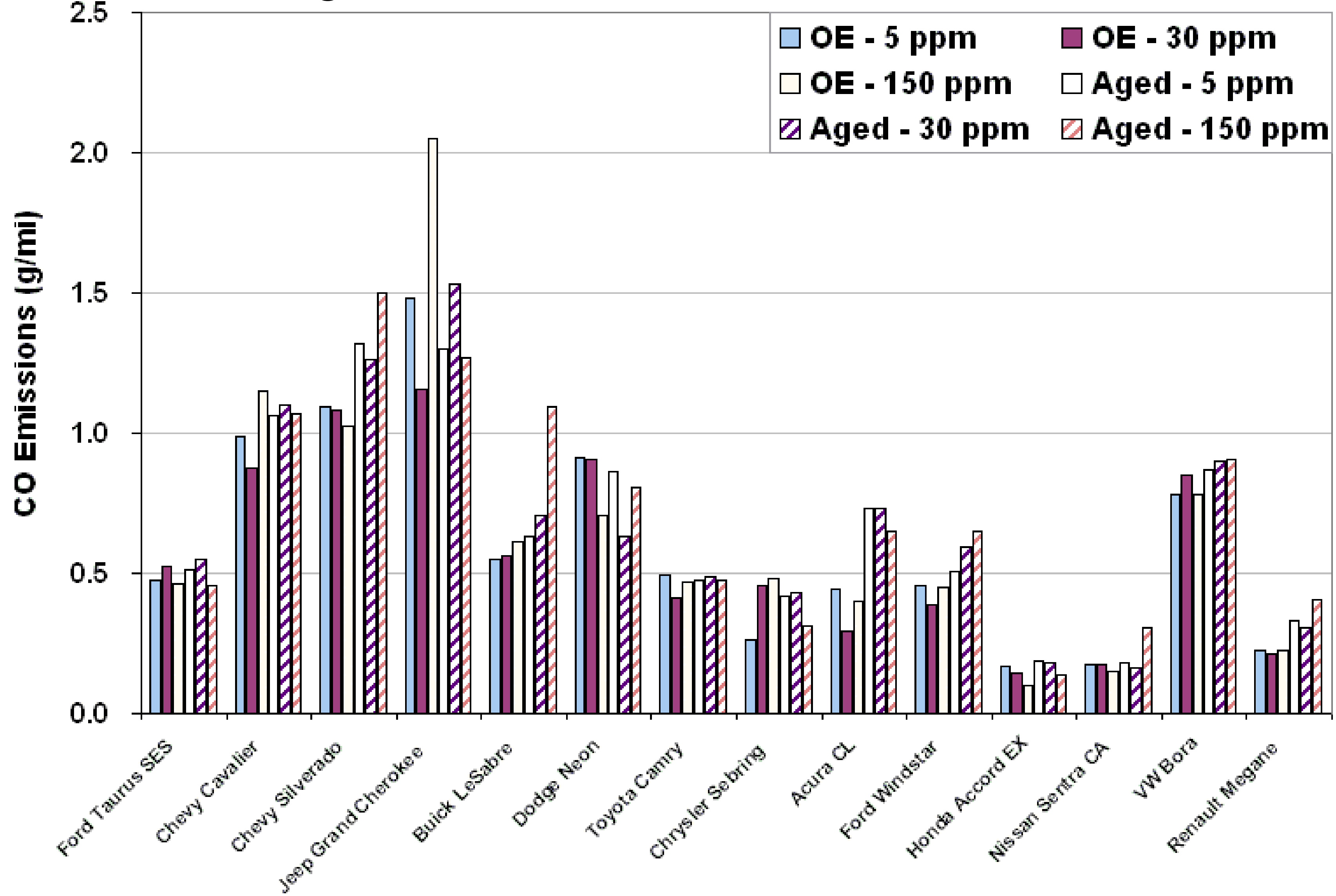
The results of FTP CO emissions for individual bags are presented in Figure 12 and in Table 7. In Figure 12, bag 1 CO emissions are divided by a factor of 20. ANOVA analyses showed that statistically significant catalyst effects were found for bags 1 and 3, although the vehicle by catalyst interaction was found to be statistically significant at the 90% confidence level for bag 1. Fuel differences were only found to be statistically significant for bag 2 between the 5 and 150 ppm fuels. It should be noted in Figure 12 that the steep increase in emissions for the 150 ppm-aged configuration for bag 3 CO emissions is due in part to high bag 3 emissions for the Buick LeSabre on this test configuration.

Table 7. FTP CO Emissions Results for Individual Bags (g/mi)

	Fuel Averages				Catalyst Averages		
	Bag 1	Bag 2	Bag 3		Bag 1	Bag 2	Bag 3
5	2.890	0.070[c]	0.065	**OE**	2.758*	0.075	0.056*
30	2.818	0.079	0.053	**Aged**	3.042*	0.085	0.100*
150	2.992	0.091[a]	0.115				

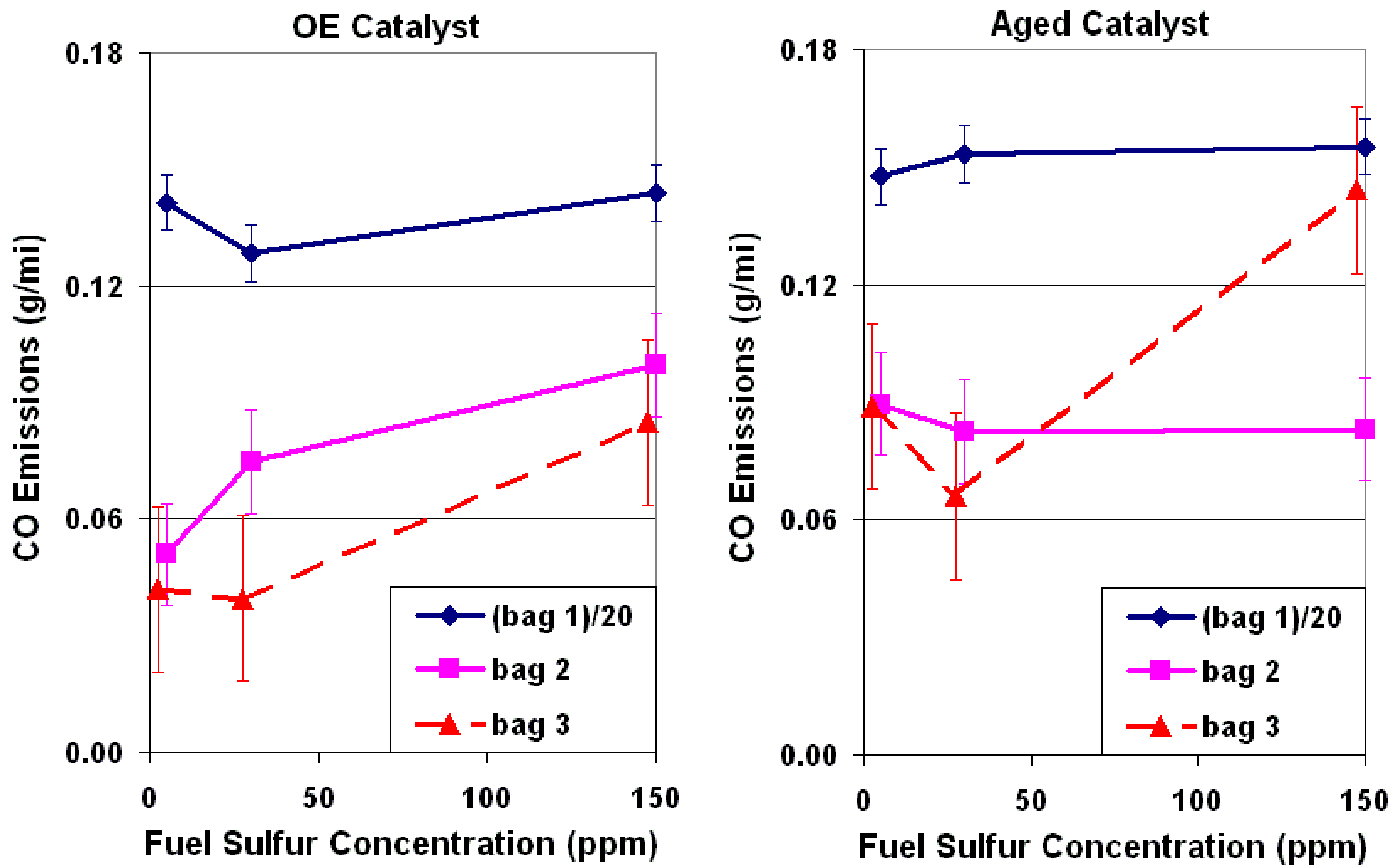
a: Statistically significant different from 5 ppm;
c: Statistically significant different from 150 ppm;
*: Statistically significant differences between catalysts.

Figure 11. FTP Individual Vehicle CO Emissions



Values are the average of all tests at condition

Figure 12. CO Emissions by Bag



Values are the average of all vehicle/fuel combination for the 12 U.S. vehicles at condition
Error bars represent half of the least significant difference

3.1.4 FTP NO_x Emissions

FTP NO_x emissions are presented in Table 8 for each of the test fuels and the two catalyst configurations. Individual vehicle results for FTP NO_x are presented in Figure 13. Fleet average NO_x emissions showed an increase in emissions with increasing fuel sulfur level, as shown in Figure 4 and Table 8. Pair-wise tests comparing the three fuel sulfur levels indicated that statistically significant differences were found between the 150 ppm fuel and the 5 ppm fuel. Statistically significant differences for NO_x emissions were also found between the 150 and 30 ppm fuels, but only at the 90% confidence level. Fleet average NO_x emissions for the 150 ppm fuel were 45% higher than those for the 5 ppm fuel and 29% higher than those for the 30 ppm fuel. A statistically significant vehicle by fuel interaction was found, however, indicating some difference in the sensitivity of individual vehicles to fuel sulfur level. The effect of catalyst age on fleet average NO_x emissions was not statistically significant.

Table 8. FTP NO_x Emissions Results (g/mi)

Fuel Averages		Catalyst Averages	
5	0.049[c]	**OE**	0.053
30	0.055[c]	**Aged**	0.064
150	0.071[a,b]		

a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;

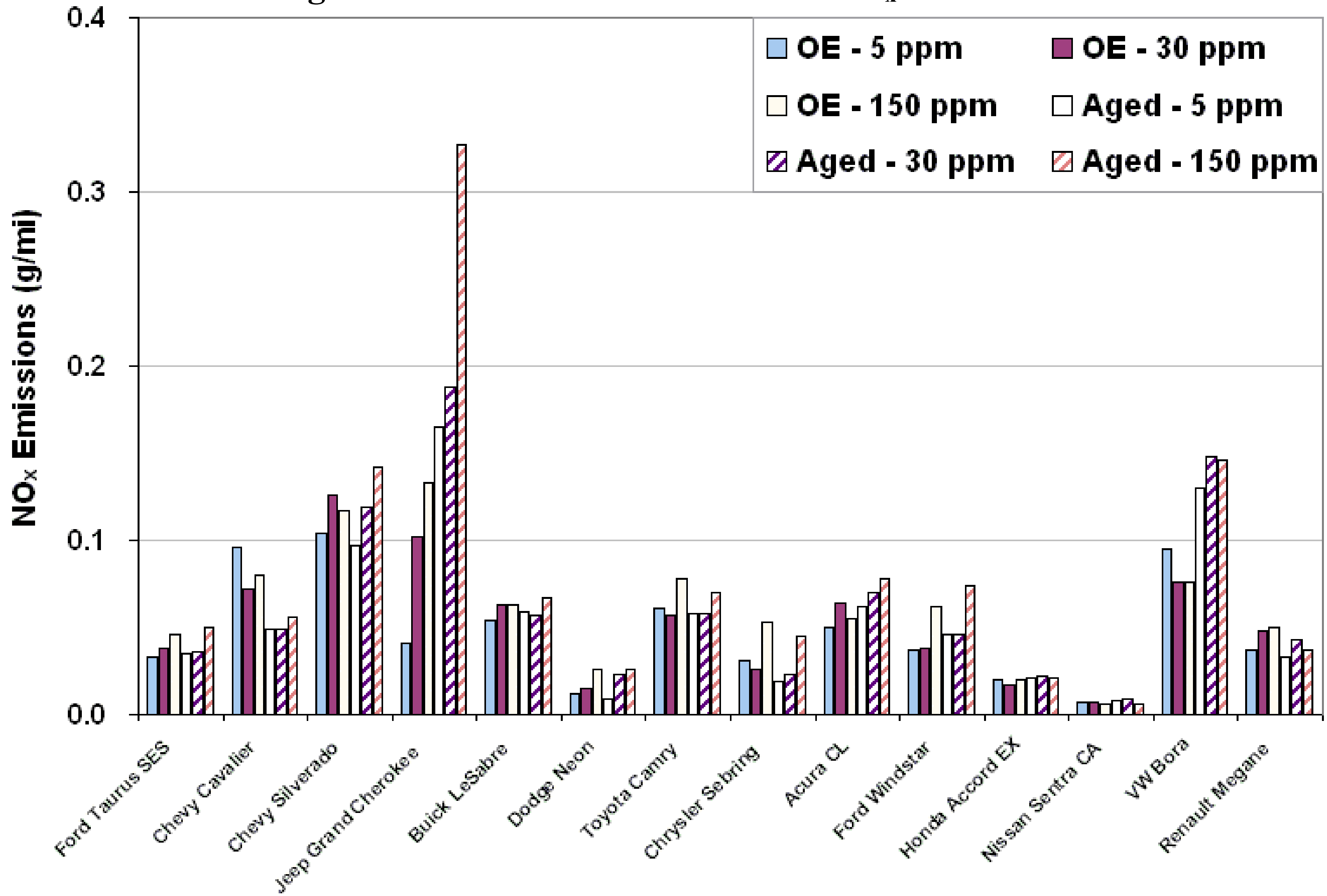
Fleet average NO_x emissions for the individual bags are presented in Figure 14. For this Figure, bag 2 NO_x emissions were multiplied by a factor of 5 to allow all of the bags to be presented in the same plot. The results of FTP NO_x emissions for individual bags are presented in Table 9 for the three test fuels and two catalyst configurations. For fuel effects, the statistical analysis for the individual bags was similar to the results for the weighted emissions, with statistically significant fuel effects, but also statistically significant vehicle by fuel interactions. Statistically significant differences in NO_x emissions between the 5 and 150 ppm were found for all three bags. The differences between the 150 and 30 ppm fuels for bag 2 were also statistically significant, but only at the 90% confidence level. A statistically significant vehicle by fuel interaction was found for bags 1 and 2. Catalyst effects were not statistically significant for the individual bags, consistent with the FTP weighted results.

Table 9. FTP NO_x Emissions Results for Individual Bags (g/mi)

Fuel Averages				Catalyst Averages			
	Bag 1	Bag 2	Bag 3		Bag 1	Bag 2	Bag 3
5	0.120[c]	0.016[c]	0.057[c]	**OE**	0.131	0.014	0.068
30	0.126	0.019[c]	0.070	**Aged**	0.129	0.029	0.081
150	0.143[a]	0.029[a,b]	0.095[a]				

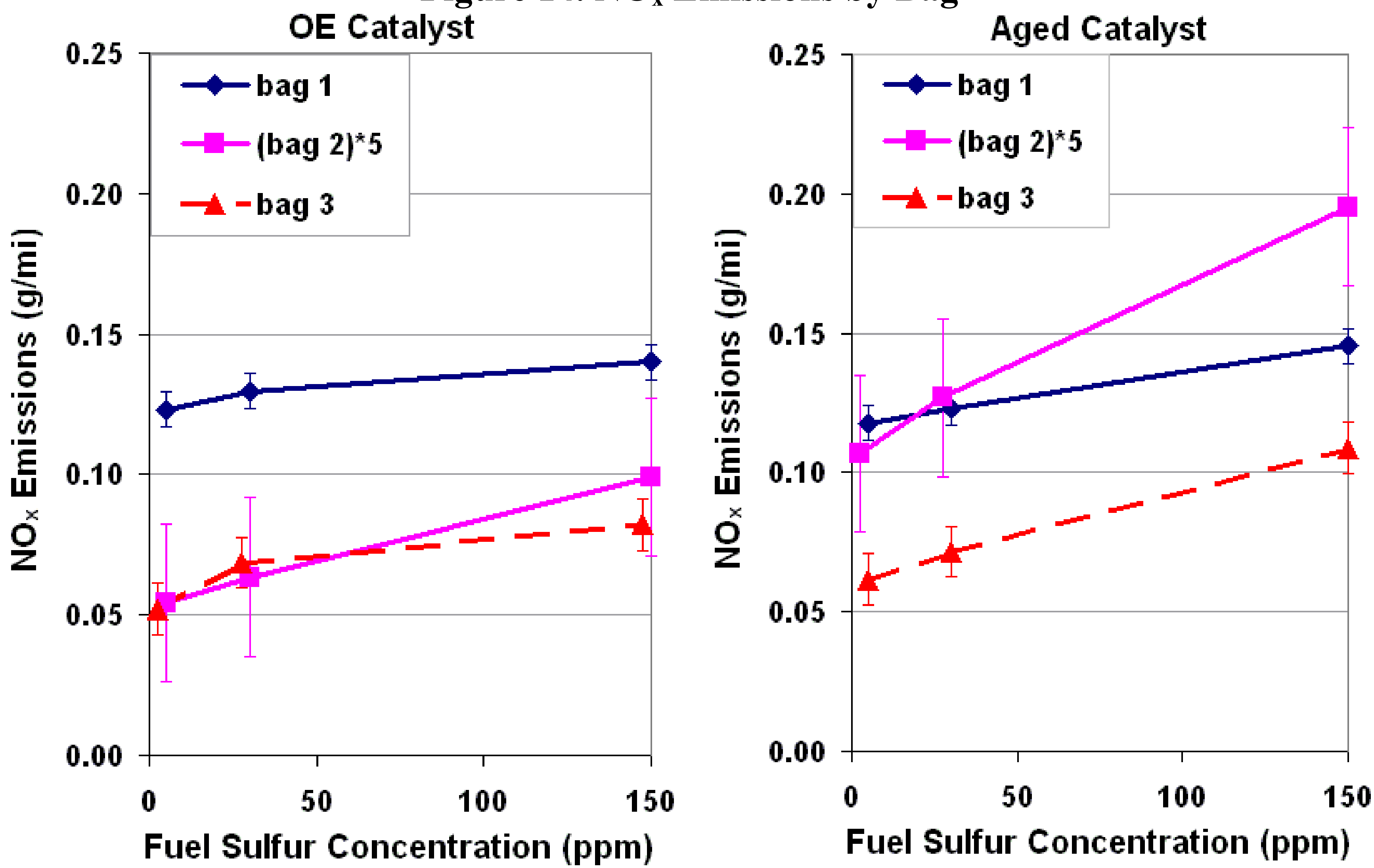
a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;

Figure 13. FTP Individual Vehicle NO_x Emissions



Values are the average of all tests at condition

Figure 14. NO_x Emissions by Bag



Values are the average of all vehicle/fuel combination for the 12 U.S. vehicles at condition
Error bars represent half of the least significant difference

3.1.5 FTP N_2O Emissions

The individual vehicle results for N_2O are presented in Figure 15. Similar to NH_3, the N_2O emissions over the FTP were generally lower than those of the regulated pollutants. Only three vehicles had N_2O emissions over 10 mg/mi averaged for most of the test configurations. Several other vehicles also had N_2O emissions over 10 mg/mi, but only for tests conducted on 150 ppm fuel. It is worth noting that no N_2O emissions are available for the Renault for the aged catalyst/30 ppm fuel configuration due to a problem with the FTIR at the time of the test.

FTP N_2O emissions are presented in Table 10 for the three fuel sulfur levels and the two catalyst configurations. The results show an increase in N_2O emissions with increasing fuel sulfur level that was statistically significant. Pair-wise comparisons showed that the N_2O emissions for the 150 ppm fuel were higher at a statistically significant level compared to the 30 and 5 ppm fuels. This is trend is consistent with previous studies that have shown that higher N_2O emissions are generally observed for higher sulfur fuels [24,25]. Statistically significant differences in N_2O emissions were not found between the as-received and the aged catalyst.

Table 10. FTP N_2O Emissions Results (mg/mi)

Fuel Averages		Catalyst Averages	
5	6^{c}	**OE**	9
30	7^{c}	**Aged**	11
150	$17^{a,b}$		

a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;

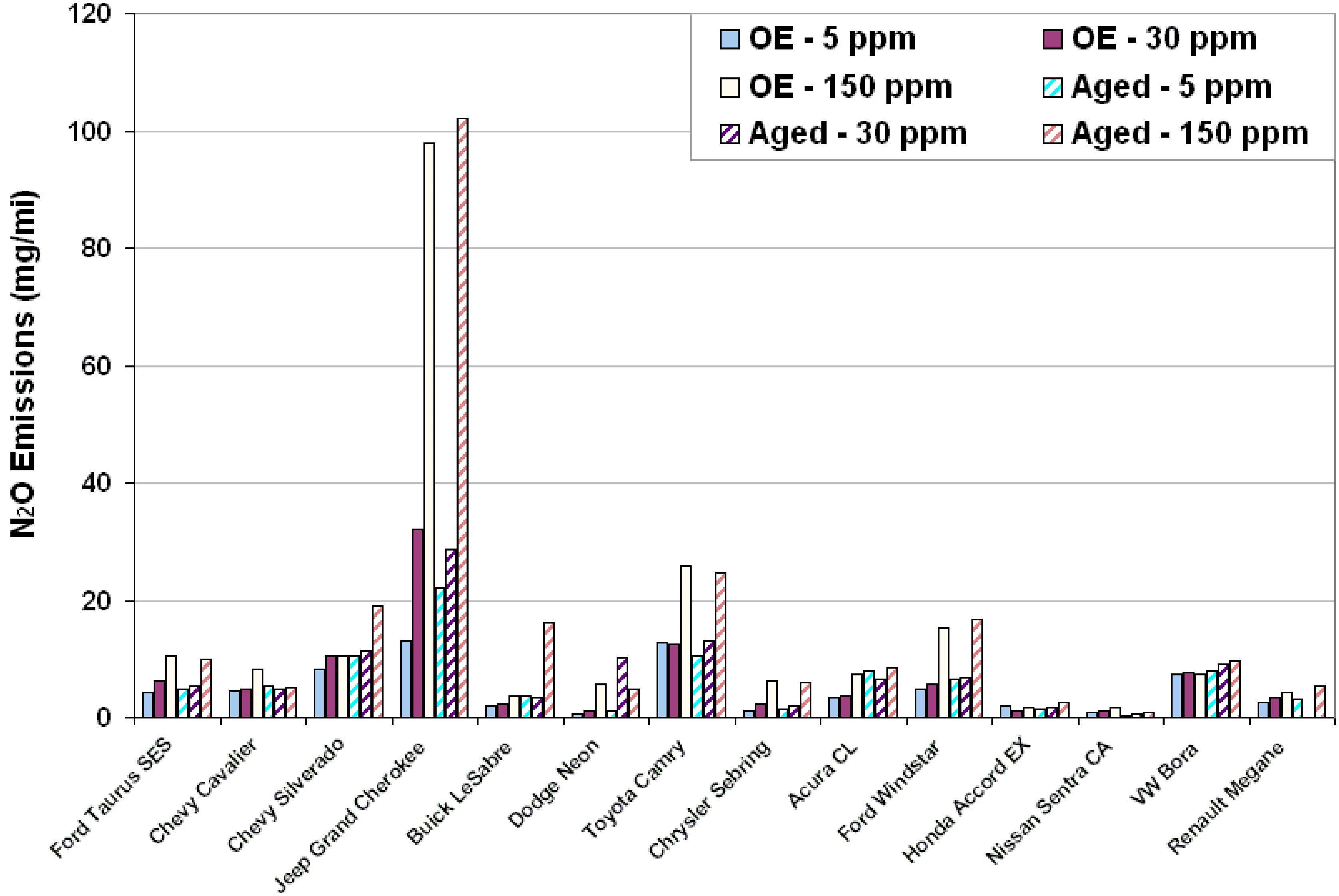
N_2O emissions for individual FTP bags are presented in Figure 16. N_2O emissions were found to be the highest for bag 1 followed by bag 3 of the FTP. Although N_2O is considered to be a by product of reactions on the catalyst, previous studies have shown that N_2O it is more readily formed at intermediate temperatures in the range of ~250°C-450°C [39-43]. Since such temperatures are typically found when the catalyst is warming up to operational temperatures, it is not surprising that N_2O emissions are highest during bags 1 and 3, which include a start-up component. A plot of real-time N_2O emissions is provided in Figure 17. Consistent with the results for the weighted FTP, statistically significant fuel effects were found for bags 1 and 3. Pair-wise comparisons showed that for N_2O emissions the 150 ppm fuel was higher at a statistically significant level compared to the 5 and 30 ppm fuels for bags 1 and 3, although the vehicle by fuel interaction was statistically significant for bag 3. Fuel effects for bag 2 were statistically significant between the 30 and 150 ppm fuels, but only at the 90% confidence level. Statistically significant catalyst effects on N_2O emissions were only found for bag 3.

Table 11. FTP N_2O Emissions for Individual Bags (mg/mi)

Fuel Averages				Catalyst Averages			
	Bag 1	Bag 2	Bag 3		Bag 1	Bag 2	Bag 3
5	14[c]	1	7[c]	**OE**	18	5	12*
30	16[c]	2[c]	10[c]	**Aged**	19	4	16*
150	27[a,b]	10[b]	24[a,b]				

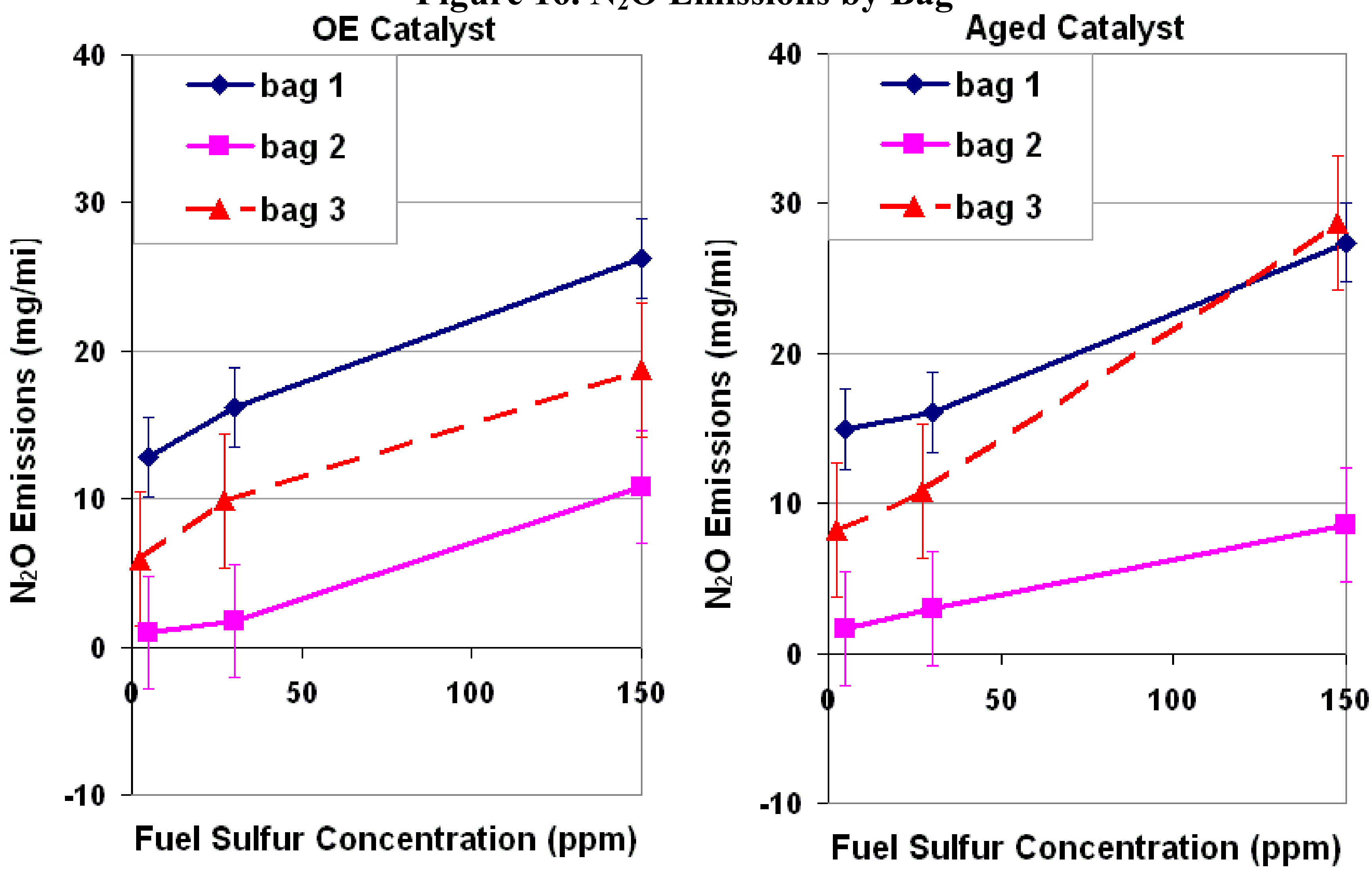
a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;
*: Statistically significant differences between catalysts.

Figure 15. FTP Individual Vehicle N_2O Emissions



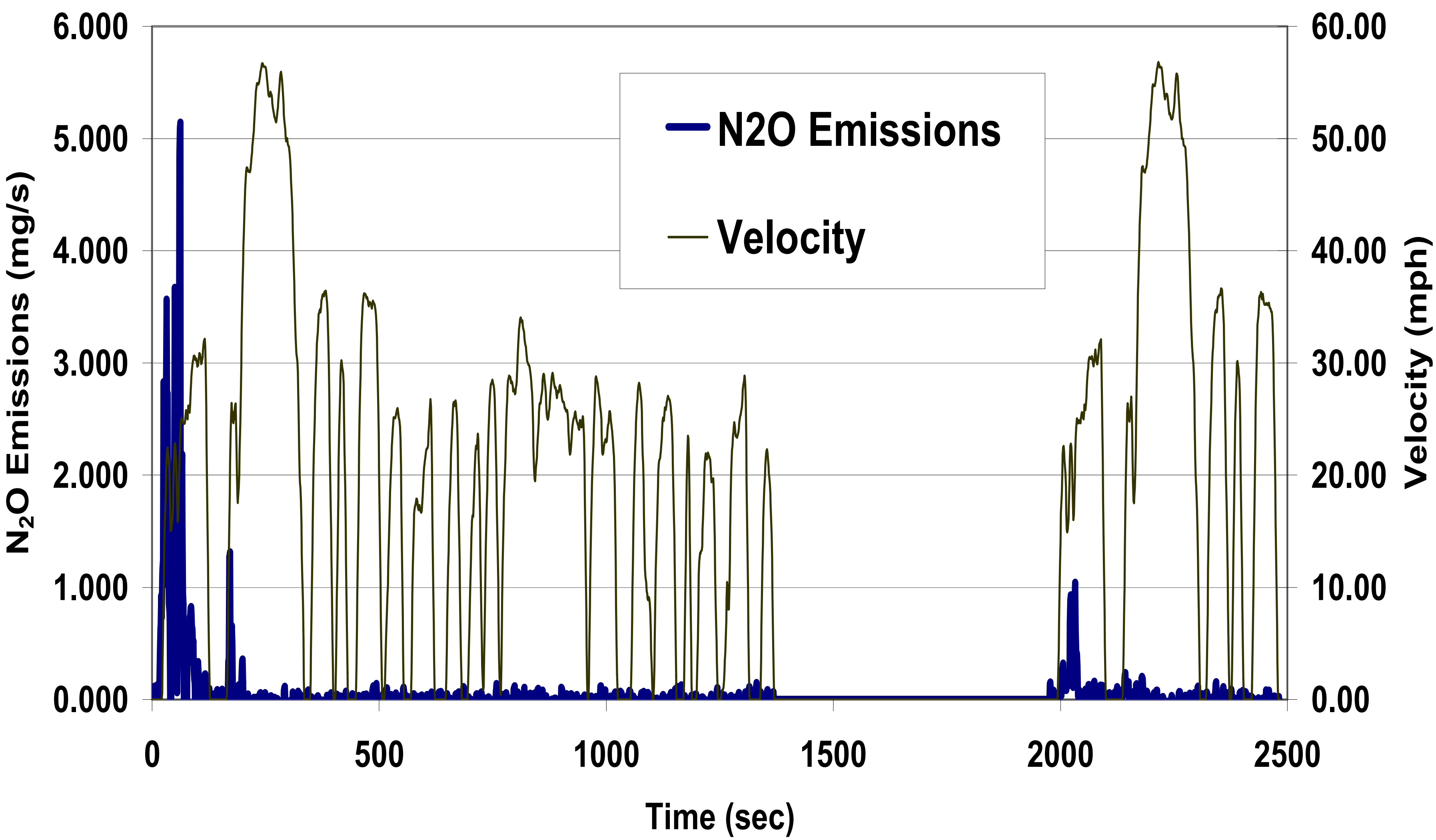
Values are the average of all tests at condition

Figure 16. N_2O Emissions by Bag



Values are the average of all vehicle/fuel combination for the 12 U.S. vehicles at condition
Error bars represent half of the least significant difference

Figure 17. Real-Time N_2O Emissions over the FTP for a ULEV Light-Duty Truck



3.2 US06 Emissions Results

The fleet average US06 emissions for NH_3, NMHC, CO, NO_x, and N_2O are presented in Figure 18. This Figure shows the average emission results on each fuel/catalyst combination for each of the 12 California-certified test vehicles. These averages exclude tests determined to be outliers by the Hawkins-Perold test. The CO emissions are divided by 50 to allow the details for the other emissions to be more clearly seen in the figure. More complete test results for the US06 are provided in Appendix H. Complete ANOVA analysis results are provided in Appendix I for the US06. It is worth noting that of the test vehicles, only the Buick LeSabre, Toyota Camry, and Nissan Sentra were certified over the US06 cycle.

3.2.1 US06 NH_3 Emissions

As shown in Figure 18, NH_3 emissions over the US06 were considerably higher than those found for the FTP and showed slightly higher fleet averages for the tests conducted with higher fuel sulfur levels and aged catalysts. The fleet average results for NH_3 emissions by fuel and by catalyst for all test configurations are presented in Table 12. The higher NH_3 emissions over the US06 cycle can primarily be attributed to higher emissions during periods of aggressive acceleration. This is shown in Figure 19, which shows a plot of NH_3 vs. time for the US06 for one of the test vehicles.

Table 12. US06 NH_3 Emissions Results (mg/mi)

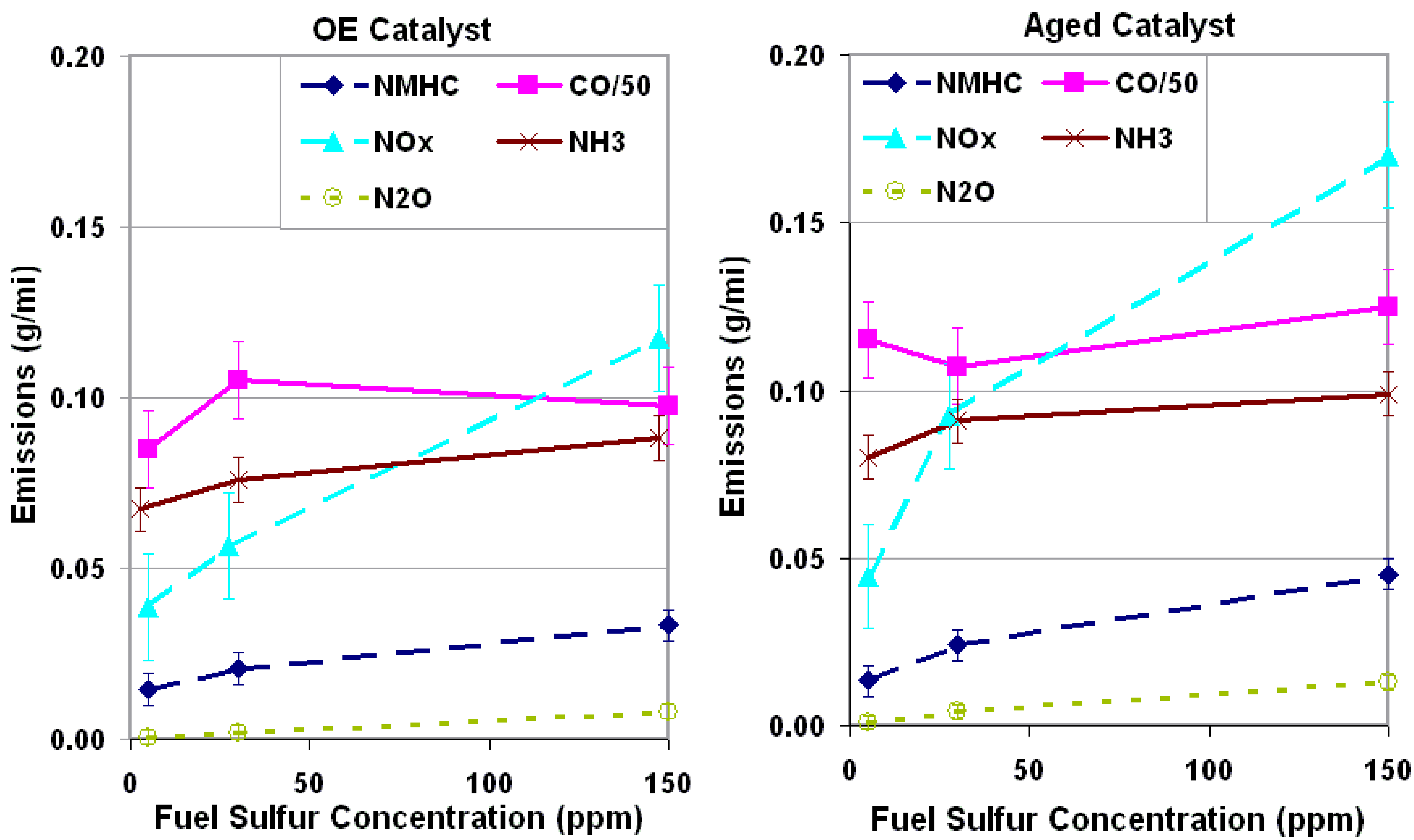
Fuel Averages		Catalyst Averages	
5	74[c]	**OE**	77*
30	83[c]	**Aged**	90*
150	94[a,b]		

a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;
*: Statistically significant catalyst differences at 90% confidence level.

ANOVA analyses showed that the fuel effects were statistically significant. Pair-wise tests showed that the differences between NH_3 emissions for the 150 ppm fuel compared with both the 30 and 5 ppm fuels were statistically significant. Fleet average NH_3 emissions for the 150 ppm fuel were 27% higher than those for the 5 ppm fuel and 12% higher than those for the 30 ppm fuel. The individual vehicle results are presented in Figure 20 for US06 NH_3 emissions. It is interesting to note that in a previous study of fuel sulfur effects in our laboratory on NH_3 emissions over the US06, it was found that a majority of the vehicles showed an opposite trend of decreasing NH_3 emissions with a higher sulfur fuel [24]. In the previous study, however, at a number of the test matrix points only single tests were performed. The vehicle conditioning for that study was also less rigorous than that used in the present work.

NH_3 emissions for the aged catalysts were 17% higher than those for the as-received catalysts. The effects of catalyst age were statistically significant, although at only the 90% confidence level. The vehicle by catalyst interaction was also statistically significant, indicating that the effects of catalyst age differed between vehicles, as shown in Figure 20.

Figure 18. Fleet Average US06 Emissions



Values are the average of all vehicle/fuel combination for the 12 U.S. vehicles at condition
Error bars represent half of the least significant difference

Figure 19. Real-Time NH_3 Emissions over the US06 for a ULEV Light-Duty Truck

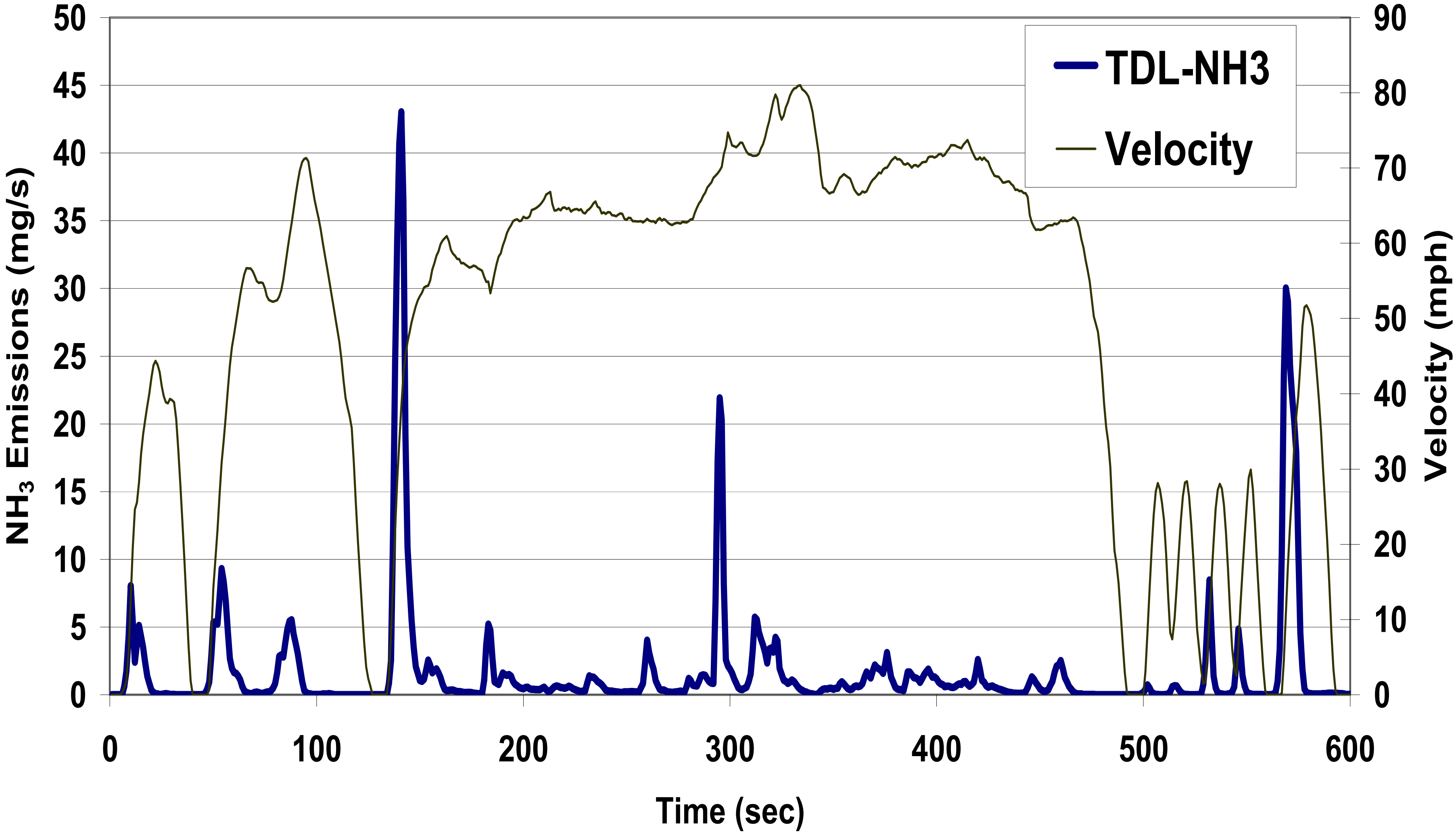
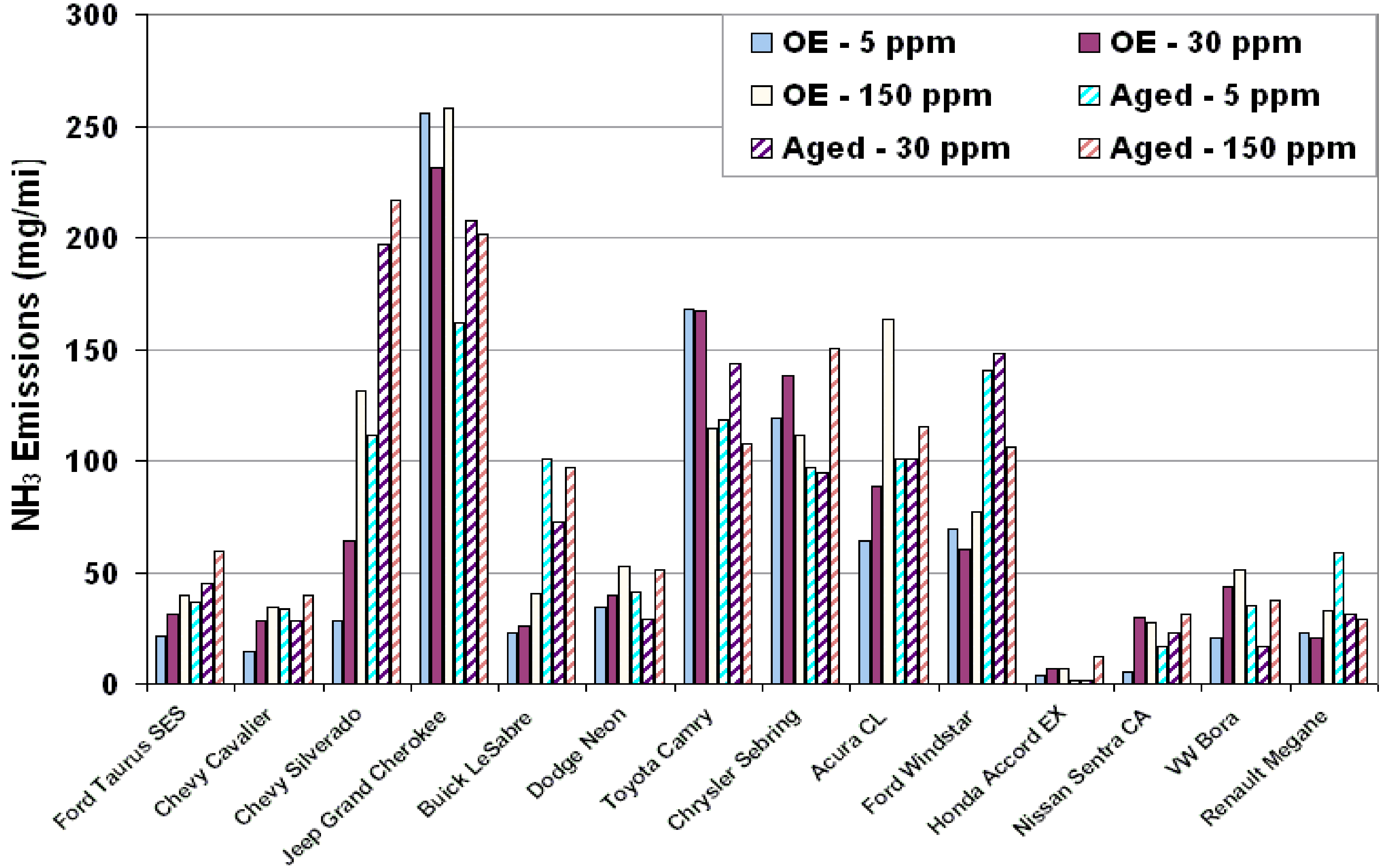


Figure 20. US06 Individual Vehicle NH_3 Emissions



Values are the average of all tests at condition

3.2.2 US06 NMHC Emissions

US06 fleet average NMHC emissions are presented in Table 13 for the three test fuels and two catalysts. The individual vehicle data for the US06 NMHC emissions are presented in Figure 21. NMHC emissions over the US06 showed more consistent trends for fuel sulfur level and catalyst age. NMHC emissions were found to increase with increasing fuel sulfur levels. Overall, the fuel sulfur trends were stronger over the US06 cycle compared to the FTP. Fleet average NMHC emissions were found to increase by 64% from the 5 to 30 ppm fuels and by 178% from the 5 to 150 ppm fuels. NMHC emissions for tests conducted on the aged catalyst were approximately 22% higher than those for the as-received catalyst.

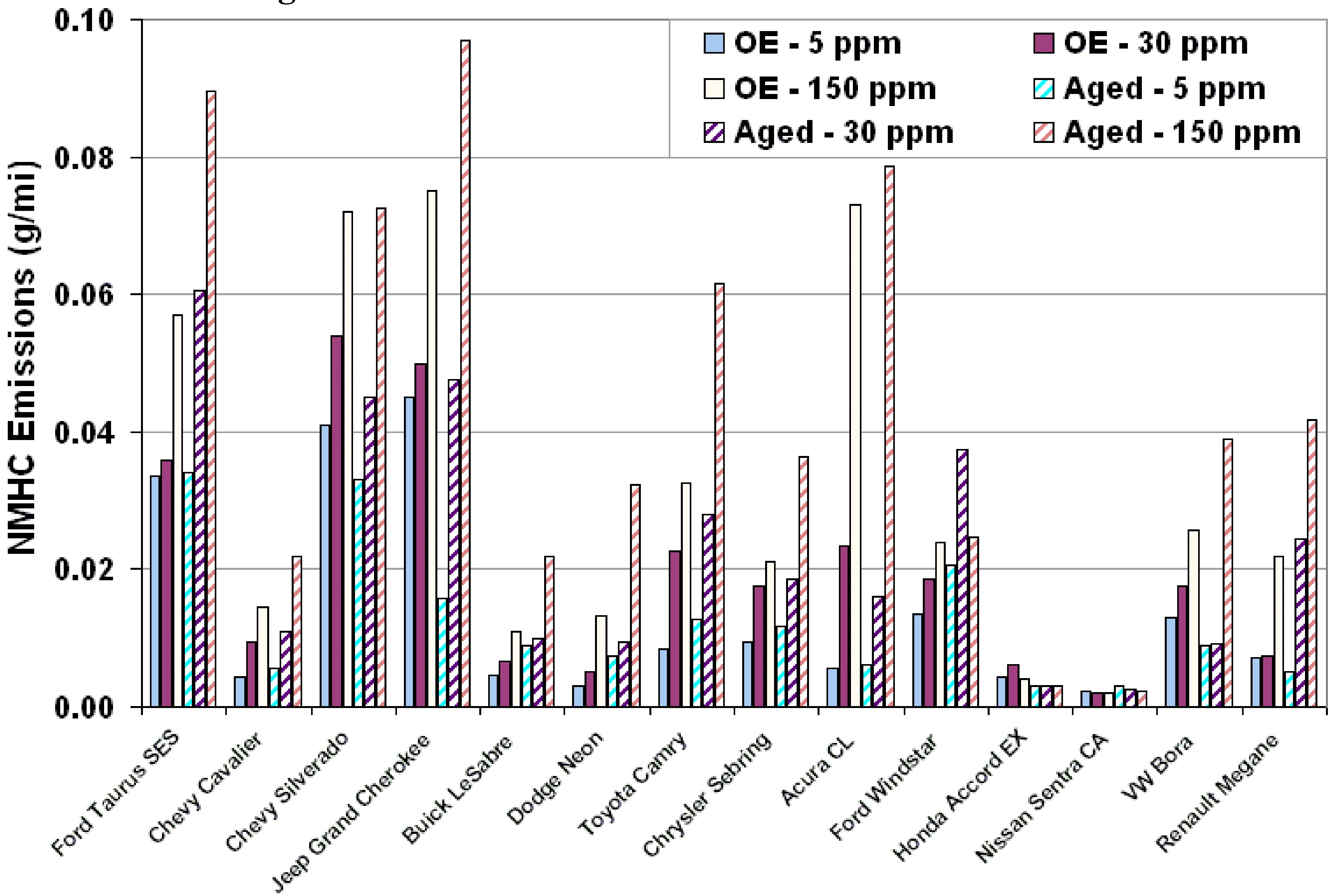
ANOVA analyses showed that fuel sulfur effects were statistically significant, although a statistically significant vehicle by fuel interaction was also found. Pair-wise comparisons showed that the 5, 30 and 150 ppm fuels were all different from each other for NMHC emissions over the US06 cycle at a statistically significant level. Catalyst effects were also statistically significant at the 90% confidence level, although the vehicle by catalyst interaction was statistically significant.

Table 13. US06 NMHC Emissions Results (g/mi)

	Fuel Averages		Catalyst Averages
5	$0.014^{b,c}$	**OE**	0.023*
30	$0.023^{a,c}$	**Aged**	0.028*
150	$0.039^{a,b}$		

a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;
*: Statistically significant differences between catalysts.

Figure 21. US06 Individual Vehicle NMHC Emissions



Values are the average of all tests at condition

3.2.3 US06 CO Emissions

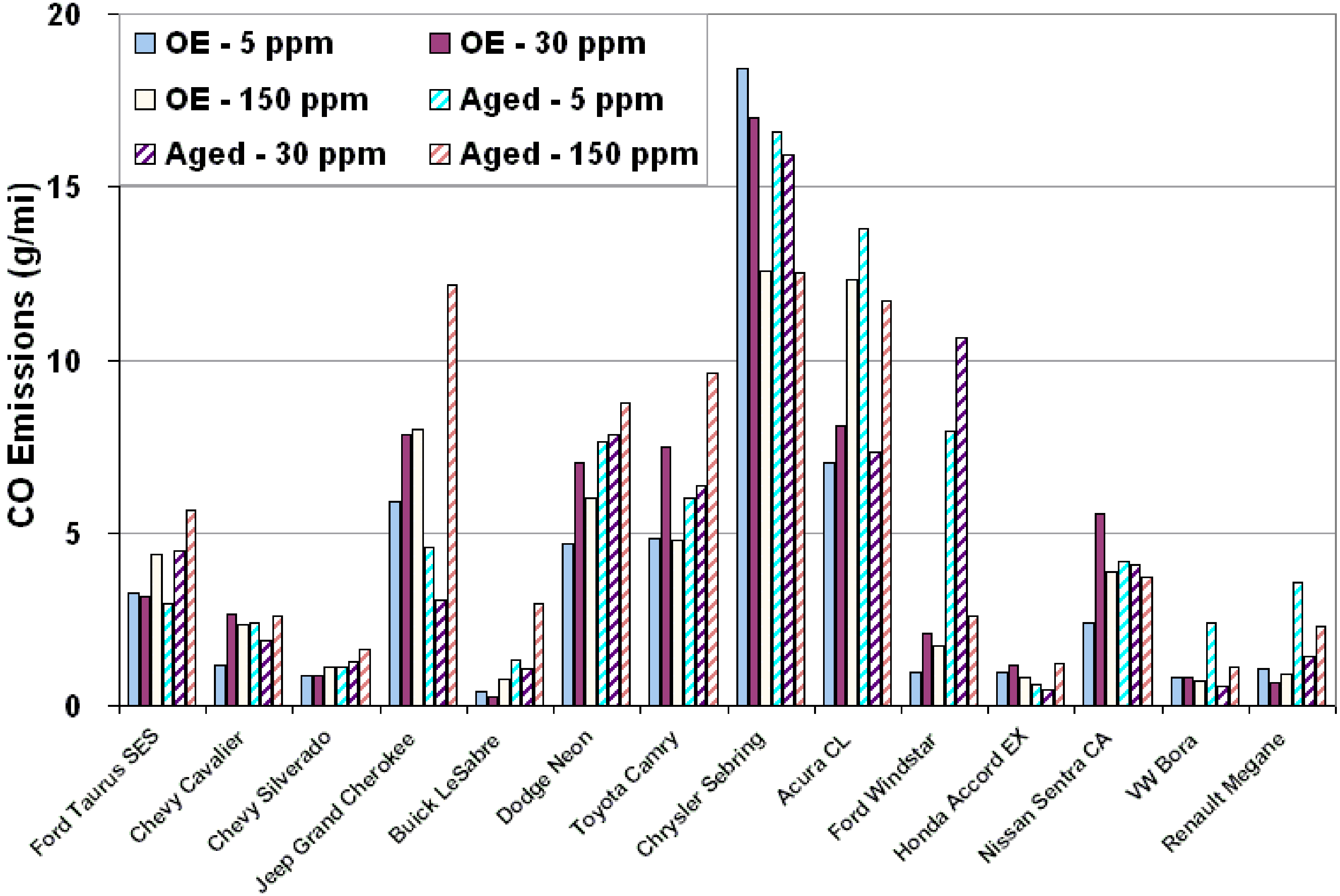
US06 CO emission results are shown in Table 14 for the three test fuels and the two catalyst configurations. The individual vehicle results for CO are presented in Figure 22. CO emissions for the aged catalysts were approximately 21% higher for the tests conducted on the aged catalysts compared with the as-received catalysts. ANOVA analyses indicate that the differences between catalysts were statistically significant at the 90% confidence level. A statistically significant vehicle by catalyst interaction was also found, however, indicating some differences in the effect of catalyst age for different vehicles. Fuel sulfur level effects were statistically significant at the 90% confidence level between only the 5 and 150 ppm fuels.

Table 14. US06 CO Emissions Results (g/mi)

	Fuel Averages		Catalyst Averages
5	4.999[c]	**OE**	4.796*
30	5.310	**Aged**	5.789*
150	5.568[a]		

a: Statistically significant different from 5 ppm;
c: Statistically significant different from 150 ppm;
*: Statistically significant differences between catalysts.

Figure 22. US06 Individual Vehicle CO Emissions



Values are the average of all tests at condition

3.2.4 US06 NO_x Emissions

Fuel effects on NO_x emissions over the US06 were relatively strong as shown in Figure 18 and Table 15. The individual vehicle data for the US06 NO_x emissions are presented in Figure 23. Fleet average NO_x emissions compared with the 5 ppm fuel were 79% higher for the 30 ppm fuel and 243% higher for the 150 ppm fuel. The ANOVA analysis results showed that fuel effects were statistically significant. Pair-wise comparisons showed that the 5, 30, and 150 ppm fuels were all different from each other at a statistically significant level.

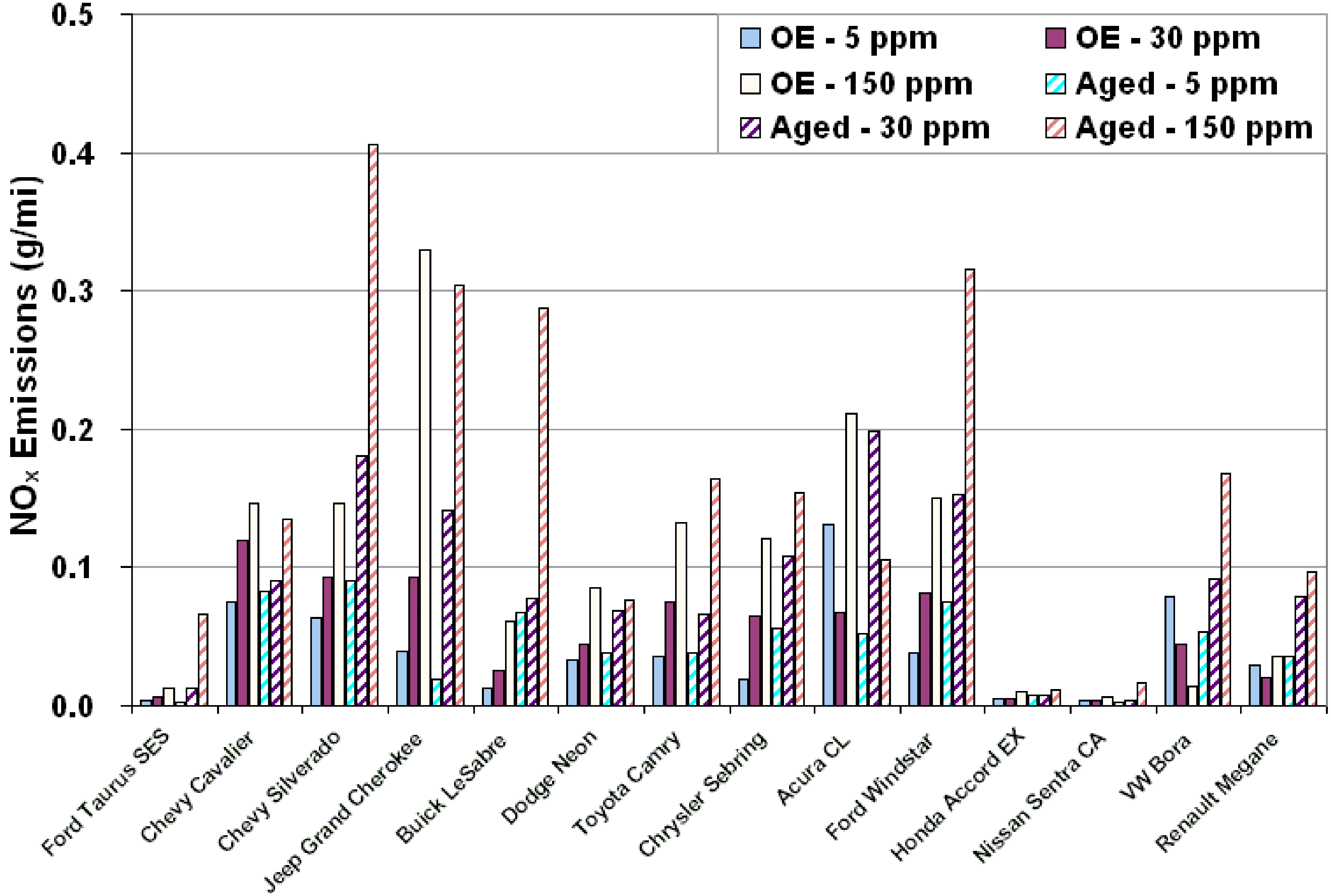
Table 15. US06 NO_x Emissions Results (g/mi)

	Fuel Averages		Catalyst Averages
5	$0.042^{b,c}$	**OE**	0.071*
30	$0.075^{a,c}$	**Aged**	0.102*
150	$0.144^{a,b}$		

a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;
*: Statistically significant differences between catalysts.

The fleet average NO_x emissions for the aged catalysts were 44% higher than those for the as-received catalysts for the US06. These catalyst age effects were found to be statistically significant.

Figure 23. US06 Individual Vehicle NO_x Emissions



Values are the average of all tests at condition

3.2.4 US06 N_2O Emissions

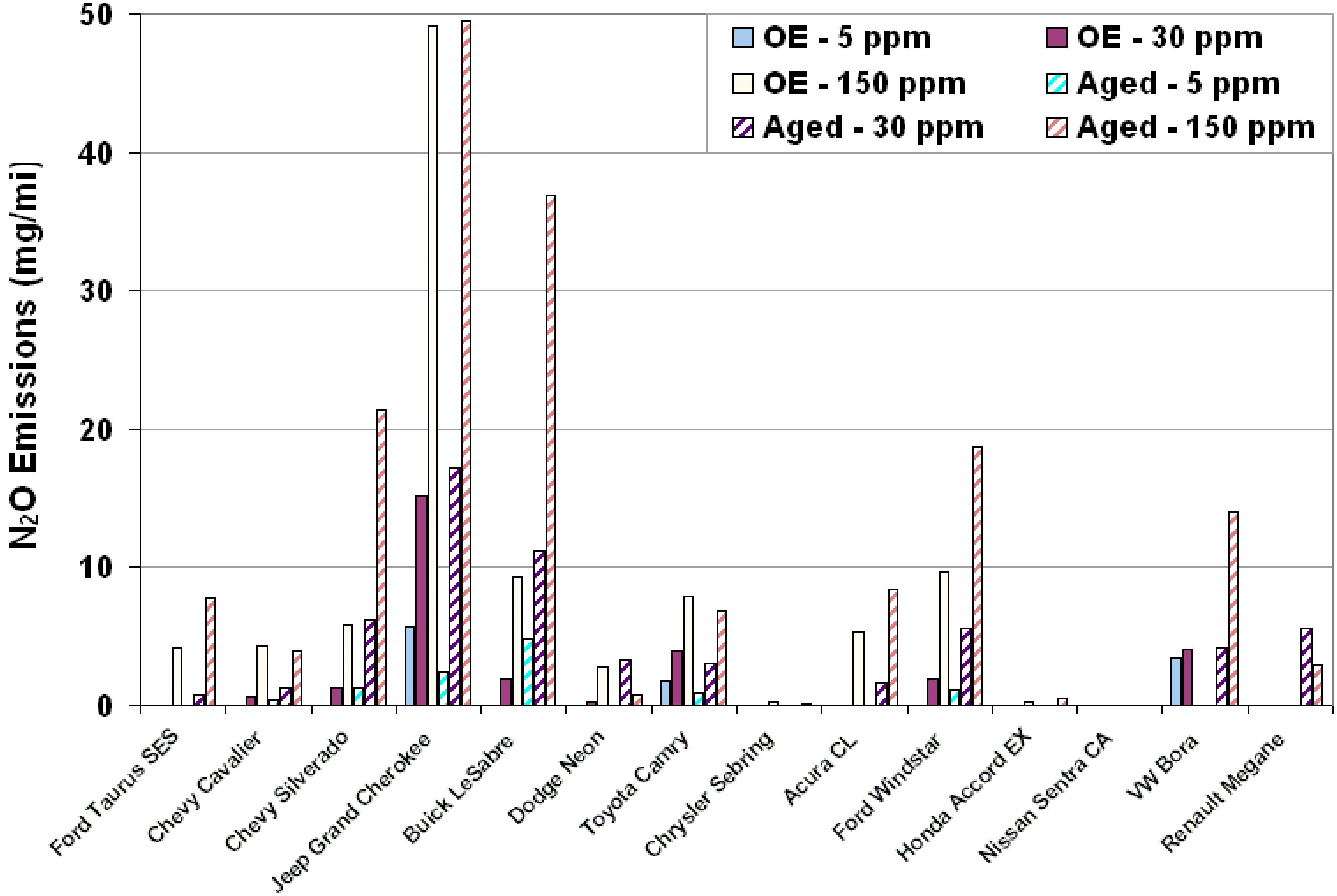
US06 N_2O emission results are presented in Table 16 for the three fuels and the two catalyst configurations. The individual vehicle results are presented in Figure 24 for US06 N_2O emissions. N_2O emissions over the US06 were lower than those obtained over the FTP. This is not surprising since N_2O is more readily formed at intermediate catalyst temperatures, as opposed to the higher temperatures observed over the US06 cycle. The ANOVA analysis results showed that fuel effects were statistically significant for N_2O emissions over the US06, while catalyst effects were not. Pair-wise comparisons showed that the 5, 30 and 150 ppm fuels were all different from each other for N_2O emissions over the US06 cycle at a statistically significant level. The absolute difference between the 5 and 30 ppm fuels was relatively small, however.

Table 16. US06 N_2O Emissions Results (g/mi)

	Fuel Averages		Catalyst Averages
5	0.001[b,c]	**OE**	0.004
30	0.003[a,c]	**Aged**	0.006
150	0.011[a,b]		

a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;

Figure 24. US06 Individual Vehicle N_2O Emissions



Values are the average of all tests at condition

3.3 European Vehicle Emissions Results

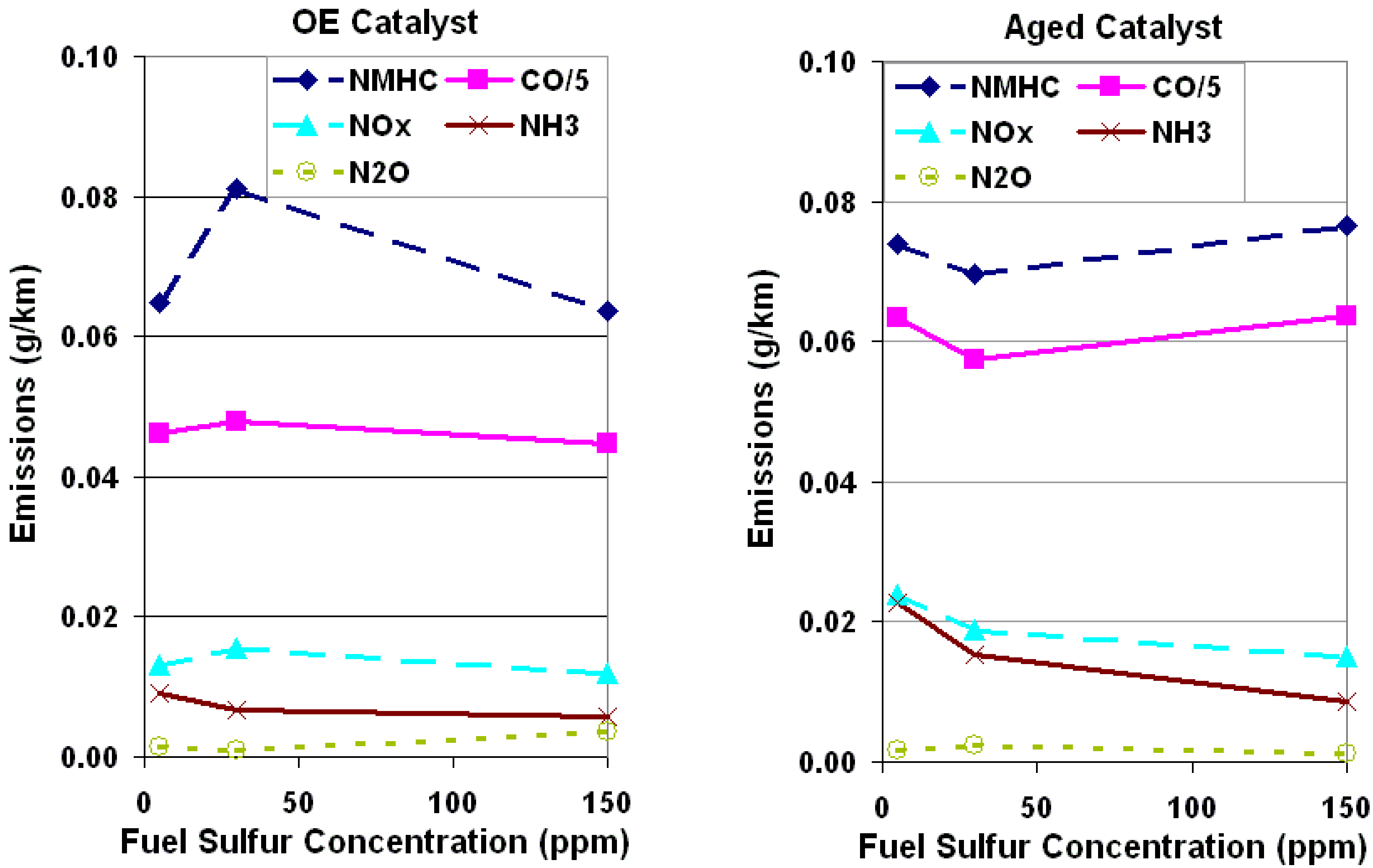
3.3.1 NEDC Emissions Results

The NEDC results for the VW Bora and Renault Megane are presented in Figures 25 and 26, respectively, for NMHC, CO, NO_x, and NH_3. Complete NEDC results are provided in Appendix J. For these graphs, the CO emissions for the Renault are divided by 5, the CO emissions for the VW Bora are divided by 10, and the NH_3 emissions for the VW Bora are multiplied by 5 to allow the features for all emissions to be presented in the Figures. In comparison with the other cycles used in this project, the NEDC cycle is more similar to the FTP in that it includes a cold start test portion and is not as aggressive as the US06 cycle.

For the Renault Megane, CO, NO_x and NH_3 were all found to be higher for the tests conducted on the aged catalyst in comparison with the as-received catalyst. NH_3 emissions also showed a trend of lower emissions with decreasing fuel sulfur level for the Renault over the NEDC. It is worth noting that a similar trend in NH_3 emissions was also observed for the aged catalyst over the FTP (see Figure 5). For the VW Bora, fuel sulfur and catalyst effects generally did not have a significant impact on emissions over the NEDC cycle, although it was found that NO_x emissions for the tests on the aged catalyst with the 5 and 30 ppm fuel were slightly higher than those for the as-received catalysts.

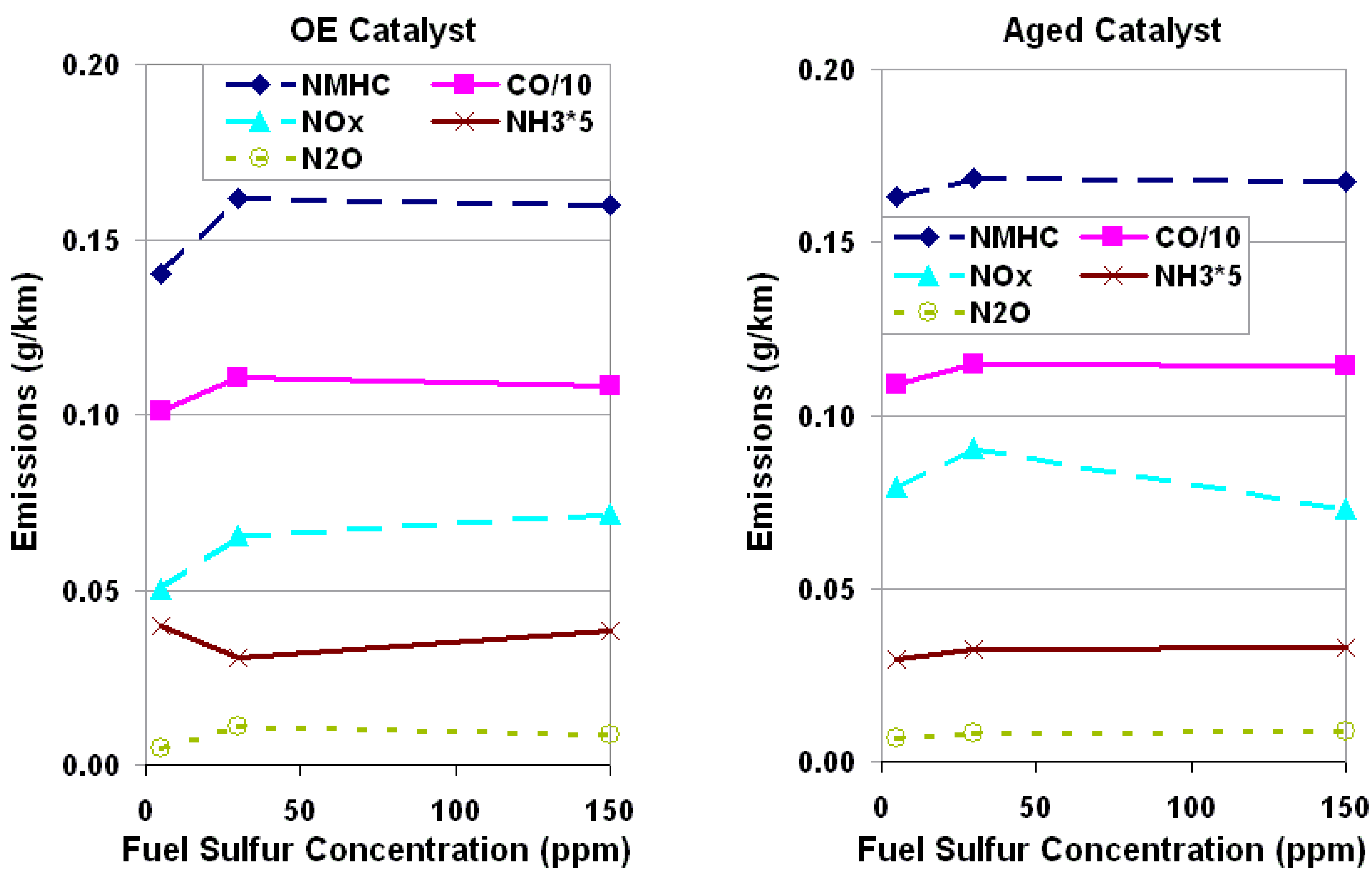
The emissions results for the ECE and EUDC (Extra Urban Driving Cycle) segments of the NEDC cycle are presented in Figures 27-30 for the VW Bora and the Renault Megane. The ECE portion of the cycle is the first part that includes four iterations of the ECE driving trace and a cold start. Since the cold start is the largest component of the overall emission rate, a majority of the emissions are generated during the ECE portion of the cycle. The trends for the ECE cycle are similar to those found for the total NEDC emissions.

Figure 25. Renault Megane NEDC Emissions Results



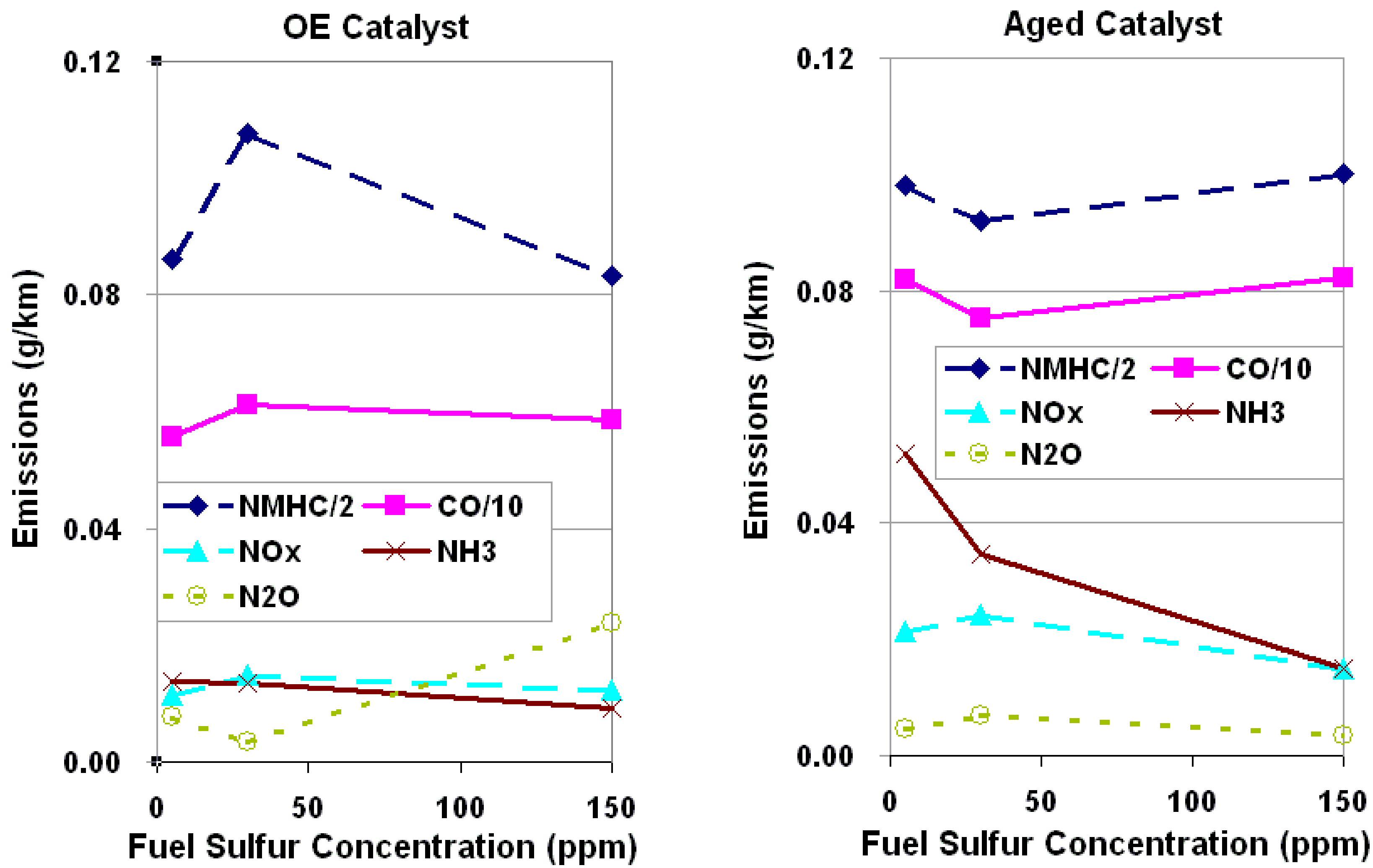
Values are the average of all tests at condition

Figure 26. VW Bora NEDC Emissions Results



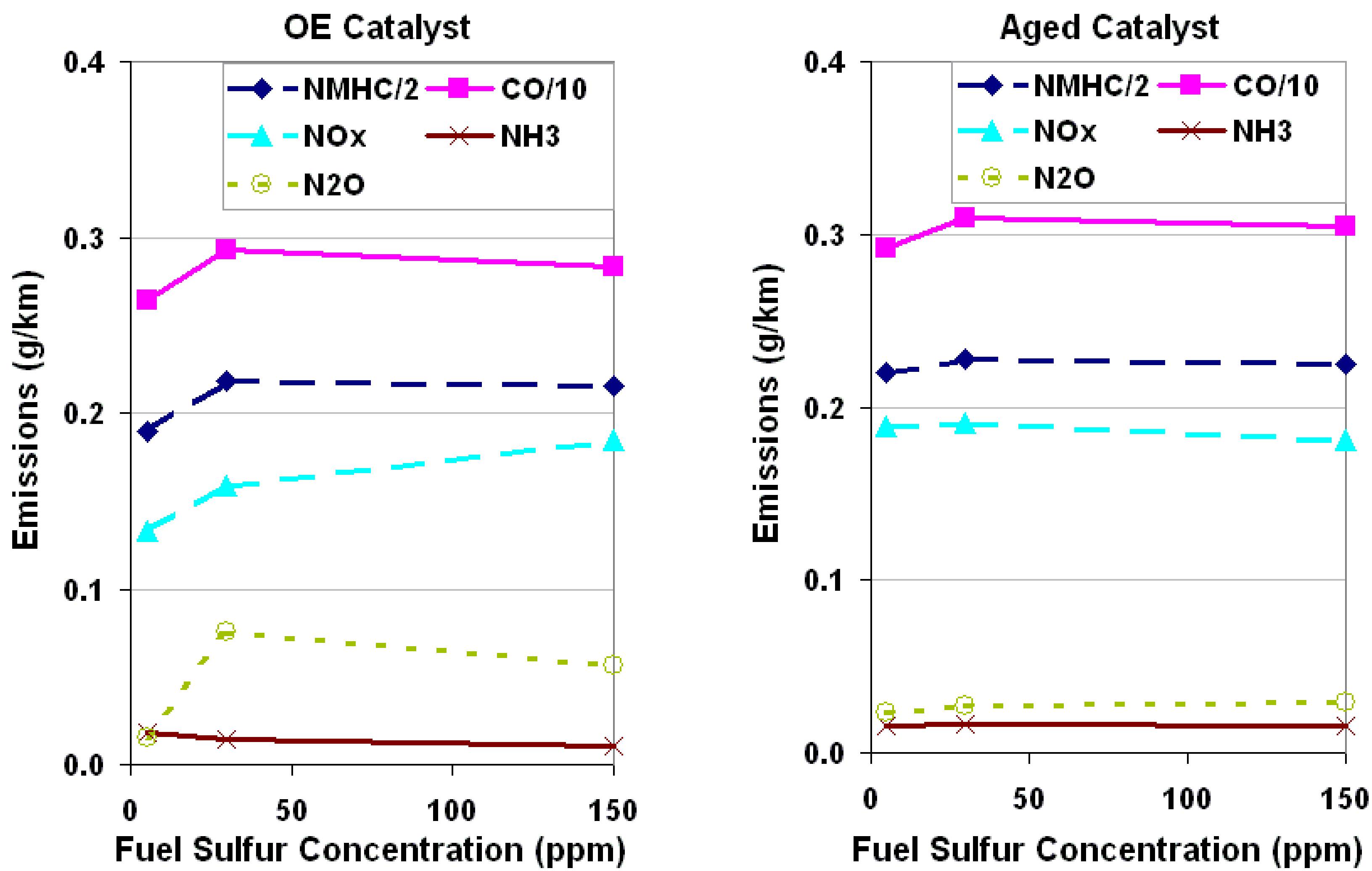
Values are the average of all tests at condition

Figure 27. Renault Megane ECE Emissions Results



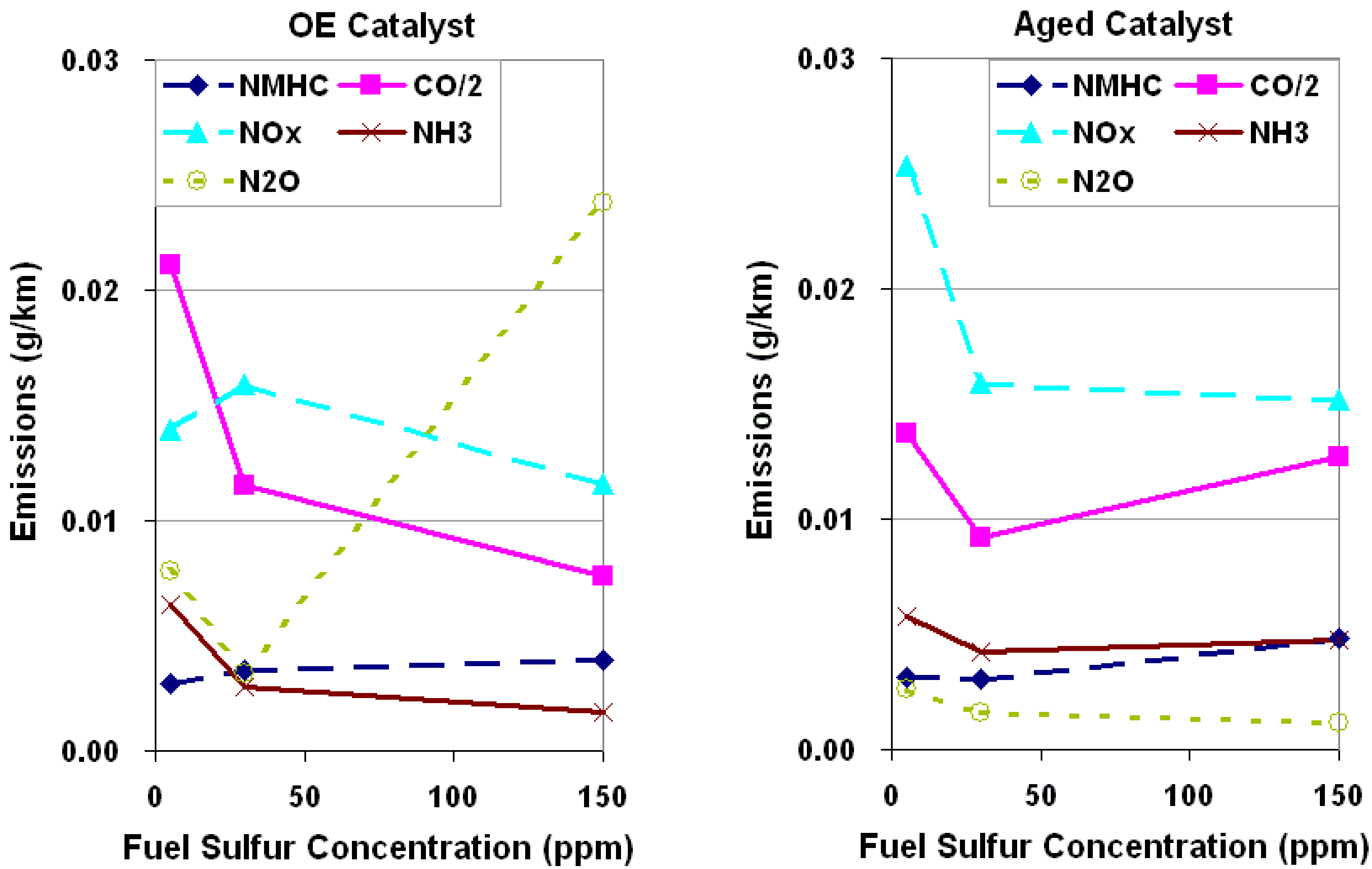
Values are the average of all tests at condition

Figure 28. VW Bora ECE Emissions Results



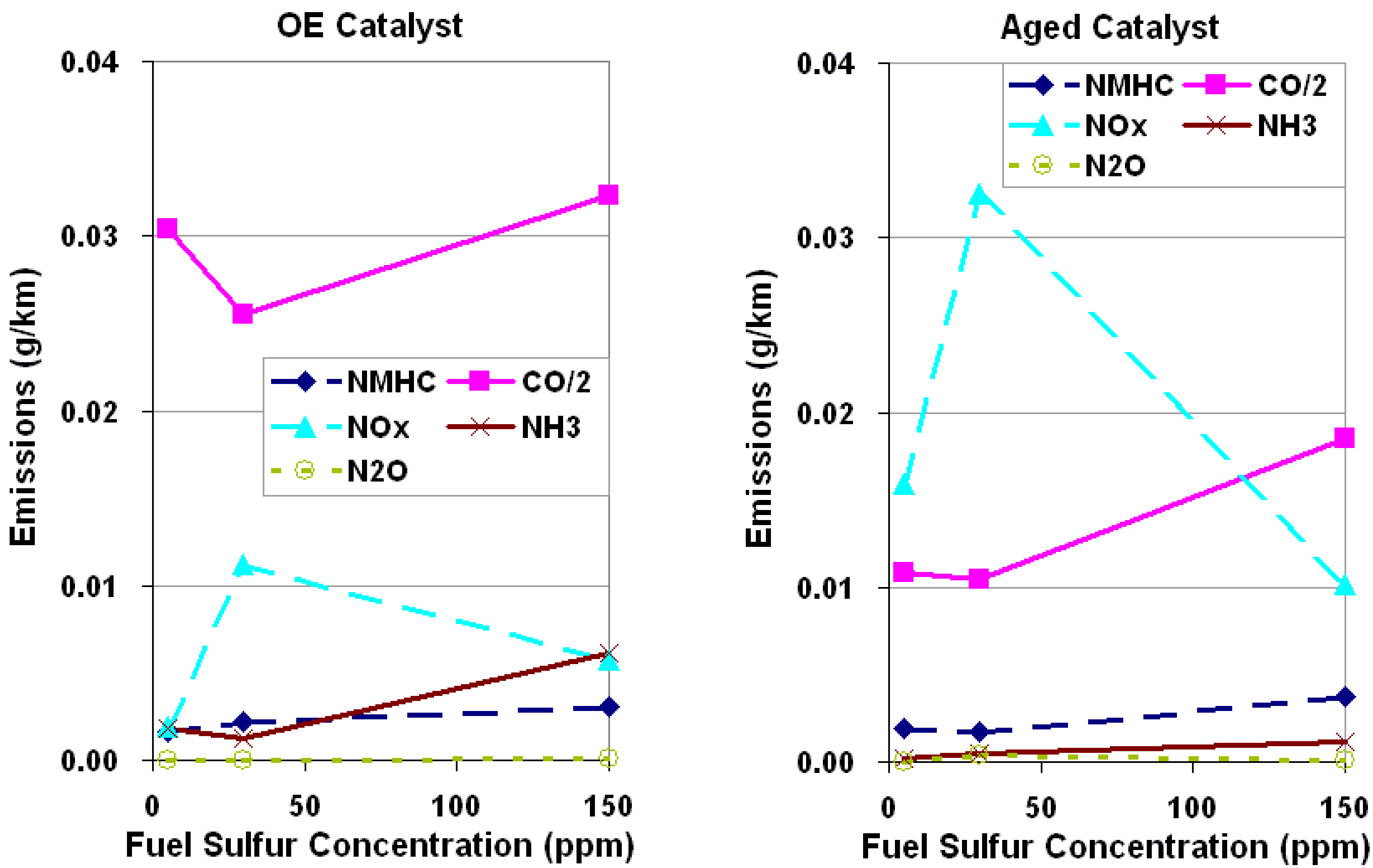
Values are the average of all tests at condition

Figure 29. Renault Megane EUDC Emissions Results



Values are the average of all tests at condition

Figure 30. VW Bora EUDC Emissions Results



Values are the average of all tests at condition

3.3.2 FTP and US06 Emissions Including European Vehicles

Since the European vehicles were excluded from the averages and statistical analyses discussed above, some additional analysis was done with these vehicles included. The results in Tables 17 and 18 show the FTP and US06 emissions for the NMHC, CO, NO_x, NH_3, and N_2O with the European vehicles included. Overall, the results with the inclusion of the European vehicles were very similar to those obtained with just the U.S. vehicles. Statistical analyses for the results were also similar for the cases where the European vehicles were excluded or included, as shown in Appendices F and I. It is worth noting that over the FTP and US06, the European vehicles generally fell within the range of emission levels found for the remaining vehicles in the fleet.

Table 17. FTP Emissions Results Including the European Vehicles (g/mi)

	Fuel Averages					Catalyst Averages					
	NMHC	CO	NO_x	NH_3	N_2O		NMHC	CO	NO_x	NH_3	N_2O
5	0.049	0.639	0.053^{c}	0.016	0.005^{c}	**OE**	0.048	0.610^{*}	0.055	0.013^{*}	0.009
30	0.048^{c}	0.629	0.059^{c}	0.016	0.007^{c}	**Aged**	0.050	0.691^{*}	0.067	0.020^{*}	0.010
150	0.052^{b}	0.682	$0.072^{a,b}$	0.018	$0.016^{a,b}$						

Table 18. US06 Emissions Results Including the European Vehicles (g/mi)

	Fuel Averages					Catalyst Averages					
	NMHC	CO	NO_x	NH_3	N_2O		NMHC	CO	NO_x	NH_3	N_2O
5	$0.013^{b,c}$	4.564	$0.043^{b,c}$	0.068^{c}	$0.001^{b,c}$	**OE**	0.022^{*}	4.229^{*}	0.066^{*}	0.071	0.003
30	$0.021^{a,c}$	4.676	$0.072^{a,c}$	0.076^{c}	$0.003^{a,c}$	**Aged**	0.027^{*}	5.233^{*}	0.100^{*}	0.082	0.006
150	$0.038^{a,b}$	4.953	$0.134^{a,b}$	$0.086^{a,b}$	$0.010^{a,b}$						

a: Statistically significant different from 5 ppm;
b: Statistically significant different from 30 ppm;
c: Statistically significant different from 150 ppm;
*:Statistically significant differences between catalysts.

4. Summary and Conclusions

For this study, the emissions impact of fuel sulfur and catalyst age was evaluated for 14 vehicles. The 14 vehicles included 12 California-certified LEV to SULEV vehicles and 2 European vehicles. Each vehicle was evaluated using 3 fuels (5, 30, and 150 ppm sulfur) and using the as-received and aged catalysts. Vehicles were tested on each fuel/catalyst configuration over the FTP and US06 test cycles. The two European vehicles were also tested over the NEDC cycle on each of the fuel/catalyst configurations. It should be noted that for the primary analyses, the European vehicles were excluded from the data set since the European vehicles are certified to different limits and procedures.

A tunable diode laser was developed and successfully used to measure engine-out and tailpipe NH_3 in real-time. The TDL offers both the detection limits and the response time necessary to investigate low-level concentrations of exhaust gases. Additionally, the TDL has the important advantage in that it can make measurements *in-situ* using raw exhaust gases. The combination of these advantages allows the measurement of highly time-resolved NH_3 emissions with sensitivity levels of better than 0.5 ppmv at two standard deviations, or minimum detection limits of roughly 0.5 mg/mi.

The major results of this study are:

NH_3 Emissions for the FTP and US06

- For the California-certified vehicles, NH_3 emissions over the FTP were generally lower than those of the regulated emissions. Fleet average FTP NH_3 emissions averaged between 14 and 21 mg/mi depending on the fuel/catalyst combination. Five of the test vehicles had NH_3 emissions below 5 mg/mi for most of the test configurations. Only 4 vehicles had NH_3 emissions over 20 mg/mi when averaged over all test configurations. The highest NH_3 emissions were found during bag 1 of the FTP after catalyst light-off.

- NH_3 emissions over the US06 were considerably higher than those found for the FTP with levels comparable with or greater than US06 emissions of other regulated emissions such as NMHC and NO_x.

- Measurements of engine-out NH_3 emissions indicated that NH_3 emissions were formed primarily over the catalyst.

- Fuel sulfur content did not affect fleet average NH_3 emissions over the FTP. Over the US06 cycle, on the other hand, fuel sulfur effects were found to be statistically significant with higher fleet average NH_3 emissions observed for increasing fuel sulfur level. Fleet average NH_3 emissions over the US06 for the 150 ppm fuel were 27% higher than those for the 5 ppm and 12% higher than those for the 30 ppm fuel.
- Catalyst aging effects on NH_3 emissions were found to be statistically significant for the FTP and for the US06, with higher emissions for the aged catalysts. Fleet average NH_3 emissions were 50% higher for the aged catalysts over the FTP and 17% higher for the aged catalysts over the US06. A statistically significant vehicle by catalyst interaction was found, however, for both the FTP and US06 cycles.

Regulated and N_2O Emissions for the FTP

- For the FTP, fleet average NO_x emissions were higher at a statistically significant level for the 150 ppm fuel compared with both the 5 and 30 ppm sulfur fuels, although the vehicle by fuel interaction was also statistically significant. For fleet average NMHC, emissions were higher at statistically significant levels for the 150 ppm fuel compared with the 30 ppm fuel, although the magnitude of this fuel effect was small.
- The effects of catalyst age were found to be statistically significant for fleet average CO emissions, with higher emissions observed for the aged catalysts.
- Similar to NH_3, the N_2O emissions over the FTP were generally lower than those of the regulated pollutants. The results showed there was a statistically significant increase in N_2O emissions for the 150 ppm fuel compared to both the 30 and 5 ppm fuels. This trend is consistent with previous studies that have shown that higher N_2O emissions are generally observed for higher sulfur fuels. The highest N_2O emissions for the FTP were found in bag 1, as the catalyst is warming up to operational temperatures.

Regulated and N_2O Emissions for the US06

- The effects of fuel sulfur on both fleet average NMHC and NO_x emissions were found to be statistically significant over the US06 cycle, although a statistically significant vehicle by fuel interaction was also found for NMHC. A pair-wise comparison showed that fuels with 5, 30 and 150 ppm sulfur were all different from one another at a statistically significant level for both fleet average NO_x and NMHC emissions over the US06 cycle. The magnitude of the fuel sulfur effects over the US06 for NMHC and NO_x was also found to be larger on a relative basis than those found for the FTP cycle. For fleet average CO emissions, only the fuel effects between the 5 and 150 ppm fuels were found to be statistically significant at the 90% confidence limits.
- Catalyst effects over the US06 were found to be statistically significant for fleet average NMHC, CO, and NO_x emissions, with higher emissions for the aged catalyst. The vehicle by catalyst interaction was statistically significant, however, for both NMHC and CO emissions.
- Fleet average N_2O emissions over the US06 were lower than those obtained over the FTP. N_2O emissions showed trends of higher emissions with increasing fuel sulfur level. Pair-wise comparisons showed that the 5, 30 and 150 ppm fuels were all different from each other for N_2O emissions over the US06 cycle at a statistically significant level.

Emission Results for the European Vehicles

- Overall, the fleet average FTP and US06 results with the inclusion of the European vehicles were very similar to those obtained with just the U.S. vehicles.
- Over the NEDC cycle, CO, NO_x and NH_3 for the Renault Megane were all found to be higher for the tests conducted on the aged catalyst in comparison with the as-received catalyst. For the VW Bora, fuel sulfur and catalyst effects generally did not have a significant impact on emissions over the NEDC cycle.

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Appendix A. Properties of the Test Fuel.

Property	Value	Method
API Gravity	66.3 @ 60/60	D1298
Density	0.712 x 10^3 kg/m^3 @ 15.6°C	
RVP	6.7 psi	Mini RVP
Base Sulfur	5 ppmw	Antek Sulfur
Benzene	0.1 wt %	
Aromatics	14.0 vol. %	D1319
Olefins	0.5 vol. %	D1319
T50	214.3°F/101.3°C	D86
T90	243.6°F/117.6°C	D86

Sulfur doping levels:
Nominal 30 ppmw: 1^{st} batch 30 ppmw and 2^{nd} batch 31.6 ppmw
Nominal 150 ppmw: 1^{st} batch 144 ppmw and 2^{nd} batch 145 ppmw

Appendix B. Description of Catalyst Aging.

Catalyst aging was conducted on catalytic systems (including pre- and post oxygen sensors) for the 14 test vehicles associated with the E-60 project. In total, 8 catalyst pairs were aged for a period of 90 hours (generic 120K miles) using the RAT-A cycle. The aging was conducted using a synthetic low-sulfur oil with a 0.01% sulfur content and an ultra-low sulfur gasoline with a 0.2 ppmw sulfur level. Catalyst aging was conducted at the Southwest Research Institute (SwRI). The steps for the RAT-A aging cycle are summarized below and described in greater detail in ref. 29. The more general steps used in the catalyst aging process are also provided below.

RAT-A Aging Protocol.

Step	Description
1	Duration=40 seconds. Stoichiometric, closed loop exhaust conditions (A/F=14.3). Catalyst inlet temperature ~ 800°C.
2	Duration= 6 seconds. Open loop, fuel injector pulse width same as used in Step 3.
3	Duration=10 seconds. Open loop, fuel injection pulse width increased from Step 1 to achieve 2.9 percent CO at catalyst inlet with secondary air source supplying additional air to achieve an oxygen concentration of 3.0 percent at the catalyst inlet. Typical catalyst bed temperature= 975 - 1020°C (catalyst bed temperature measured one inch downstream of catalyst front face).
4	Duration=4 seconds. Fuel control returned to closed-loop (stoichiometric conditions). Air injection from Step 3 continues for duration (air injection point is located downstream of oxygen sensor used to control the engine).

General Steps of Catalyst Aging Procedure Including Configuration for Testing

Step	Description
1	CE-CERT provided SwRI with 8 sets of catalyst systems to age (i.e., 8 pair of catalysts). Each catalyst was fabricated to make inlet and outlet inline, with 2.5" marmon flanges on inlet and outlet.
2	SwRI installed thermocouples in the first catalyst substrate, and installed on test stand (no fabrication or modification included).
3	The engine oil was drained and synthetic lubricating oil with low-sulfur (Lube 1 identified in the oil matrix) was used.
4	The RAT-A aging cycle was set up and cycle specifications were verified. If more than one converter was in a system, then setup was performed on the first catalyst only. Flows were adjusted to provide equal flows through each of the two catalyst systems being simultaneously aged. Aging was conducted with an ultra-low sulfur gasoline provided by

CRC. Raw exhaust concentrations were monitored at the start of the aging (zero hours).

5 After 24 hours of aging, the exhaust conditions were verified to insure correct and stable operating conditions.

6 After 48 hours of aging, the exhaust conditions were verified and the test parts were rotated between the banks of the engine.

7 After 72 hours of aging, the exhaust conditions were verified to insure correct and stable operating conditions.

8 After 90 hours of aging, a final emissions verification was made and the parts were removed from the test stand.

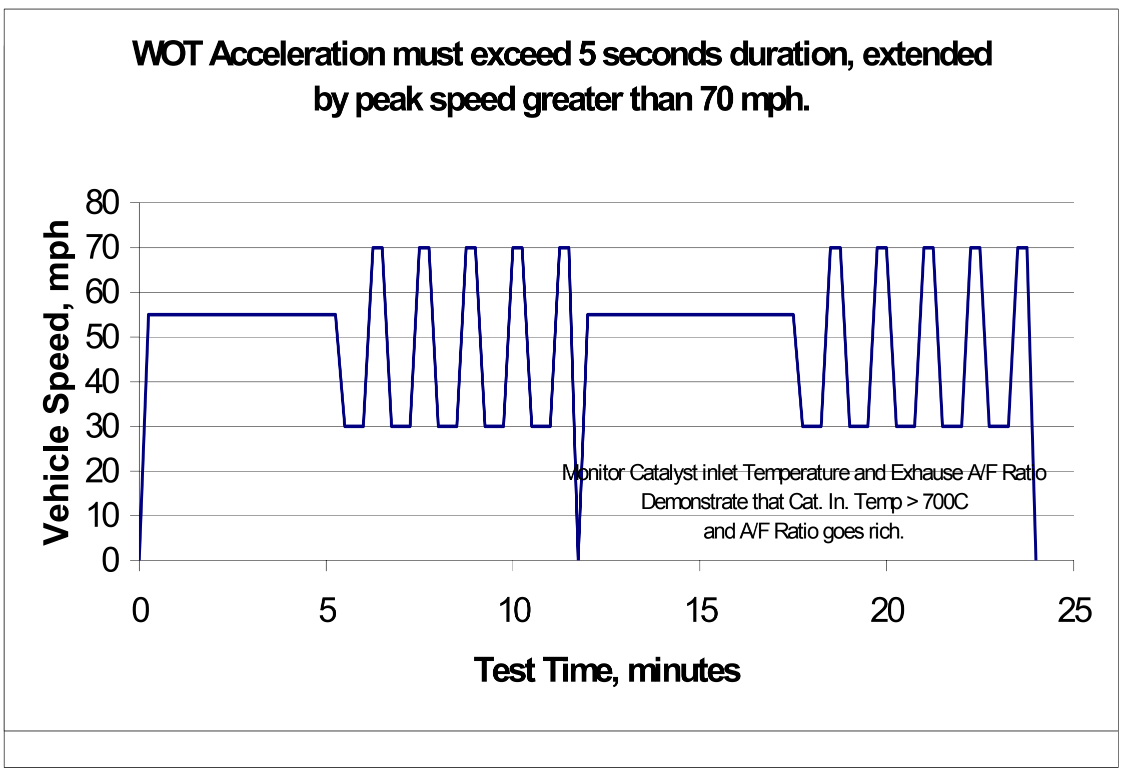
9 Steps 3 through 8 were repeated for the next seven (7) sets of catalysts.

10 The catalysts were labeled and repackaged for return to CE-CERT.

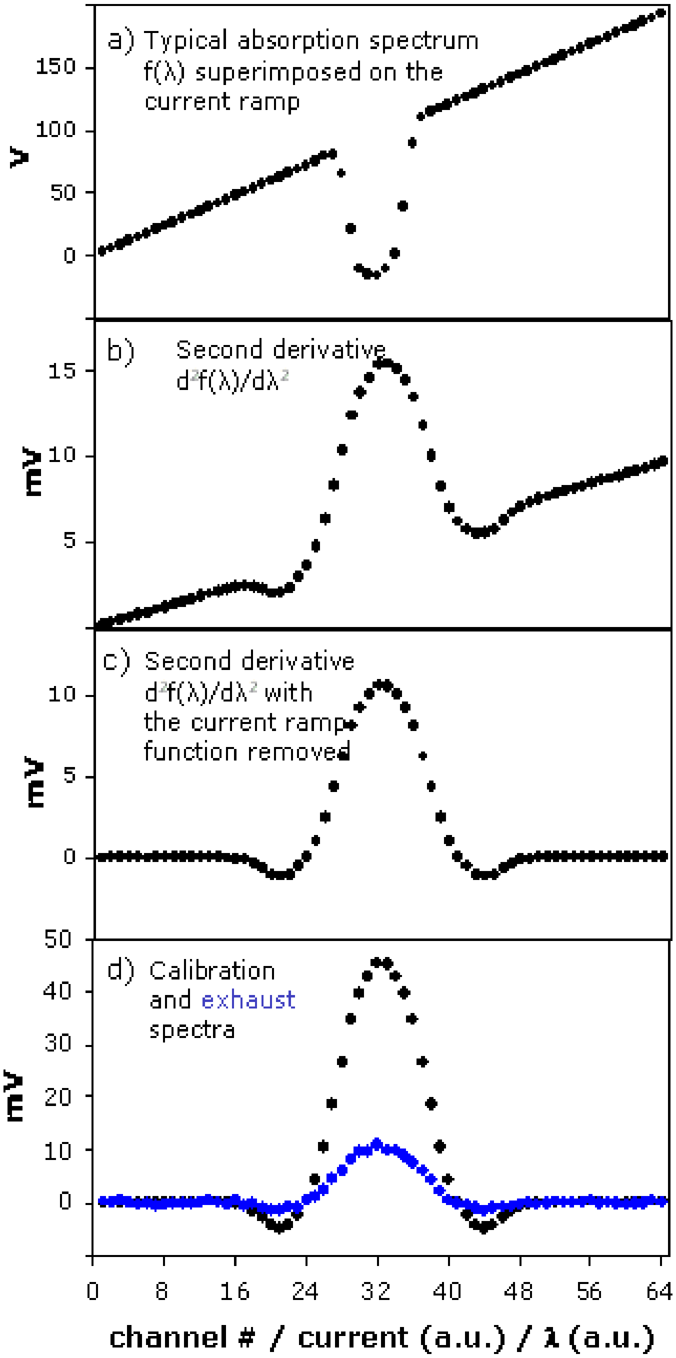
Appendix C. Sulfur Removal Protocol.

This procedure is designed to cause the vehicle to transiently run rich at high catalyst temperature, to remove accumulated sulfur from the catalyst, via hydrogen sulfide formation. The drive trace is shown below the descriptive protocol. The catalyst inlet temperature and the exhaust A/F ratio must be monitored during this procedure. It is required to demonstrate that the catalyst inlet temperature must exceed 700°C during the WOT accelerations and that rich fuel/air mixtures are achieved during WOT. If these parameters are not achieved, increased loading on the dynamometer should be added for this protocol (but not during the emissions test).

1. Drive the vehicle from idle to 55 mph and hold speed for 5 minutes (to bring catalyst to full working temperature).
2. Reduce vehicle speed to 30 mph and hold speed for one minute.
3. Accelerate at WOT (wide-open throttle) for a minimum of 5 seconds, to achieve a speed in excess of 70 mph. Continue WOT above 70 mph, if necessary to achieve 5-second acceleration duration. Hold the peak speed for 15 seconds and then decelerate to 30 mph.
4. Maintain 30 mph for one minute.
5. Repeat steps 3 and 4 to achieve 5 WOT excursions.
6. One sulfur removal cycle has been completed.
7. Repeat steps 1 to 5 for the second sulfur removal cycle.
8. The protocol is complete if the necessary parameters have been achieved.



Appendix D. Processing of the TDL Signal.



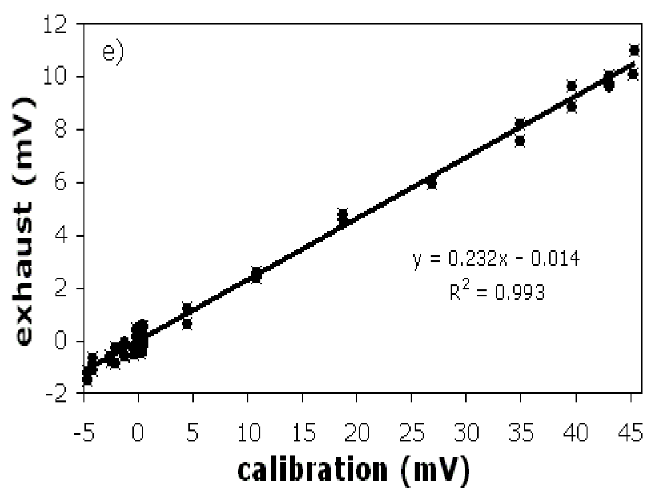
a) A current ramp divided into 64 bits is applied to the GaAs laser to vary the wavelength of emission.

b) An additional sinusoidal modulation is delivered to the diode. The modulation signal is frequency doubled and the output amplified. The detected signal is therefore the second derivative of the absorption signal.

c) A quadratic equation is applied to the second derivative signal. The signal is smoothed and the ramp function is taken out via a deconvolution procedure.

d) A stored calibration spectrum is compared to each of the exhaust spectra bit by bit.

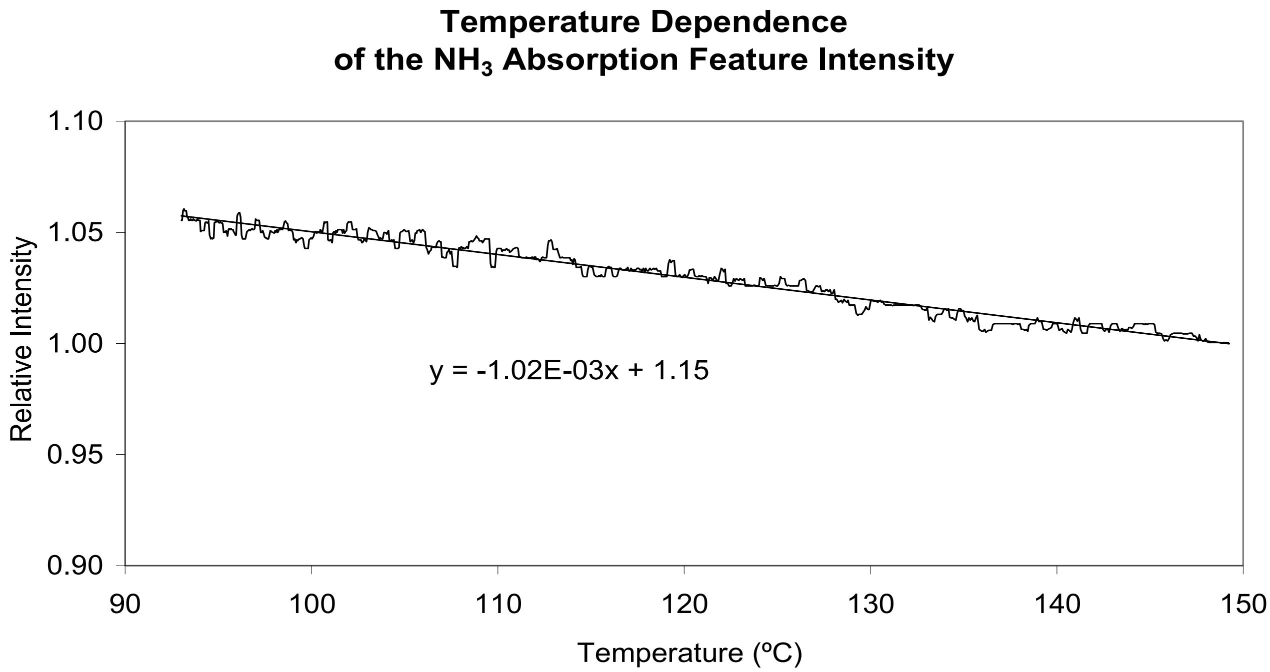
e) Linear regression of exhaust spectrum versus calibration spectrum. The exhaust concentration is obtained by multi-plying the concentration of the calibration spectrum with the regression slope.

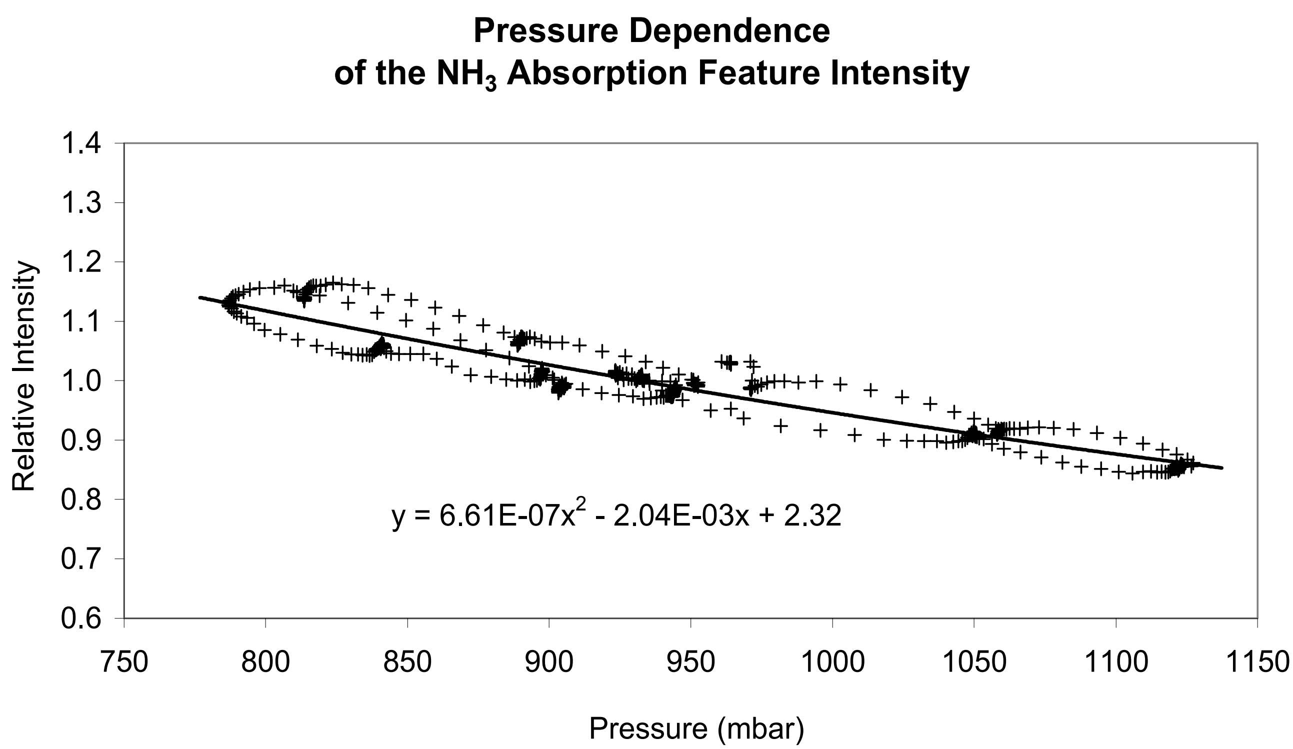


Appendix D. Cont.

TDL Pressure and Temperature Effects.

The following graphs show the temperature and pressure dependence of the NH_3 absorption feature intensity for the TDL. The effects were incorporated into the calculations of the NH_3 mass emission rates.





Appendix D. Cont.

Results for Comparison Tests between TDL and Citric Acid Coated Filters

Recoveries for Injection of 150 ppm of calibration gas for 45 seconds at 20 lpm

TDL	Citric Acid Coated Filters	Sampling Location
1590 µg	1700 µg	In front of Sampling Line
1590 µg	1640 µg	Behind Pre-Filter in Sampling Line
1590 µg	1690 µg	Immediately after TDL sampling system

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0204010	OE	5	0.191	0.003	0.014	0.045	2.305	0.001	0.000	0.479	0.088	0.000	0.051	0.032	450.2	462.5	385.0	438.6	0.004	0.004	-0.001	0.003	0.000	0.000	0.000	0.000	0.007	0.000	0.010	0.004
Ford	I0204014	OE	5	0.182	0.005	0.013	0.044	2.289	0.004	0.000	0.477	0.092	0.000	0.057	0.035	447.0	456.9	389.3	436.2	0.005	0.003	-0.001	0.002	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Taurus	average						0.045				0.478				0.034				437.4				0.002				0.000				0.004
	stdev						0.001				0.001				0.002				1.680				0.001				N/A				N/A
	I0204020	OE	30	0.196	0.004	0.011	0.046	2.691	0.000	0.000	0.558	0.095	0.001	0.049	0.034	457.1	461.4	380.2	438.2	0.003	0.001	-0.001	0.001	0.000	0.000	0.000	0.000	0.018	0.000	0.006	0.005
	I0204024	OE	30	0.183	0.007	0.012	0.045	2.334	0.006	0.000	0.486	0.101	0.001	0.078	0.043	442.3	454.2	375.3	430.1	-0.001	0.002	-0.002	0.000	0.000	0.000	0.000	0.000	0.019	0.000	0.012	0.007
	average						0.045				0.522				0.039				434.1				0.001				0.000				0.006
	stdev						0.001				0.051				0.006				5.735				0.000				0.000				0.001
	I0204033	OE	150	0.170	0.003	0.011	0.040	2.477	0.001	0.000	0.514	0.092	0.000	0.083	0.042	441.2	459.3	377.0	432.9	0.001	0.003	-0.002	0.001	0.000	0.000	0.000	0.000	0.024	0.000	0.019	0.010
	I0204036	OE	150	0.179	0.011	0.011	0.046	1.933	0.030	0.000	0.416	0.103	0.005	0.099	0.051	441.6	450.5	382.0	429.8	0.001	0.003	-0.006	0.000	0.000	0.000	0.000	0.000	0.022	0.001	0.020	0.011
	average						0.043				0.465				0.047				431.4				0.001				0.000				0.010
	stdev						0.004				0.069				0.006				2.166				0.001				0.000				0.000
	I0204048	Aged	5	0.204	0.005	0.014	0.049	2.596	0.002	0.000	0.538	0.090	0.001	0.054	0.034	447.6	450.7	378.7	430.3	0.003	0.004	0.000	0.003	0.000	0.000	0.000	0.000	0.017	0.000	0.007	0.005
	I0204050	Aged	5	0.177	0.005	0.018	0.044	2.350	0.000	0.000	0.487	0.120	0.000	0.040	0.036	443.7	448.3	376.6	427.7	0.006	0.005	-0.002	0.003	0.000	0.000	0.000	0.000	0.016	0.000	0.004	0.004
	average						0.046				0.513				0.035				429.0				0.003				0.000				0.005
	stdev						0.003				0.036				0.001				1.865				0.000				0.000				0.001
	I0204057	Aged	30	0.182	0.006	0.016	0.045	2.958	0.000	0.000	0.613	0.105	0.000	0.076	0.043	447.0	456.4	378.8	433.2	0.002	0.004	0.003	0.003	0.000	0.000	0.000	0.000	0.019	0.000	0.009	0.006
	I0204059	Aged	30	0.165	0.003	0.013	0.039	2.597	0.000	0.000	0.537	0.092	0.000	0.023	0.025	455.6	452.9	378.0	432.8	0.003	0.003	-0.002	0.001	0.000	0.000	0.000	0.000	0.016	0.000	0.003	0.004
	I0204063	Aged	30	0.203	0.012	0.014	0.052	2.361	0.016	0.000	0.498	0.107	0.004	0.027	0.040	442.4	457.4	377.5	432.3	0.005	0.003	-0.001	0.002	0.000	0.000	0.000	0.000	0.017	0.000	0.008	0.006
	average						0.046				0.549				0.036				432.8				0.002				0.000				0.005
	stdev						0.006				0.058				0.010				0.406				0.001				0.000				0.001
	I0204068	Aged	150	0.182	0.010	0.014	0.047	2.300	0.010	0.000	0.482	0.123	0.001	0.076	0.047	449.0	459.5	381.5	435.9	0.004	0.002	-0.005	0.001	0.000	0.000	0.000	0.000	0.022	0.000	0.017	0.009
	I0204074	Aged	150	0.177	0.010	0.015	0.046	1.998	0.021	0.000	0.425	0.137	0.001	0.087	0.053	437.5	453.5	379.0	429.7	0.003	0.004	-0.004	0.002	0.000	0.000	0.000	0.000	0.024	0.001	0.020	0.011
	average						0.046				0.454				0.050				432.8				0.001				0.000				0.010
	stdev						0.001				0.040				0.004				4.354				0.001				0.000				0.001

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0206012	OE	5	0.322	0.002	0.012	0.071	4.731	0.042	0.089	1.027	0.337	0.048	0.139	0.133	354.2	360.7	294.3	341.1	0.004	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.024	0.000	0.001	0.005
Chevy	I0206016	OE	5	0.191	0.002	0.013	0.044	4.930	0.012	0.104	1.059	0.191	0.038	0.059	0.076	351.6	358.5	293.6	339.2	0.002	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.021	0.000	0.000	0.004
Cavalier	I0206017	OE	5	0.166	0.002	0.007	0.037	4.039	0.039	0.064	0.875	0.187	0.059	0.034	0.079	351.0	358.0	294.1	339.2	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.000	0.004
	average						0.051				0.987				0.096				339.8				0.001				0.000				0.005
	stdev						0.018				0.098				0.032				1.1				0.001				0.000				0.001
	I0206024	OE	30	0.179	0.002	0.011	0.041	3.840	0.030	0.092	0.838	0.209	0.033	0.058	0.076	358.9	358.2	296.3	341.3	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.000	0.001	0.006
	I0206029	OE	30	0.190	0.002	0.004	0.042	4.178	0.063	0.061	0.916	0.167	0.043	0.041	0.068	354.1	356.1	294.3	338.7	0.003	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.019	0.000	0.000	0.004
	average						0.041				0.877				0.072				340.0				0.001				0.000				0.005
	stdev						0.000				0.055				0.006				1.9				0.001				0.000				0.001
	I0206057	OE	150	0.248	0.003	0.020	0.058	5.555	0.053	0.130	1.215	0.196	0.052	0.079	0.089	353.9	358.4	294.6	339.9	0.003	0.001	0.003	0.002	0.000	0.000	0.000	0.000	0.025	0.003	0.007	0.008
	I0206058	OE	150	0.190	0.003	0.023	0.047	4.871	0.044	0.186	1.084	0.139	0.038	0.087	0.072	354.0	358.9	300.0	341.7	0.002	0.001	0.002	0.001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	average						0.053				1.150				0.081				340.8				0.002				0.000				0.008
	stdev						0.008				0.093				0.012				1.3				0.001				N/A				N/A
	I0206068	Aged	5	0.235	0.003	0.015	0.054	5.200	0.070	0.111	1.145	0.120	0.029	0.043	0.052	344.2	342.8	287.5	327.9	0.007	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.024	0.000	0.001	0.005
	I0207003	Aged	5	0.172	0.002	0.014	0.041	4.384	0.068	0.137	0.982	0.104	0.036	0.025	0.047	351.4	355.9	291.3	337.2	0.008	0.001	0.001	0.002	0.000	0.000	0.000	0.000	0.020	0.002	0.002	0.005
	average						0.047				1.064				0.050				332.5				0.002				0.000				0.005
	stdev						0.010				0.115				0.004				6.6				0.000				0.000				0.000
	I0207009	Aged	30	0.224	0.003	0.006	0.050	5.318	0.064	0.087	1.161	0.123	0.030	0.026	0.048	352.5	355.5	291.4	337.2	0.015	0.001	0.001	0.004	0.000	0.000	0.000	0.000	0.017	0.001	0.001	0.004
	I0207017	Aged	30	0.202	0.003	0.009	0.046	4.641	0.089	0.087	1.033	0.109	0.033	0.037	0.050	349.5	349.5	287.0	332.3	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.023	0.000	0.002	0.005
	average						0.048				1.097				0.049				334.7				0.002				0.000				0.005
	stdev						0.003				0.091				0.001				3.5				0.002				0.000				0.001
	I0207021	Aged	150	0.397	0.004	0.011	0.087	5.361	0.037	0.123	1.165	0.193	0.036	0.026	0.066	351.1	355.0	287.6	335.6	0.008	0.001	0.001	0.003	0.000	0.000	0.000	0.000	0.021	0.000	0.001	0.005
	I0207024	Aged	150	0.189	0.003	0.010	0.043	4.331	0.077	0.122	0.974	0.107	0.026	0.038	0.046	348.2	351.1	285.2	332.3	0.008	0.002	0.002	0.003	0.000	0.000	0.000	0.000	0.023	0.000	0.003	0.006
	average						0.065				1.070				0.056				334.0				0.003				0.000				0.005
	stdev						0.031				0.135				0.014				2.3				0.000				0.000				0.001

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0207038	OE	5	0.340	0.011	0.024	0.083	4.585	0.232	0.172	1.118	0.255	0.010	0.126	0.093	539.0	561.4	475.8	533.2	0.059	0.026	0.007	0.028	0.032	0.043	0.009	0.031	0.026	0.000	0.013	0.009
Chevy	I0207040	OE	5	0.272	0.010	0.023	0.068	4.388	0.225	0.167	1.073	0.309	0.018	0.149	0.115	535.1	560.5	476.1	532.0	0.026	0.029	0.011	0.023	0.005	0.033	0.008	0.020	0.024	0.000	0.010	0.008
Silverado	average						0.075				1.096				0.104				532.6				0.026				0.026				0.008
	stdev						0.011				0.032				0.016				0.9				0.003				0.008				0.001
	I0207043	OE	30	0.296	0.012	0.026	0.075	4.455	0.228	0.189	1.094	0.273	0.010	0.217	0.121	533.8	564.6	472.9	533.0	0.032	0.028	0.018	0.026	0.003	0.029	0.011	0.018	0.027	0.000	0.018	0.010
	I0207044	OE	30	0.265	0.012	0.023	0.068	4.217	0.282	0.177	1.069	0.372	0.010	0.181	0.132	542.8	565.7	474.5	535.9	0.036	0.038	0.013	0.031	0.020	0.065	0.015	0.042	0.034	0.000	0.013	0.011
	average						0.072				1.082				0.127				534.5				0.028				0.030				0.011
	stdev						0.005				0.018				0.008				2.0				0.003				0.016				0.000
	I0207046	OE	150	0.392	0.013	0.028	0.096	4.594	0.256	0.141	1.124	0.294	0.012	0.111	0.098	540.4	570.0	476.6	538.2	0.048	0.035	0.012	0.031	0.037	0.054	0.010	0.038	0.033	0.001	0.012	0.010
	I0207047	OE	150	0.554	0.013	0.030	0.130	7.482	0.106	0.140	1.645	0.245	0.107	0.193	0.159	578.5	645.6	492.4	589.6	0.103	0.014	0.018	0.033	0.056	0.028	0.011	0.029	0.054	0.002	0.017	0.017
	I0207050	OE	150	0.263	0.015	0.032	0.071	3.867	0.169	0.151	0.931	0.416	0.017	0.150	0.136	540.8	572.2	480.7	540.6	0.043	0.015	0.025	0.024	0.006	0.028	0.014	0.020	0.032	0.000	0.014	0.011
	average						0.099				1.233				0.131				556.1				0.029				0.029				0.013
	stdev						0.030				0.369				0.031				29.0				0.005				0.009				0.004
	I0208001	Aged	5	0.550	0.011	0.036	0.130	5.449	0.353	0.276	1.389	0.223	0.008	0.065	0.068	531.5	559.7	469.4	529.0	0.131	0.111	0.061	0.101	0.105	0.161	0.065	0.123	0.033	0.000	0.008	0.009
	I0208003	Aged	5	0.370	0.010	0.033	0.091	5.490	0.282	0.292	1.365	0.354	0.008	0.077	0.099	530.5	556.9	471.0	527.8	0.092	0.099	0.073	0.091	0.065	0.116	0.067	0.092	0.035	0.000	0.011	0.010
	I0208007	Aged	5	0.306	0.010	0.032	0.077	4.837	0.241	0.269	1.202	0.387	0.019	0.123	0.124	534.6	558.6	467.7	528.7	0.081	0.073	0.054	0.069	0.056	0.089	0.044	0.070	0.032	0.001	0.017	0.012
	average						0.099				1.319				0.097				528.5				0.087				0.095				0.010
	stdev						0.027				0.102				0.028				0.6				0.016				0.027				0.001
	I0208008	Aged	30	0.331	0.007	0.030	0.081	5.071	0.305	0.236	1.274	0.364	0.016	0.123	0.118	530.4	554.5	466.3	525.3	0.097	0.111	0.068	0.096	0.086	0.137	0.057	0.104	0.037	0.001	0.018	0.013
	I0208009	Aged	30	0.492	0.011	0.032	0.117	7.246	0.232	0.244	1.743	0.397	0.030	0.122	0.135	570.3	675.4	479.5	597.1	0.127	0.095	0.081	0.098	0.089	0.110	0.064	0.092	0.057	0.001	0.020	0.019
	I0208012	Aged	30	0.329	0.010	0.032	0.082	5.135	0.233	0.228	1.248	0.369	0.021	0.119	0.120	531.0	557.1	469.4	527.6	0.073	0.061	0.054	0.061	0.040	0.071	0.035	0.055	0.027	0.000	0.015	0.010
	average						0.093				1.422				0.124				550.0				0.085				0.084				0.014
	stdev						0.020				0.279				0.009				40.8				0.021				0.026				0.004
	I0208013	Aged	150	0.397	0.015	0.051	0.104	5.921	0.271	0.439	1.489	0.327	0.039	0.216	0.147	529.5	557.0	467.6	526.7	0.119	0.055	0.077	0.074	0.071	0.099	0.058	0.082	0.043	0.004	0.043	0.023
	I0208014	Aged	150	0.385	0.013	0.039	0.097	6.373	0.202	0.316	1.513	0.385	0.032	0.152	0.138	533.5	554.2	466.3	525.7	0.092	0.040	0.059	0.056	0.055	0.076	0.042	0.062	0.040	0.001	0.022	0.015
	average						0.101				1.501				0.143				526.2				0.065				0.072				0.019
	stdev						0.005				0.017				0.006				0.7				0.013				0.014				0.006

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	**Test**	**Cat.**	**Fuel S**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**
2000	I0206005	OE	5	0.346	0.003	0.013	0.077	6.040	0.033	0.069	1.289	0.145	0.009	0.008	0.037	566.2	611.7	507.6	573.7	0.133	0.010	0.011	0.036	0.140	0.046	0.015	0.057	0.023	0.000	0.008	0.007
Jeep	I0206014	OE	5	0.397	0.004	0.011	0.087	8.039	0.000	0.038	1.679	0.112	0.038	0.007	0.045	565.1	613.4	505.7	573.8	0.185	0.008	0.015	0.047	0.200	0.034	0.009	0.062	0.026	0.022	0.008	0.019
Grand	average						0.082				1.484				0.041				573.8				0.041				0.059				0.013
Cherokee	stdev						0.007				0.276				0.006				0.1				0.008				0.003				0.009
	I0206022	OE	30	0.352	0.005	0.013	0.079	4.776	0.022	0.019	1.005	0.194	0.050	0.160	0.110	572.4	617.9	511.2	579.1	0.051	0.004	0.046	0.025	0.008	0.000	0.000	0.002	0.035	0.017	0.057	0.032
	I0206025	OE	30	0.359	0.004	0.010	0.079	6.234	0.027	0.019	1.310	0.164	0.044	0.138	0.095	573.2	616.7	508.3	577.9	0.091	0.008	0.032	0.032	0.093	0.033	0.000	0.036	0.032	0.022	0.053	0.033
	average						0.079				1.158				0.103				578.5				0.029				0.019				0.032
	stdev						0.000				0.216				0.011				0.9				0.004				0.024				0.001
	I0206031	OE	150	0.427	0.015	0.013	0.100	9.940	0.395	0.034	2.269	0.239	0.194	0.442	0.271	587.0	622.8	522.2	587.9	0.121	0.033	0.014	0.046	0.084	0.072	0.000	0.055	0.131	0.165	0.200	0.167
	I0206048	OE	150	0.363	0.012	0.021	0.087	7.873	0.033	0.495	1.785	0.185	0.086	0.012	0.086	555.5	594.8	503.4	561.6	0.176	0.018	0.116	0.078	0.152	0.055	0.070	0.079	0.059	0.104	0.024	0.072
	I0206056	OE	150	0.381	0.010	0.022	0.090	8.983	0.160	0.582	2.105	0.136	0.022	0.009	0.042	566.3	608.0	520.5	575.3	0.197	0.032	0.226	0.120	0.233	0.099	0.123	0.133	0.074	0.057	0.031	0.053
	average						0.092				2.053				0.133				574.9				0.081				0.089				0.098
	stdev						0.007				0.246				0.122				13.1				0.037				0.040				0.061
	I0207002	Aged	5	0.244	0.006	0.015	0.058	4.961	0.014	0.112	1.065	0.169	0.188	0.182	0.182	541.4	587.5	487.0	550.3	0.035	0.002	0.005	0.010	0.000	0.000	0.000	0.000	0.032	0.021	0.029	0.025
	I0207006	Aged	5	0.311	0.005	0.013	0.071	7.116	0.018	0.101	1.512	0.093	0.120	0.155	0.124	545.0	585.6	483.2	549.1	0.113	0.006	0.008	0.029	0.063	0.016	0.006	0.023	0.019	0.015	0.024	0.018
	I0207014	Aged	5	0.288	0.005	0.015	0.066	6.331	0.014	0.047	1.332	0.124	0.175	0.265	0.189	541.0	575.3	479.5	541.9	0.082	0.004	0.000	0.019	0.031	0.003	0.000	0.008	0.020	0.018	0.034	0.023
	average						0.065				1.303				0.165				547.1				0.019				0.010				0.022
	stdev						0.007				0.225				0.036				4.6				0.010				0.011				0.004
	I0207022	Aged	30	0.363	0.005	0.012	0.081	8.285	0.036	0.055	1.751	0.155	0.165	0.177	0.166	546.2	584.9	482.6	548.8	0.096	0.031	0.002	0.036	0.057	0.041	0.000	0.033	0.024	0.022	0.051	0.030
	I0207025	Aged	30	0.275	0.007	0.014	0.065	6.206	0.015	0.057	1.311	0.113	0.253	0.203	0.210	524.5	561.5	463.0	526.7	0.077	0.003	0.003	0.018	0.026	0.005	0.000	0.008	0.024	0.022	0.039	0.027
	average						0.073				1.531				0.188				537.8				0.027				0.020				0.029
	stdev						0.012				0.311				0.031				15.6				0.013				0.017				0.003
	I0207035	Aged	150	0.283	0.005	0.012	0.065	5.516	0.018	0.040	1.163	0.304	0.318	0.427	0.345	554.2	595.6	490.1	558.1	0.037	0.003	0.003	0.010	0.001	0.000	0.000	0.000	0.085	0.091	0.176	0.113
	I0207037	Aged	150	0.306	0.006	0.014	0.070	6.489	0.016	0.081	1.375	0.181	0.340	0.352	0.310	553.4	594.2	490.3	557.2	0.077	0.003	0.004	0.019	0.038	0.007	0.000	0.012	0.063	0.078	0.139	0.092
	average						0.067				1.269				0.328				557.6				0.014				0.006				0.102
	stdev						0.004				0.150				0.025				0.6				0.006				0.008				0.015

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0203016	OE	5	0.119	0.003	0.004	0.027	2.428	0.046	0.027	0.535	0.160	0.008	0.080	0.059	452.8	453.5	365.5	429.2	0.002	0.001	-0.001	0.001	0.000	0.000	0.000	0.000	0.003	0.000	0.004	0.002
Buick	I0203020	OE	5	0.115	0.003	0.003	0.026	2.642	0.030	0.010	0.566	0.135	0.005	0.068	0.050	443.8	452.4	367.9	427.4	0.007	0.002	0.001	0.003	0.000	0.000	0.000	0.000	0.002	0.000	0.006	0.002
LeSabre	average						0.027				0.551				0.055				428.3				0.002				0.000				0.002
	stdev						0.001				0.022				0.006				1.253				0.001				0.000				0.000
	I0203031	OE	30	0.102	0.002	0.003	0.023	2.617	0.040	0.030	0.572	0.189	0.008	0.095	0.069	449.7	444.5	358.7	422.0	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.003	0.000	0.006	0.002
	I0203040	OE	30	0.120	0.003	0.004	0.028	2.516	0.056	0.008	0.553	0.147	0.007	0.085	0.057	446.7	443.9	356.6	420.5	0.006	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.003	0.000	0.006	0.002
	average						0.026				0.563				0.063				421.3				0.001				0.000				0.002
	stdev						0.004				0.013				0.008				1.068				0.000				0.000				0.000
	I0203048	OE	150	0.107	0.004	0.006	0.026	2.306	0.024	0.023	0.498	0.177	0.005	0.102	0.067	446.5	447.3	367.0	425.1	0.003	0.002	0.001	0.002	0.000	0.000	0.000	0.000	0.006	0.000	0.012	0.004
	I0203051	OE	150	0.111	0.002	0.005	0.025	3.349	0.051	0.010	0.725	0.165	0.004	0.087	0.060	445.7	443.7	360.9	421.3	0.003	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.003	0.000	0.008	0.003
	average						0.026				0.612				0.064				423.2				0.002				0.000				0.004
	stdev						0.000				0.161				0.005				2.655				0.001				0.000				0.001
	I0202051	Aged	5	0.116	0.004	0.008	0.028	2.350	0.022	0.082	0.521	0.170	0.003	0.084	0.060	442.3	443.2	363.2	421.0	0.010	0.001	0.004	0.004	0.000	0.000	0.000	0.000	0.007	0.000	0.008	0.004
	I0202054	Aged	5	0.126	0.002	0.008	0.029	3.325	0.032	0.132	0.743	0.166	0.003	0.080	0.058	446.6	449.9	365.5	426.0	0.008	0.003	0.008	0.005	0.000	0.000	0.000	0.000	0.008	0.000	0.007	0.004
	average						0.029				0.632				0.059				423.5				0.005				0.000				0.004
	stdev						0.001				0.157				0.001				3.536				0.001				0.000				0.000
	I0202063	Aged	30	0.135	0.004	0.009	0.033	3.382	0.009	0.126	0.741	0.122	0.003	0.088	0.051	442.1	442.8	360.3	420.0	0.001	0.000	-0.002	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.007	0.003
	I0203002	Aged	30	0.119	0.003	0.008	0.028	3.061	0.014	0.111	0.673	0.187	0.004	0.085	0.064	443.9	441.6	359.9	419.6	0.010	0.002	0.006	0.004	0.003	0.000	0.000	0.001	0.007	0.000	0.007	0.003
	average						0.030				0.707				0.058				419.8				0.002				0.000				0.003
	stdev						0.003				0.048				0.009				0.257				0.003				0.000				0.000
	I0203006	Aged	150	0.124	0.005	0.016	0.033	3.584	0.236	0.929	1.121	0.197	0.009	0.111	0.076	445.2	449.7	368.2	426.4	0.013	0.010	0.030	0.016	0.008	0.010	0.018	0.012	0.024	0.001	0.039	0.016
	I0203009	Aged	150	0.155	0.004	0.009	0.037	4.540	0.087	0.295	1.067	0.108	0.003	0.129	0.059	483.3	507.3	396.3	471.8	0.020	0.005	0.012	0.010	0.002	0.002	0.004	0.003	N/A	N/A	N/A	N/A
	average						0.035				1.094				0.068				449.1				0.013				0.007				0.016
	stdev						0.003				0.038				0.012				32.149				0.004				0.006				N/A

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0203021	OE	5	0.365	0.003	0.003	0.078	4.907	0.063	0.001	1.051	0.035	0.000	0.018	0.012	329.2	335.9	285.2	320.6	0.094	0.016	0.001	0.028	0.062	0.014	0.000	0.020	0.002	0.000	0.000	0.000
Dodge	I0203024	OE	5	0.296	0.003	0.002	0.063	3.655	0.024	0.000	0.771	0.029	0.001	0.020	0.012	328.1	335.1	285.2	319.9	0.077	0.012	0.000	0.023	0.043	0.011	0.000	0.015	0.004	0.000	0.000	0.001
Neon	average						0.071				0.911				0.012				320.2				0.025				0.018				0.001
	stdev						0.010				0.198				0.000				0.501				0.004				0.004				0.000
	I0203046	OE	30	0.333	0.002	0.002	0.071	4.136	0.023	0.000	0.870	0.041	0.003	0.018	0.015	329.0	337.8	286.8	322.0	0.097	0.011	-0.001	0.025	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	I0203050	OE	30	0.370	0.002	0.002	0.078	4.528	0.012	0.000	0.947	0.039	0.006	0.013	0.015	330.8	338.1	285.1	322.0	0.077	0.006	-0.002	0.018	0.058	0.008	0.000	0.016	0.003	0.000	0.001	0.001
	average						0.075				0.909				0.015				322.0				0.022				0.016				0.001
	stdev						0.005				0.054				0.000				0.011				0.005				N/A				N/A
	I0203030	OE	150	0.349	0.002	0.003	0.074	4.014	0.065	0.063	0.883	0.047	0.004	0.014	0.016	326.7	331.6	280.8	316.6	0.100	0.026	0.007	0.036	0.077	0.024	0.005	0.030	0.010	0.001	0.006	0.004
	I0203034	OE	150	0.232	0.003	0.003	0.050	2.492	0.028	0.053	0.546	0.098	0.009	0.023	0.031	323.4	334.2	281.3	317.4	0.013	0.012	0.003	0.010	0.002	0.004	0.000	0.002	0.013	0.001	0.008	0.005
	I0203039	OE	150	0.278	0.002	0.004	0.060	2.964	0.088	0.090	0.685	0.067	0.015	0.034	0.031	326.9	335.5	285.8	320.1	0.037	0.020	0.003	0.019	0.023	0.015	0.002	0.013	0.014	0.004	0.010	0.008
	average						0.061				0.705				0.026				318.0				0.022				0.015				0.006
	stdev						0.012				0.169				0.009				1.792				0.013				0.014				0.002
	I0202043	Aged	5	0.341	0.004	0.006	0.074	4.327	0.030	0.002	0.915	0.020	0.004	0.009	0.009	335.5	341.1	289.2	325.6	0.068	0.016	0.003	0.023	0.039	0.012	0.000	0.014	0.002	0.000	0.000	0.000
	I0202046	Aged	5	0.314	0.003	0.003	0.067	3.722	0.045	0.029	0.805	0.033	0.003	0.002	0.009	333.1	337.3	285.0	322.1	0.066	0.016	0.008	0.024	0.043	0.015	0.003	0.018	0.009	0.000	0.000	0.002
	average						0.071				0.860				0.009				323.9				0.024				0.016				0.001
	stdev						0.005				0.078				0.000				2.534				0.001				0.002				0.001
	I0202050	Aged	30	0.288	0.004	0.004	0.063	2.990	0.051	0.001	0.648	0.030	0.002	0.039	0.018	327.3	335.2	283.0	319.2	0.055	0.018	0.001	0.021	0.052	0.011	0.000	0.016	0.020	0.021	0.014	0.019
	I0202053	Aged	30	0.235	0.003	0.003	0.051	2.878	0.026	0.001	0.610	0.023	0.024	0.044	0.029	324.9	331.8	283.7	317.1	0.057	0.010	0.001	0.017	0.044	0.006	0.000	0.012	0.006	0.000	0.000	0.001
	average						0.057				0.629				0.024				318.2				0.019				0.014				0.010
	stdev						0.008				0.027				0.008				1.474				0.003				0.003				0.013
	I0202062	Aged	150	0.359	0.001	0.005	0.076	4.696	0.035	0.045	1.006	0.044	0.007	0.018	0.018	330.7	337.5	285.0	321.7	0.080	0.016	0.007	0.027	0.054	0.018	0.002	0.021	0.009	0.001	0.006	0.004
	I0203001	Aged	150	0.285	0.004	0.004	0.062	3.040	0.029	0.025	0.654	0.080	0.003	0.033	0.027	329.1	334.8	284.4	319.7	0.040	0.020	0.006	0.020	0.019	0.011	0.004	0.011	0.011	0.001	0.005	0.004
	I0203008	Aged	150	0.274	0.002	0.004	0.059	3.407	0.062	0.069	0.759	0.075	0.016	0.030	0.032	328.8	335.9	282.8	319.8	0.062	0.029	0.010	0.031	0.050	0.029	0.008	0.027	0.017	0.003	0.005	0.006
	average						0.066				0.806				0.026				320.4				0.026				0.020				0.005

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0203007	OE	5	0.184	0.002	0.008	0.041	2.373	0.014	0.050	0.513	0.164	0.010	0.093	0.065	392.5	369.3	313.4	358.7	0.018	0.009	0.006	0.010	0.006	0.003	0.000	0.003	0.024	0.001	0.023	0.012
Toyota	I0203010	OE	5	0.171	0.003	0.009	0.039	2.179	0.018	0.033	0.470	0.162	0.009	0.070	0.058	393.3	369.2	310.7	358.1	0.010	0.009	0.008	0.009	0.004	0.002	0.000	0.002	0.037	0.001	0.020	0.014
Camry	average						0.040				0.492				0.062				358.4				0.010				0.002				0.013
	stdev						0.001				0.030				0.005				0.4				0.001				0.001				0.001
	I0203017	OE	30	0.152	0.003	0.009	0.036	1.924	0.013	0.074	0.426	0.143	0.009	0.068	0.053	373.4	340.8	299.5	336.2	0.019	0.010	0.001	0.009	0.001	0.001	0.000	0.001	0.029	0.001	0.020	0.012
	I0203022	OE	30	0.139	0.003	0.008	0.033	1.685	0.021	0.048	0.373	0.155	0.008	0.083	0.059	386.3	369.2	312.7	357.2	0.011	0.007	0.005	0.007	0.000	0.000	0.000	0.000	0.032	0.000	0.020	0.012
	I0203026	OE	30	0.157	0.002	0.011	0.037	1.954	0.018	0.097	0.441	0.155	0.010	0.077	0.058	385.4	364.3	311.4	354.1	0.011	0.006	0.011	0.008	0.000	0.000	0.000	0.000	0.035	0.001	0.018	0.013
	average						0.035				0.413				0.057				349.2				0.008				0.000				0.012
	stdev						0.002				0.036				0.003				11.3				0.001				0.001				0.000
	I0203041	OE	150	0.155	0.003	0.011	0.037	2.039	0.037	0.118	0.474	0.206	0.026	0.114	0.088	388.6	367.1	310.4	356.0	0.015	0.003	0.001	0.005	0.000	0.000	0.000	0.000	0.056	0.008	0.037	0.026
	I0203045	OE	150	0.154	0.002	0.011	0.036	2.089	0.009	0.099	0.465	0.200	0.010	0.082	0.069	385.1	366.3	309.7	354.6	0.017	0.002	0.001	0.005	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	average						0.037				0.470				0.079				355.3				0.005				0.000				0.026
	stdev						0.001				0.006				0.013				1.0				0.000				N/A				N/A
	I0201046	Aged	5	0.200	0.004	0.010	0.046	2.762	0.016	0.034	0.591	0.135	0.013	0.109	0.065	395.6	376.1	314.5	363.2	0.035	0.004	0.027	0.017	0.028	0.005	0.000	0.008	0.023	0.001	0.019	0.010
	I0202001	Aged	5	0.123	0.003	0.011	0.030	1.719	0.015	0.073	0.384	0.174	0.006	0.079	0.061	385.6	375.0	316.0	361.0	0.013	0.008	0.018	0.012	0.004	0.001	0.005	0.003	0.026	0.000	0.019	0.011
	I0202008	Aged	5	0.133	0.002	0.008	0.031	2.075	0.014	0.043	0.450	0.101	0.009	0.080	0.048	389.3	372.1	313.8	359.6	0.023	0.005	0.015	0.011	0.006	0.000	0.001	0.002	0.026	0.000	0.018	0.010
	average						0.036				0.475				0.058				361.3				0.013				0.004				0.010
	stdev						0.009				0.106				0.009				1.8				0.003				0.004				0.000
	I0202016	Aged	30	0.164	0.004	0.011	0.039	2.565	0.016	0.045	0.553	0.141	0.010	0.084	0.058	386.8	372.3	314.7	359.5	0.033	0.008	0.011	0.014	0.007	0.004	0.000	0.004	0.027	0.004	0.022	0.014
	I0202018	Aged	30	0.161	0.002	0.008	0.037	1.974	0.020	0.021	0.425	0.148	0.012	0.079	0.059	405.8	383.6	318.5	370.3	0.027	0.008	0.005	0.011	0.006	0.004	0.000	0.003	0.031	0.002	0.019	0.012
	average						0.038				0.489				0.059				364.9				0.012				0.003				0.013
	stdev						0.002				0.091				0.001				7.7				0.002				0.000				0.001
	I0202036	Aged	150	0.172	0.003	0.014	0.041	3.366	0.025	0.110	0.741	0.166	0.017	0.099	0.070	399.9	374.5	315.0	363.4	0.019	0.001	0.008	0.007	0.000	0.000	0.000	0.000	0.045	0.007	0.038	0.023
	I0202037	Aged	150	0.128	0.002	0.010	0.030	1.712	0.011	0.056	0.377	0.189	0.008	0.087	0.068	385.7	370.4	313.9	358.0	0.017	0.005	0.008	0.008	0.000	0.000	0.000	0.000	0.063	0.001	0.029	0.021
	I0202057	Aged	150	0.116	0.003	0.013	0.029	1.381	0.011	0.088	0.316	0.181	0.019	0.091	0.073	377.3	365.8	311.1	353.1	0.020	0.002	0.005	0.007	0.001	0.000	0.000	0.000	0.072	0.008	0.037	0.029
	average						0.033				0.478				0.070				358.2				0.007				0.000				0.025
	stdev						0.007				0.230				0.003				5.1				0.001				0.000				0.004

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	**Test**	**Cat.**	**Fuel S**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**	**bag 1**	**bag 2**	**bag 3**	**Wgtd**
2001	I0205020	OE	5	0.134	0.003	0.004	0.030	1.243	0.013	0.000	0.265	0.107	0.003	0.015	0.028	417.3	436.4	362.8	412.2	0.005	0.001	0.008	0.004	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.001
Chrysler	I0205023	OE	5	0.145	0.003	0.003	0.033	1.248	0.005	0.000	0.262	0.154	0.002	0.008	0.035	413.1	431.4	359.4	407.8	0.004	0.002	0.017	0.007	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.001
Sebring	average						0.032				0.264				0.032				410.0				0.005				0.000				0.001
	stdev						0.002				0.002				0.005				3.094				0.002				0.000				0.000
	I0205027	OE	30	0.143	0.003	0.003	0.032	1.737	0.328	0.000	0.530	0.074	0.000	0.027	0.023	408.3	428.0	359.0	404.9	0.027	0.044	0.004	0.030	0.005	0.048	0.000	0.026	0.009	0.000	0.000	0.002
	I0205031	OE	30	0.129	0.003	0.003	0.029	1.467	0.156	0.000	0.385	0.096	0.001	0.027	0.028	407.6	431.8	360.2	407.1	0.010	0.016	0.020	0.016	0.000	0.004	0.000	0.002	0.011	0.000	0.000	0.002
	average						0.031				0.458				0.026				406.0				0.023				0.014				0.002
	stdev						0.002				0.103				0.004				1.540				0.010				0.017				0.000
	I0205039	OE	150	0.155	0.007	0.003	0.036	1.889	0.510	0.000	0.656	0.101	0.044	0.086	0.067	408.0	425.6	359.5	403.8	0.014	0.030	-0.002	0.018	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	I0205040	OE	150	0.148	0.003	0.002	0.033	1.324	0.123	0.000	0.338	0.164	0.001	0.083	0.057	412.4	437.8	361.9	411.7	0.006	0.014	-0.001	0.008	0.000	0.000	0.000	0.000	0.019	0.000	0.004	0.005
	I0205044	OE	150	0.149	0.006	0.002	0.035	1.416	0.296	0.000	0.447	0.106	0.010	0.032	0.036	417.6	440.2	362.2	414.1	0.006	0.025	0.001	0.015	0.000	0.000	0.000	0.000	0.014	0.006	0.005	0.008
	average						0.035				0.480				0.053				409.8				0.014				0.000				0.006
	stdev						0.002				0.162				0.016				5.400				0.005				0.000				0.002
	I0205051	Aged	5	0.130	0.004	0.004	0.030	1.827	0.143	0.000	0.453	0.059	0.000	0.030	0.021	413.4	432.4	358.6	408.2	0.038	0.033	0.024	0.031	0.018	0.028	0.000	0.018	0.007	0.000	0.000	0.001
	I0205054	Aged	5	0.136	0.002	0.003	0.030	1.753	0.253	0.000	0.495	0.057	0.000	0.008	0.014	410.9	429.3	357.1	405.6	0.023	0.033	0.007	0.024	0.001	0.024	0.000	0.013	0.006	0.000	0.000	0.001
	I0205060	Aged	5	0.122	0.003	0.004	0.028	1.184	0.122	0.000	0.309	0.065	0.000	0.034	0.023	416.2	444.5	365.0	416.8	0.011	0.010	-0.003	0.006	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.001
	average						0.029				0.419				0.019				410.2				0.021				0.010				0.001
	stdev						0.001				0.098				0.005				5.856				0.013				0.009				0.000
	I0205065	Aged	30	0.122	0.004	0.004	0.028	1.996	0.182	0.000	0.508	0.065	0.001	0.039	0.024	404.5	424.0	354.9	400.9	0.018	0.023	-0.003	0.015	0.000	0.014	0.000	0.007	0.008	0.000	0.000	0.002
	I0205066	Aged	30	0.123	0.003	0.002	0.028	1.444	0.101	0.000	0.352	0.088	0.000	0.017	0.023	414.6	438.8	360.1	412.2	0.010	0.010	0.007	0.009	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.002
	average						0.028				0.430				0.024				406.5				0.012				0.004				0.002
	stdev						0.001				0.110				0.001				7.931				0.004				0.005				0.000
	I0206004	Aged	150	0.120	0.003	0.002	0.027	1.202	0.080	0.000	0.290	0.101	0.013	0.115	0.059	415.4	438.5	363.0	413.0	0.012	0.005	0.000	0.005	0.000	0.000	0.000	0.000	0.017	0.006	0.013	0.010
	I0206011	Aged	150	0.138	0.003	0.003	0.031	1.399	0.061	0.000	0.322	0.088	0.002	0.095	0.045	405.7	425.9	356.1	402.5	0.007	0.006	-0.003	0.004	0.000	0.000	0.000	0.000	0.012	0.001	0.005	0.004
	I0206015	Aged	150	0.138	0.002	0.003	0.030	1.359	0.070	0.000	0.318	0.102	0.001	0.029	0.030	405.3	426.3	354.1	402.0	0.005	0.012	0.006	0.009	0.000	0.000	0.000	0.000	0.012	0.000	0.002	0.003
	average						0.029				0.310				0.045				405.9				0.006				0.000				0.006
	stdev						0.002				0.017				0.015				6.177				0.003				0.000				0.004

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0205061	OE	5	0.172	0.003	0.006	0.039	2.373	0.057	0.000	0.521	0.059	0.030	0.105	0.057	431.4	429.1	352.6	408.6	0.078	0.003	-0.001	0.017	0.053	0.007	0.000	0.015	0.007	0.000	0.008	0.004
Acura	I0206010	OE	5	0.141	0.004	0.007	0.033	1.746	0.049	0.000	0.387	0.053	0.011	0.058	0.032	417.6	421.5	346.0	399.9	0.047	0.005	0.005	0.013	0.020	0.001	0.000	0.005	0.008	0.000	0.005	0.003
3.2 CL	I0206013	OE	5	0.161	0.003	0.006	0.037	1.984	0.024	0.000	0.423	0.063	0.036	0.107	0.061	427.9	427.8	347.2	405.7	0.069	0.002	-0.002	0.015	0.047	0.007	0.000	0.013	0.004	0.000	0.010	0.003
	average						0.036				0.444				0.050				404.7				0.015				0.011				0.003
	stdev						0.003				0.069				0.016				4.4				0.002				0.006				0.000
	I0206023	OE	30	0.134	0.003	0.006	0.031	1.296	0.042	0.008	0.292	0.070	0.037	0.149	0.075	420.7	420.8	343.1	399.4	0.041	0.004	0.000	0.011	0.020	0.004	0.000	0.006	0.005	0.000	0.010	0.004
	I0206027	OE	30	0.140	0.002	0.005	0.031	1.279	0.058	0.012	0.298	0.106	0.031	0.059	0.054	426.9	426.6	347.3	404.9	0.026	0.003	0.002	0.008	0.011	0.000	0.000	0.002	0.008	0.000	0.008	0.004
	average						0.031				0.295				0.065				402.1				0.009				0.004				0.004
	stdev						0.000				0.004				0.015				3.9				0.002				0.003				0.000
	I0206049	OE	150	0.146	0.004	0.006	0.034	1.695	0.078	0.011	0.394	0.065	0.010	0.131	0.055	418.4	416.4	338.2	395.3	0.029	0.004	0.000	0.008	0.010	0.003	0.000	0.004	0.010	0.000	0.015	0.006
	I0206055	OE	150	0.146	0.004	0.007	0.034	1.619	0.131	0.014	0.407	0.061	0.023	0.113	0.055	419.9	422.6	343.9	400.5	0.054	0.017	0.000	0.020	0.027	0.012	0.000	0.012	0.008	0.000	0.024	0.008
	average						0.034				0.401				0.055				397.9				0.014				0.008				0.007
	stdev						0.000				0.009				0.000				3.6				0.009				0.006				0.002
	I0206064	Aged	5	0.180	0.002	0.011	0.041	3.149	0.113	0.054	0.726	0.097	0.031	0.112	0.067	429.7	430.0	357.5	410.0	0.039	0.011	0.002	0.014	0.027	0.019	0.001	0.016	0.014	0.000	0.018	0.008
	I0206069	Aged	5	0.173	0.002	0.012	0.040	3.025	0.185	0.040	0.733	0.061	0.035	0.096	0.057	428.3	428.2	350.9	407.0	0.032	0.014	0.000	0.014	0.022	0.027	0.000	0.018	0.006	0.000	0.018	0.006
	average						0.041				0.730				0.062				408.5				0.014				0.017				0.008
	stdev						0.001				0.005				0.007				2.1				0.000				0.002				0.001
	I0207005	Aged	30	0.222	0.002	0.011	0.050	3.748	0.212	0.017	0.889	0.054	0.011	0.201	0.072	415.4	416.0	341.3	395.4	0.103	0.031	0.000	0.037	0.077	0.056	0.002	0.046	0.007	0.000	0.021	0.007
	I0207007	Aged	30	0.179	0.003	0.009	0.041	2.638	0.050	0.011	0.575	0.070	0.018	0.162	0.068	414.2	417.2	339.4	395.2	0.059	0.006	0.000	0.015	0.043	0.015	0.000	0.017	0.007	0.000	0.017	0.006
	average						0.046				0.732				0.070				395.3				0.026				0.031				0.007
	stdev						0.006				0.222				0.003				0.1				0.015				0.020				0.001
	I0207015	Aged	150	0.190	0.003	0.009	0.043	3.196	0.062	0.013	0.697	0.065	0.014	0.215	0.080	411.1	410.9	340.7	391.7	0.098	0.005	0.000	0.023	0.077	0.017	0.000	0.025	0.011	0.000	0.019	0.007
	I0207016	Aged	150	0.186	0.003	0.009	0.043	3.005	0.056	0.013	0.655	0.074	0.033	0.078	0.054	405.4	416.0	339.4	392.8	0.068	0.005	0.001	0.017	0.031	0.006	0.000	0.010	0.015	0.001	0.016	0.008
	I0207020	Aged	150	0.177	0.005	0.012	0.043	2.492	0.139	0.011	0.592	0.061	0.023	0.271	0.099	408.5	414.0	339.6	392.4	0.052	0.016	0.001	0.019	0.035	0.025	0.000	0.021	0.011	0.000	0.029	0.010
	average						0.043				0.648				0.078				392.3				0.020				0.018				0.009
	stdev						0.000				0.053				0.023				0.6				0.003				0.008				0.002

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0202024	OE	5	0.140	0.004	0.006	0.033	2.134	0.041	0.038	0.474	0.107	0.000	0.073	0.042	484.1	489.0	414.4	467.5	0.045	0.004	0.006	0.013	0.042	0.005	0.000	0.011	0.015	0.000	0.006	0.005
Ford	I0202029	OE	5	0.131	0.005	0.006	0.031	1.968	0.030	0.032	0.433	0.124	0.000	0.018	0.031	479.2	485.2	407.7	462.6	0.035	0.011	0.010	0.016	0.019	0.010	0.001	0.009	0.021	0.000	0.002	0.005
Windstar	average						0.032				0.454				0.037				465.1				0.014				0.010				0.005
	stdev						0.001				0.029				0.008				3.4				0.002				0.001				0.000
	I0202047	OE	30	0.140	0.008	0.010	0.036	1.843	0.040	0.022	0.409	0.114	0.000	0.044	0.036	498.5	505.4	414.9	479.1	0.025	0.015	0.007	0.015	0.005	0.012	0.000	0.007	0.022	0.000	0.004	0.006
	I0202049	OE	30	0.119	0.009	0.008	0.032	1.620	0.028	0.046	0.363	0.174	0.001	0.013	0.040	469.4	485.5	409.3	461.2	0.031	0.014	0.036	0.023	0.008	0.012	0.022	0.014	0.027	0.000	0.001	0.006
	average						0.034				0.386				0.038				470.1				0.019				0.011				0.006
	stdev						0.003				0.033				0.003				12.7				0.006				0.005				0.000
	I0202056	OE	150	0.132	0.011	0.021	0.039	1.863	0.083	0.170	0.475	0.158	0.013	0.109	0.070	481.9	488.7	412.7	466.4	0.070	0.048	0.020	0.045	0.064	0.060	0.015	0.048	0.043	0.009	0.028	0.021
	I0202058	OE	150	0.121	0.008	0.009	0.032	1.790	0.066	0.051	0.420	0.150	0.003	0.082	0.055	470.5	481.9	407.6	459.1	0.040	0.035	0.013	0.030	0.053	0.052	0.013	0.041	0.030	0.001	0.009	0.009
	average						0.035				0.448				0.063				462.8				0.037				0.045				0.015
	stdev						0.005				0.039				0.011				5.174				0.010				0.005				0.008
	I0201036	Aged	5	0.136	0.003	0.008	0.032	2.055	0.065	0.180	0.509	0.172	0.001	0.023	0.042	470.4	485.4	412.2	462.1	0.088	0.028	0.057	0.049	0.084	0.038	0.060	0.054	0.029	0.000	0.004	0.007
	I0201041	Aged	5	0.136	0.006	0.011	0.034	1.852	0.065	0.317	0.505	0.181	0.001	0.047	0.051	485.3	494.0	416.8	470.9	0.096	0.038	0.074	0.060	0.085	0.053	0.075	0.066	0.023	0.000	0.004	0.006
	average						0.033				0.507				0.047				466.5				0.054				0.060				0.006
	stdev						0.002				0.003				0.006				6.2				0.008				0.009				0.001
	I0201045	Aged	30	0.170	0.004	0.008	0.040	2.614	0.050	0.128	0.604	0.176	0.002	0.028	0.045	490.4	493.3	414.0	470.9	0.105	0.027	0.057	0.051	0.101	0.042	0.060	0.059	0.031	0.000	0.003	0.007
	I0202002	Aged	30	0.147	0.004	0.009	0.035	2.432	0.063	0.187	0.589	0.205	0.001	0.019	0.048	481.8	486.7	412.3	465.2	0.122	0.039	0.079	0.067	0.154	0.058	0.091	0.087	0.026	0.000	0.003	0.006
	average						0.037				0.597				0.047				468.0				0.059				0.073				0.007
	stdev						0.003				0.011				0.002				4.0				0.011				0.020				0.001
	I0202009	Aged	150	0.158	0.008	0.020	0.042	2.361	0.158	0.453	0.697	0.218	0.025	0.137	0.096	483.4	492.4	412.5	468.5	0.113	0.061	0.057	0.071	0.126	0.074	0.055	0.079	0.050	0.010	0.037	0.026
	I0202011	Aged	150	0.155	0.005	0.013	0.038	2.381	0.073	0.287	0.611	0.202	0.002	0.039	0.054	479.1	485.5	412.1	464.0	0.124	0.050	0.101	0.079	0.112	0.063	0.099	0.083	0.026	0.000	0.008	0.008
	I0202014	Aged	150	0.141	0.010	0.014	0.038	2.454	0.131	0.255	0.648	0.224	0.016	0.064	0.072	472.7	481.7	411.3	460.4	0.123	0.070	0.056	0.077	0.091	0.079	0.052	0.074	N/A	N/A	N/A	N/A
	average						0.040				0.652				0.074				464.3				0.076				0.079				0.017
	stdev						0.002				0.043				0.021				4.0				0.005				0.005				0.013

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2000	I0204042	OE	5	0.082	0.001	0.002	0.018	0.333	0.164	0.089	0.178	0.065	0.000	0.020	0.019	368.6	353.2	302.5	342.5	0.008	0.003	-0.002	0.003	0.000	0.000	0.000	0.000	0.006	0.000	0.003	0.002
Honda	I0204045	OE	5	0.101	0.009	0.007	0.028	0.271	0.153	0.090	0.160	0.069	0.000	0.013	0.018	368.5	354.9	305.2	344.1	0.004	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.004	0.000	0.002	0.001
Accord	I0204051	OE	5	0.097	0.003	0.004	0.023	0.302	0.127	0.123	0.162	0.075	0.000	0.030	0.024	372.7	356.8	307.5	346.5	0.001	0.002	0.001	0.002	0.000	0.000	0.000	0.000	0.006	0.000	0.006	0.003
	average						0.023				0.167				0.020				344.4				0.002				0.000				0.002
	stdev						0.005				0.010				0.003				2.0				0.000				0.000				0.001
	I0204056	OE	30	0.077	0.001	0.001	0.017	0.284	0.152	0.038	0.148	0.064	0.000	0.020	0.019	365.5	356.2	303.5	343.6	0.008	0.004	-0.001	0.003	0.000	0.000	0.000	0.000	0.003	0.000	0.001	0.001
	I0204060	OE	30	0.077	0.006	0.006	0.021	0.305	0.126	0.049	0.142	0.066	0.000	0.009	0.016	369.3	358.0	307.3	346.4	0.001	0.000	-0.002	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.001	0.001
	average						0.019				0.145				0.018				345.0				0.002				0.000				0.001
	stdev						0.003				0.004				0.002				1.974				0.003				0.000				0.000
	I0204069	OE	150	0.074	0.002	0.003	0.017	0.240	0.113	0.013	0.112	0.063	0.000	0.013	0.017	368.4	356.5	306.1	345.2	0.002	0.004	-0.001	0.002	0.000	0.000	0.000	0.000	0.005	0.000	0.001	0.001
	I0204075	OE	150	0.089	0.003	0.004	0.021	0.201	0.076	0.001	0.081	0.073	0.000	0.032	0.024	373.3	358.9	305.9	347.3	0.006	0.003	0.001	0.003	0.000	0.000	0.000	0.000	0.004	0.000	0.004	0.002
	I0205007	OE	150	0.085	0.004	0.004	0.021	0.259	0.108	0.003	0.111	0.070	0.001	0.015	0.019	365.2	357.2	305.4	344.7	0.006	0.004	0.001	0.004	0.000	0.000	0.000	0.000	0.004	0.000	0.003	0.002
	average						0.020				0.101				0.020				345.7				0.003				0.000				0.002
	stdev						0.002				0.018				0.004				1.416				0.001				0.000				0.000
	I0204011	Aged	5	0.066	0.003	0.004	0.016	0.293	0.199	0.083	0.187	0.061	0.001	0.020	0.019	373.0	356.0	306.2	345.8	0.009	0.005	0.000	0.004	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	I0204015	Aged	5	0.073	0.001	0.004	0.017	0.311	0.198	0.087	0.191	0.077	0.000	0.027	0.023	372.3	352.9	305.3	343.8	0.001	0.004	-0.001	0.002	0.000	0.001	0.000	0.001	0.003	0.000	0.003	0.001
	average						0.016				0.189				0.021				344.8				0.003				0.001				0.001
	stdev						0.001				0.003				0.003				1.420				0.002				N/A				N/A
	I0204019	Aged	30	0.061	0.003	0.006	0.016	0.291	0.198	0.060	0.180	0.073	0.000	0.029	0.023	376.6	358.4	308.1	348.3	0.010	0.014	0.004	0.009	0.000	0.010	0.000	0.005	0.004	0.000	0.004	0.002
	I0204023	Aged	30	0.069	0.002	0.004	0.016	0.346	0.165	0.088	0.181	0.075	0.000	0.019	0.021	368.7	354.1	305.8	343.9	0.004	0.004	0.001	0.003	0.000	0.001	0.000	0.000	0.002	0.000	0.003	0.001
	average						0.016				0.181				0.022				346.1				0.006				0.003				0.002
	stdev						0.000				0.001				0.001				3.161				0.004				0.003				0.001
	I0204028	Aged	150	0.070	0.002	0.005	0.017	0.356	0.134	0.059	0.159	0.069	0.000	0.025	0.021	367.6	355.7	304.8	344.2	0.015	0.018	0.009	0.015	0.005	0.018	0.001	0.011	0.005	0.000	0.005	0.002
	I0204029	Aged	150	0.068	0.001	0.005	0.016	0.274	0.099	0.020	0.113	0.070	0.000	0.028	0.022	366.1	356.8	305.8	344.7	0.006	0.014	0.006	0.010	0.000	0.000	0.000	0.000	0.004	0.000	0.006	0.003
	average						0.016				0.136				0.022				344.5				0.013				0.005				0.002
	stdev						0.001				0.033				0.001				0.402				0.003				0.008				0.000

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0205062	OE	5	0.102	0.002	0.002	0.023	0.951	0.000	0.000	0.197	0.025	0.000	0.007	0.007	360.1	331.9	298.8	328.6	0.006	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.002
Nissan	I0205064	OE	5	0.034	0.001	0.002	0.008	0.670	0.000	0.000	0.139	0.016	0.000	0.009	0.006	358.1	332.2	299.5	328.6	0.008	0.005	0.003	0.005	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000
Sentra	I0205069	OE	5	0.039	0.002	0.002	0.010	0.884	0.000	0.000	0.183	0.024	0.000	0.006	0.007	353.0	328.9	296.4	325.0	0.010	0.001	0.000	0.003	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.001
	average						0.014				0.173				0.007				327.4				0.003				0.000				0.001
	stdev						0.008				0.030				0.001				2.1				0.001				0.000				0.001
	I0206032	OE	30	0.030	0.001	0.002	0.007	0.519	0.015	0.014	0.119	0.013	0.001	0.006	0.005	352.9	327.5	298.7	324.9	0.008	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.001
	I0206062	OE	30	0.049	0.002	0.002	0.012	1.181	0.028	0.015	0.263	0.013	0.000	0.004	0.004	354.1	332.7	303.3	329.1	0.009	0.003	0.001	0.003	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.001
	I0206067	OE	30	0.025	0.002	0.002	0.007	0.624	0.020	0.027	0.147	0.055	0.000	0.005	0.013	357.6	330.5	304.6	329.0	0.011	0.004	0.001	0.005	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.002
	average						0.009				0.176				0.007				327.6				0.003				0.000				0.001
	stdev						0.003				0.076				0.005				2.4				0.001				0.000				0.001
	I0207004	OE	150	0.073	0.001	0.001	0.016	0.491	0.014	0.027	0.116	0.016	0.000	0.005	0.005	351.3	321.9	292.2	319.8	0.011	0.002	0.001	0.003	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.002
	I0207039	OE	150	0.039	0.001	0.001	0.009	0.804	0.017	0.026	0.183	0.018	0.000	0.007	0.006	353.6	328.2	300.8	325.9	0.011	0.002	0.000	0.003	0.000	0.000	0.000	0.000	0.006	0.001	0.000	0.002
	I0207041	OE	150	0.032	0.002	0.002	0.008	0.649	0.014	0.016	0.146	0.027	0.000	0.006	0.007	354.4	330.0	297.8	326.2	0.007	0.002	0.000	0.003	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.002
	average						0.011				0.148				0.006				324.0				0.003				0.000				0.002
	stdev						0.004				0.034				0.001				3.6				0.000				0.000				0.000
	I0205021	Aged	5	0.054	0.002	0.003	0.013	1.019	0.031	0.024	0.234	0.005	0.000	0.004	0.002	358.5	334.0	301.2	330.0	0.009	0.000	0.001	0.002	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	I0205022	Aged	5	0.032	0.002	0.001	0.008	0.650	0.029	0.010	0.152	0.060	0.000	0.007	0.014	355.0	330.3	298.7	326.7	0.010	0.002	0.000	0.003	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
	I0205026	Aged	5	0.042	0.002	0.002	0.011	0.671	0.034	0.039	0.167	0.024	0.000	0.008	0.007	356.0	330.7	298.2	327.0	0.005	0.001	-0.001	0.001	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.001
	average						0.011				0.184				0.008				327.9				0.002				0.000				0.000
	stdev						0.003				0.044				0.006				1.8				0.001				N/A				N/A
	I0205029	Aged	30	0.075	0.001	0.002	0.017	0.596	0.037	0.013	0.146	0.017	0.000	0.011	0.007	363.3	336.3	301.0	332.2	0.013	0.001	0.001	0.004	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000
	I0205035	Aged	30	0.041	0.002	0.003	0.010	0.778	0.031	0.017	0.182	0.025	0.000	0.005	0.006	355.3	330.0	300.7	327.1	0.006	0.000	-0.001	0.001	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.001
	I0205045	Aged	30	0.041	0.002	0.003	0.010	0.634	0.034	0.027	0.156	0.047	0.000	0.011	0.013	357.6	330.2	293.3	325.7	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
	average						0.012				0.161				0.009				328.3				0.002				0.000				0.001
	stdev						0.004				0.019				0.004				3.4				0.002				0.000				0.000
	I0205049	Aged	150	0.087	0.002	0.002	0.020	1.421	0.087	0.070	0.359	0.011	0.000	0.005	0.004	356.0	330.5	296.0	326.3	0.031	0.004	0.004	0.010	0.007	0.002	0.000	0.003	0.004	0.000	0.000	0.001
	I0205050	Aged	150	0.051	0.002	0.002	0.012	1.268	0.039	0.014	0.287	0.027	0.000	0.007	0.007	353.1	329.4	295.1	324.9	0.021	0.003	0.003	0.006	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	I0205055	Aged	150	0.047	0.002	0.002	0.011	1.097	0.050	0.045	0.266	0.026	0.000	0.005	0.007	354.9	327.9	296.1	324.8	0.013	0.008	0.002	0.007	0.002	0.002	0.000	0.002	0.003	0.000	0.000	0.001
	average						0.014				0.304				0.006				325.3				0.008				0.002				0.001
	stdev						0.005				0.049				0.002				0.9				0.002				0.001				0.000

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2000	I0204046	OE	5	0.449	0.004	0.003	0.096	2.723	0.194	0.076	0.685	0.490	0.007	0.016	0.110	297.4	319.0	274.0	302.4	0.016	0.001	0.001	0.004	0.001	0.000	0.000	0.000	0.023	0.000	0.000	0.005
VW	I0204053	OE	5	0.492	0.002	0.002	0.103	3.815	0.225	0.069	0.943	0.284	0.020	0.020	0.075	299.4	319.5	275.6	303.3	0.031	0.002	0.001	0.008	0.020	0.005	0.000	0.007	0.034	0.000	0.001	0.007
Bora	I0204055	OE	5	0.398	0.003	0.002	0.084	2.935	0.163	0.098	0.719	0.402	0.007	0.048	0.100	301.2	324.9	277.4	306.9	0.010	0.002	0.001	0.003	0.000	0.000	0.000	0.000	0.047	0.000	0.002	0.010
	average						0.094				0.782				0.095				304.2				0.005				0.002				0.007
	stdev						0.010				0.140				0.018				2.4				0.002				0.004				0.003
	I0204070	OE	30	0.572	0.004	0.003	0.121	3.920	0.245	0.124	0.973	0.283	0.009	0.045	0.076	301.7	330.3	280.1	310.6	0.048	0.008	0.002	0.014	0.015	0.012	0.000	0.009	0.033	0.000	0.002	0.007
	I0204076	OE	30	0.504	0.004	0.003	0.107	2.936	0.195	0.067	0.727	0.317	0.004	0.031	0.076	304.7	340.2	278.1	315.9	0.024	0.005	0.001	0.008	0.000	0.000	0.000	0.000	0.037	0.000	0.001	0.008
	average						0.114				0.850				0.076				313.2				0.011				0.005				0.008
	stdev						0.010				0.174				0.000				3.7				0.005				0.01				0.000
	I0205025	OE	150	0.559	0.003	0.002	0.118	3.260	0.205	0.067	0.799	0.286	0.002	0.034	0.069	295.7	323.3	273.5	303.9	0.026	0.006	-0.001	0.008	0.002	0.001	0.000	0.001	0.036	0.000	0.002	0.008
	I0205030	OE	150	0.446	0.003	0.003	0.095	2.839	0.286	0.070	0.756	0.400	0.006	0.053	0.101	306.1	337.0	280.8	315.2	0.009	0.005	0.001	0.005	0.000	0.000	0.000	0.000	0.036	0.000	0.003	0.008
	I0205034	OE	150	0.587	0.004	0.003	0.125	3.181	0.221	0.066	0.791	0.244	0.008	0.015	0.059	318.5	344.6	293.9	325.2	0.015	0.004	0.001	0.006	0.000	0.000	0.000	0.000	0.027	0.000	0.000	0.006
	average						0.112				0.782				0.076				314.8				0.006				0.000				0.007
	stdev						0.016				0.023				0.022				10.7				0.002				0.001				0.001
	I0202059	Aged	5	0.545	0.003	0.005	0.116	3.587	0.318	0.145	0.935	0.365	0.028	0.145	0.130	301.2	325.6	281.8	308.5	0.043	0.009	0.002	0.014	0.034	0.013	0.001	0.014	0.029	0.000	0.009	0.009
	I0202061	Aged	5	0.558	0.002	0.015	0.121	3.253	0.204	0.083	0.803	0.374	0.030	0.139	0.131	301.6	324.9	280.5	307.9	0.033	0.005	0.003	0.010	0.020	0.005	0.000	0.007	0.024	0.000	0.009	0.007
	average						0.119				0.869				0.131				308.2				0.012				0.010				0.008
	stdev						0.004				0.093				0.001				0.5				0.003				0.005				0.001
	I0203029	Aged	30	0.489	0.004	0.004	0.105	3.583	0.161	0.088	0.849	0.468	0.043	0.118	0.152	301.2	328.5	280.1	309.5	0.020	0.006	0.002	0.008	0.003	0.004	0.000	0.003	0.033	0.000	0.008	0.009
	I0203043	Aged	30	0.506	0.003	0.004	0.108	3.994	0.220	0.040	0.953	0.447	0.045	0.105	0.145	300.4	322.1	277.3	305.3	0.037	0.003	-0.002	0.009	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	average						0.107				0.901				0.149				307.4				0.008				0.003				0.009
	stdev						0.002				0.074				0.005				3.0				0.001				N/A				N/A
	I0203068	Aged	150	0.518	0.003	0.005	0.110	4.342	0.097	0.061	0.966	0.522	0.052	0.102	0.163	294.4	318.4	276.9	302.0	0.031	0.003	0.001	0.008	0.008	0.005	0.000	0.004	0.035	0.001	0.007	0.010
	I0204002	Aged	150	0.524	0.003	0.004	0.111	3.721	0.115	0.062	0.848	0.460	0.013	0.098	0.129	297.5	324.8	278.0	306.3	0.027	0.003	0.002	0.008	0.000	0.000	0.000	0.000	0.036	0.000	0.007	0.009
	average						0.111				0.907				0.146				304.2				0.008				0.002				0.010
	stdev						0.001				0.083				0.024				3.0				0.000				0.003				0.000

Appendix E. Detailed FTP Emission Results

				NMHC (g/mi)				CO (g/mi)				NO_x (g/mi)				CO_2 (g/mi)				TDL-NH_3 (g/mi)				FTIR - NH_3 (g/mi)				FTIR - N_2O (g/mi)			
Vehicle	Test	Cat.	Fuel S	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd	bag 1	bag 2	bag 3	Wgtd
2001	I0204039	OE	5	0.228	0.002	0.003	0.049	1.146	0.020	0.030	0.256	0.023	0.035	0.040	0.034	303.3	292.6	263.1	286.7	0.022	0.003	-0.001	0.006	0.003	0.002	0.000	0.002	0.002	0.001	0.004	0.002
Renault	I0204040	OE	5	0.208	0.003	0.003	0.045	0.824	0.015	0.038	0.189	0.025	0.030	0.029	0.029	297.7	298.1	260.1	287.6	0.025	0.004	0.002	0.007	0.000	0.000	0.000	0.000	0.003	0.001	0.005	0.003
Megane	I0205041	OE	5	0.220	0.003	0.003	0.048	0.930	0.035	0.047	0.223	0.028	0.038	0.054	0.040	313.6	318.0	276.2	305.8	0.016	0.003	0.000	0.005	0.000	0.000	0.000	0.000	0.004	0.000	0.003	0.002
	I0205046	OE	5	0.231	0.003	0.005	0.051	1.050	0.002	0.023	0.225	0.029	0.042	0.056	0.043	305.2	289.8	261.7	285.3	0.015	0.001	0.000	0.004	0.000	0.000	0.000	0.000	0.005	0.001	0.007	0.004
	average						0.048				0.223				0.037				291.3				0.005				0.000				0.002
	stdev						0.002				0.027				0.006				9.67				0.002				0.001				0.001
	I0204064	OE	30	0.215	0.003	0.004	0.047	0.858	0.006	0.028	0.189	0.031	0.036	0.088	0.049	298.9	300.6	263.3	290.0	0.019	0.001	0.000	0.004	0.001	0.000	0.000	0.000	0.004	0.002	0.008	0.004
	I0204067	OE	30	0.227	0.004	0.004	0.050	1.124	0.011	0.031	0.247	0.025	0.028	0.068	0.039	299.0	299.0	264.4	289.5	0.021	0.002	0.002	0.006	0.002	0.000	0.000	0.000	0.002	0.000	0.008	0.003
	I0205052	OE	30	0.250	0.003	0.004	0.054	0.914	0.008	0.023	0.200	0.031	0.029	0.149	0.062	298.1	290.5	256.7	282.8	0.034	0.004	0.000	0.009	0.005	0.000	0.000	0.001	0.004	0.000	0.010	0.003
	I0205056	OE	30	0.226	0.003	0.004	0.050	0.980	0.014	0.034	0.220	0.050	0.030	0.055	0.041	298.0	293.9	261.0	285.7	0.037	0.003	0.001	0.009	0.004	0.001	0.000	0.001	0.002	0.001	0.007	0.003
	average						0.050				0.214				0.048				287.0				0.007				0.001				0.003
	stdev						0.003				0.025				0.010				3.389				0.003				0.000				0.001
	I0205002	OE	150	0.324	0.005	0.004	0.071	1.172	0.014	0.023	0.257	0.048	0.031	0.067	0.044	327.9	315.6	278.7	308.0	0.022	0.005	0.001	0.007	0.000	0.000	0.000	0.000	0.008	0.000	0.006	0.003
	I0205008	OE	150	0.267	0.003	0.005	0.058	0.877	0.008	0.026	0.193	0.031	0.034	0.120	0.057	301.6	291.1	263.6	285.7	0.024	0.002	0.001	0.006	0.000	0.000	0.000	0.000	0.004	0.000	0.015	0.005
	average						0.065				0.225				0.051				296.9				0.007				0.000				0.004
	stdev						0.009				0.045				0.009				15.782				0.001				0.000				0.001
	I0203023	Aged	5	0.247	0.003	0.008	0.055	1.369	0.038	0.139	0.341	0.028	0.028	0.050	0.034	301.4	309.8	263.9	295.5	0.052	0.008	0.026	0.022	0.037	0.021	0.021	0.025	0.007	0.002	0.004	0.004
	I0203025	Aged	5	0.277	0.004	0.007	0.061	1.342	0.051	0.080	0.327	0.024	0.032	0.042	0.033	304.9	302.5	268.9	293.8	0.054	0.011	0.012	0.021	0.033	0.019	0.009	0.019	0.004	0.001	0.004	0.002
	average						0.058				0.334				0.034				294.6				0.021				0.022				0.003
	stdev						0.004				0.010				0.001				1.206				0.001				0.004				0.001
	I0203044	Aged	30	0.255	0.002	0.007	0.056	1.194	0.040	0.091	0.294	0.047	0.031	0.056	0.041	306.4	297.8	266.2	290.9	0.051	0.008	0.013	0.018	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	I0203049	Aged	30	0.256	0.003	0.010	0.057	1.211	0.028	0.203	0.321	0.042	0.049	0.043	0.046	305.3	293.2	263.3	287.5	0.039	0.006	0.018	0.016	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	average						0.057				0.308				0.044				289.2				0.017				N/A				N/A
	stdev						0.001				0.019				0.004				2.414				0.002				N/A				N/A
	I0203067	Aged	150	0.293	0.003	0.017	0.067	1.435	0.027	0.167	0.358	0.048	0.034	0.073	0.048	311.1	301.9	264.6	293.6	0.025	0.003	0.005	0.008	0.008	0.002	0.000	0.003	0.011	0.001	0.011	0.006
	I0204003	Aged	150	0.260	0.002	0.029	0.063	1.486	0.054	0.259	0.407	0.023	0.022	0.044	0.028	295.5	290.6	262.3	283.9	0.037	0.005	0.007	0.012	0.009	0.008	0.000	0.006	0.012	0.000	0.007	0.005
	I0204008	Aged	150	0.356	0.004	0.035	0.085	1.700	0.025	0.354	0.462	0.049	0.031	0.036	0.036	301.4	292.7	262.6	286.2	0.035	0.007	0.009	0.013	0.004	0.006	0.000	0.004	0.017	0.000	0.008	0.006
	average						0.072				0.409				0.037				287.9				0.011				0.004				0.005
	stdev						0.012				0.052				0.010				5.1				0.003				0.002				0.001

Appendix F. FTP Statistical Analysis Results

Statistical Analysis for FTP Emissions Results Excluding the European Vehicles

			NMHC	THC	CO	NO_x	NH_3	N_2O
			p-value	p-value	p-value	p-value	p-value	p-value
Logarithmic	No outliers	Vehicle	0.0107	0.0110	0.0110	0.0135	0.0146	0.0140
		Catalyst age	0.5630	0.1137	0.0256	0.4406	0.0212	0.2463
		Fuel sulfur level	0.0329	<0.0001	0.7118	0.0024	0.4059	<0.0001
		Vehicle*Catalyst	0.0350	0.0234	0.1185	0.0195	0.0738	0.0732
		Vehicle*Fuel	-	-	-	0.0074	0.3845	0.1179
		Catalyst*Fuel	0.0806	0.0427	0.8674	0.8163	0.8973	0.8220
	All Data	Vehicle	0.0106	0.0109	0.0110	0.0134	0.0145	0.0139
		Catalyst age	0.5746	0.1154	0.0266	0.4521	0.0211	0.2455
		Fuel sulfur level	0.0361	<0.0001	0.6758	0.0021	0.4053	<0.0001
		Vehicle*Catalyst	0.0382	0.0246	0.1189	0.0190	0.0701	0.0694
		Vehicle*Fuel	-	-	-	0.0069	0.3865	0.1097
		Catalyst*Fuel	0.0847	0.0513	0.8238	0.8306	0.8801	0.7269
Arithmetic	No outliers	Vehicle	0.0118	0.0128	0.0119	0.0465	0.0710	0.0513
		Catalyst age	0.6483	0.1906	0.1112	0.3897	0.2680	0.0456
		Fuel sulfur level	0.0794	0.0011	0.2698	0.0200	0.3819	0.0649
		Vehicle*Catalyst	0.0281	0.0208	0.1191	0.0137	0.0175	0.4376
		Vehicle*Fuel	0.2930	0.2453	-	0.0060	-	0.0006
		Catalyst*Fuel	0.5901	0.4431	0.6693	0.1670	0.4370	0.8133
	All Data	Vehicle	0.0115	0.0125	0.0118	0.0456	0.0710	0.0513
		Catalyst age	0.6711	0.1912	0.1125	0.4009	0.2664	0.0454
		Fuel sulfur level	0.0774	0.0010	0.2117	0.0173	0.3960	0.0633
		Vehicle*Catalyst	0.0384	0.0230	0.1172	0.0135	0.0174	0.3737
		Vehicle*Fuel	0.3921	0.2522	-	0.0053	-	0.0006
		Catalyst*Fuel	0.6289	0.5653	0.4472	0.2277	0.3809	0.9253

"-" = no interaction

Appendix F. Cont.

Statistical Analysis Results for Individual Bags

ANOVA Analyses for FTP Bag 1 NH_3 Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0126	0.0329
Catalyst age	0.0069	0.3622
Fuel sulfur level	0.5945	0.5747
Vehicle*Catalyst	0.0640	0.0225
Vehicle*Fuel	-	-
Catalyst*Fuel	0.4928	0.2612

ANOVA Analyses for FTP Bag 2 NH_3 Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0136	0.0468
Catalyst age	0.0272	0.1391
Fuel sulfur level	0.0944	0.6818
Vehicle*Catalyst	0.4086	0.0282
Vehicle*Fuel	-	0.1106
Catalyst*Fuel	0.4966	0.1696

ANOVA Analyses for FTP Bag 3 NH_3 Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0665	0.2855
Catalyst age	0.4439	0.4746
Fuel sulfur level	0.2115	0.3010
Vehicle*Catalyst	0.0368	0.0213
Vehicle*Fuel	-	0.4883
Catalyst*Fuel	0.0652	0.5246

"-" = no interaction

Appendix F. Cont.

Statistical Analysis Results for Individual Bags

ANOVA Analyses for FTP Bag 1 NMHC Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0107	0.0119
Catalyst age	0.6337	0.7521
Fuel sulfur level	0.1054	0.2070
Vehicle*Catalyst	0.0398	0.0296
Vehicle*Fuel	-	-
Catalyst*Fuel	0.0418	0.3909

ANOVA Analyses for FTP Bag 2 NMHC Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0160	0.0137
Catalyst age	0.9052	0.5188
Fuel sulfur level	0.0260	0.0063
Vehicle*Catalyst	0.0985	-
Vehicle*Fuel	0.2235	-
Catalyst*Fuel	0.5167	0.6605

ANOVA Analyses for FTP Bag 3 NMHC Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0124	0.0137
Catalyst age	0.0085	0.0537
Fuel sulfur level	0.0555	0.0101
Vehicle*Catalyst	0.0379	0.0439
Vehicle*Fuel	0.0229	0.0684
Catalyst*Fuel	0.4006	0.4996

"-" = no interaction

Appendix F. Cont.

Statistical Analysis Results for Individual Bags

ANOVA Analyses for FTP Bag 1 THC Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0107	0.0119
Catalyst age	0.3867	0.5316
Fuel sulfur level	0.0468	0.1290
Vehicle*Catalyst	0.0326	0.0273
Vehicle*Fuel	-	-
Catalyst*Fuel	0.0263	0.3606

ANOVA Analyses for FTP Bag 2 THC Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0182	0.0302
Catalyst age	0.2814	0.0905
Fuel sulfur level	0.0220	0.0008
Vehicle*Catalyst	0.0257	0.0192
Vehicle*Fuel	0.0628	0.0064
Catalyst*Fuel	0.3977	0.8519

ANOVA Analyses for FTP Bag 3 THC Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0117	0.0189
Catalyst age	0.0019	0.0231
Fuel sulfur level	<0.0001	<0.0001
Vehicle*Catalyst	0.0235	0.0185
Vehicle*Fuel	0.1107	0.0927
Catalyst*Fuel	0.5961	0.7134

"-" = no interaction

Appendix F. Cont.

Statistical Analysis Results for Individual Bags

ANOVA Analyses for FTP Bag 1 CO Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0103	0.0111
Catalyst age	0.0328	0.1222
Fuel sulfur level	0.7357	0.4895
Vehicle*Catalyst	0.0770	0.1192
Vehicle*Fuel	-	-
Catalyst*Fuel	0.3054	0.4137

ANOVA Analyses for FTP Bag 2 CO Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0142	0.0145
Catalyst age	0.2814	0.3814
Fuel sulfur level	0.0220	0.2912
Vehicle*Catalyst	-	-
Vehicle*Fuel	-	-
Catalyst*Fuel	0.3977	0.1359

ANOVA Analyses for FTP Bag 3 CO Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0537	0.1155
Catalyst age	0.0347	0.1442
Fuel sulfur level	0.1152	0.0198
Vehicle*Catalyst	0.2595	0.0772
Vehicle*Fuel	0.2006	-
Catalyst*Fuel	0.4500	0.7390

"-" = no interaction

Appendix F. Cont.

Statistical Analysis Results for Individual Bags

ANOVA Analyses for FTP Bag 1 NO_x Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0119	0.0123
Catalyst age	0.6204	0.8133
Fuel sulfur level	0.0388	0.0092
Vehicle*Catalyst	0.0486	0.0399
Vehicle*Fuel	0.0362	0.1748
Catalyst*Fuel	0.3813	0.5020

ANOVA Analyses for FTP Bag 2 NO_x Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0185	0.1175
Catalyst age	0.2879	0.3597
Fuel sulfur level	0.0227	0.1860
Vehicle*Catalyst	0.0690	0.0114
Vehicle*Fuel	0.0117	0.0034
Catalyst*Fuel	0.6881	0.3407

ANOVA Analyses for FTP Bag 3 NO_x Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0174	0.0416
Catalyst age	0.4861	0.3840
Fuel sulfur level	0.0051	0.0037
Vehicle*Catalyst	0.1277	0.0297
Vehicle*Fuel	0.2567	0.1038
Catalyst*Fuel	0.9962	0.3066

Appendix F. Cont.

FTP Statistical Analysis Results

Statistical Analysis Results for Individual Bags

ANOVA Analyses for FTP Bag 1 N_2O Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0168	0.0242
Catalyst age	0.4536	0.4581
Fuel sulfur level	<0.0001	0.0040
Vehicle*Catalyst	0.0230	0.0534
Vehicle*Fuel	0.1115	0.0010
Catalyst*Fuel	0.7401	0.4845

ANOVA Analyses for FTP Bag 2 N_2O Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0316	0.0741
Catalyst age	0.3929	0.8716
Fuel sulfur level	0.0571	0.2488
Vehicle*Catalyst	-	-
Vehicle*Fuel	0.2634	0.0007
Catalyst*Fuel	0.5663	0.1469

ANOVA Analyses for FTP Bag 3 N_2O Emissions

	No Outliers	
	logarithm	arithmetic
	p-value	p-value
Vehicle	0.0205	0.0398
Catalyst age	0.0357	0.0994
Fuel sulfur level	0.0002	0.0219
Vehicle*Catalyst	-	0.3254
Vehicle*Fuel	0.0457	0.0050
Catalyst*Fuel	0.8808	0.2035

“-” = no interaction

Appendix F. cont.

Statistical Analysis Results for FTP Emissions Including the European Vehicles

			NMHC	THC	CO	NO_x	NH_3	N_2O
			p-value	p-value	p-value	p-value	p-value	p-value
Logarithmic	No outliers	Vehicle	0.0060	0.0062	0.0065	0.0083	0.0090	0.0087
		Catalyst age	0.3715	0.0574	0.0084	0.3217	0.0072	0.1698
		Fuel sulfur level	0.0135	<0.0001	0.5905	0.0021	0.6112	<0.0001
		Vehicle*Catalyst	0.0346	0.0206	0.0740	0.0115	0.0610	0.0607
		Vehicle*Fuel	-	-	-	0.0041	0.4070	0.0545
		Catalyst*Fuel	0.3309	0.1714	0.8407	0.6832	0.9087	0.8609
	All Data	Vehicle	0.0060	0.0061	0.0064	0.0083	0.0090	0.0087
		Catalyst age	0.3794	0.0581	0.0088	0.3304	0.0072	0.1682
		Fuel sulfur level	0.0129	<0.0001	0.5476	0.0018	0.6104	<0.0001
		Vehicle*Catalyst	0.0376	0.0217	0.0742	0.0112	0.0612	0.0567
		Vehicle*Fuel	-	-	-	0.0037	0.4095	0.0496
		Catalyst*Fuel	0.3238	0.1998	0.8527	0.6727	0.8962	0.7717
Arithmetic	No outliers	Vehicle	0.0063	0.0069	0.0069	0.0328	0.0529	0.0389
		Catalyst age	0.3890	0.0883	0.0514	0.2540	0.2016	0.0259
		Fuel sulfur level	0.0281	0.0003	0.2356	0.0182	0.5259	0.0602
		Vehicle*Catalyst	0.0394	0.0197	0.1026	0.0083	0.0113	-
		Vehicle*Fuel	0.4631	0.2727	-	0.0040	-	0.0002
		Catalyst*Fuel	0.8967	0.7086	0.7487	0.1674	0.3483	0.7893
	All Data	Vehicle	0.0062	0.0068	0.0068	0.0323	0.0528	0.0389
		Catalyst age	0.4008	0.0874	0.0516	0.2621	0.2010	0.0253
		Fuel sulfur level	0.0230	0.0002	0.1811	0.0158	0.5408	0.0587
		Vehicle*Catalyst	0.0500	0.0226	0.1021	0.0081	0.0112	-
		Vehicle*Fuel	-	0.2985	-	0.0034	-	0.0002
		Catalyst*Fuel	0.9351	0.9720	0.5413	0.2183	0.3101	0.9053

"-" = no interaction

Appendix G. THC Emissions Results

FTP THC Emissions Results (g/mi)

Fuel Averages			Catalyst Averages		
	European Excluded	European Included		European Excluded	European Included
5	0.053	0.058	**OE**	0.052	0.058
30	0.052	0.058	**Aged**	0.057	0.064
150	0.059	0.066			

FTP THC Emissions Results for Individual Bags (g/mi)

Fuel Averages				Catalyst Averages			
	Bag 1	Bag 2	Bag 3		Bag 1	Bag 2	Bag 3
5	0.219	0.007	0.016	**OE**	0.213	0.007	0.016
30	0.210	0.008	0.016	**Aged**	0.221	0.010	0.022
150	0.223	0.012	0.024				

US06 THC Emissions Results (g/mi)

Fuel Averages			Catalyst Averages		
	European Excluded	European Included		European Excluded	European Included
5	0.024	0.023	**OE**	0.034	0.033
30	0.037	0.035	**Aged**	0.046	0.044
150	0.059	0.058			

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Ford Taurus SES	I0204010	4/4/2002	23,680	OE	5	0.034	3.610	0.003	365.1	0.022	0.025	0.000
	I0204014	4/5/2002	23,699	OE	5	0.033	2.870	0.004	360.2	0.020	N/A	N/A
	average					0.034	3.240	0.004	362.7	0.021	0.025	0.000
	stdev					0.001	0.523	0.001	3.499	0.002	N/A	N/A
	I0204020	4/9/2002	23,801	OE	30	0.030	2.785	0.004	357.1	0.029	0.022	0.000
	I0204024	4/10/2002	23,820	OE	30	0.042	3.492	0.008	348.5	0.033	0.026	0.000
	average					0.036	3.139	0.006	352.8	0.031	0.024	0.000
	stdev					0.008	0.500	0.003	6.109	0.003	0.003	0.000
	I0204033	4/12/2002	23,951	OE	150	0.059	4.515	0.000	351.6	0.040	0.032	0.003
	I0204036	4/16/2002	23,978	OE	150	0.055	4.209	0.025	355.7	0.039	0.029	0.005
	average					0.057	4.362	0.013	353.7	0.040	0.031	0.004
	stdev					0.003	0.216	0.018	2.907	0.001	0.002	0.002
	I0204048	4/18/2002	24,154	Aged	5	0.031	2.680	0.000	359.2	0.035	0.025	0.000
	I0204050	4/19/2002	24,173	Aged	5	0.037	3.256	0.005	354.8	0.039	0.029	0.000
	average					0.034	2.968	0.003	357.0	0.037	0.027	0.000
	stdev					0.004	0.407	0.004	3.096	0.003	0.003	0.000
	I0204057	4/23/2002	24,273	Aged	30	0.050	3.600	0.016	351.0	0.050	0.031	0.001
	I0204059	4/24/2002	24,322	Aged	30	0.070	5.532	0.010	357.8	0.044	0.032	0.001
	I0204063	4/25/2002	24,341	Aged	30	0.062	4.350	0.013	353.8	0.041	0.024	0.001
	average					0.061	4.494	0.013	354.2	0.045	0.029	0.001
	stdev					0.010	0.974	0.003	3.417	0.004	0.004	0.000
	I0204068	4/26/2002	24,441	Aged	150	0.098	6.929	0.058	359.0	0.057	0.042	0.007
	I0204074	4/30/2002	24,468	Aged	150	0.081	4.400	0.074	351.7	0.062	0.041	0.009
	average					0.090	5.665	0.066	355.4	0.060	0.042	0.008
	stdev					0.012	1.788	0.011	5.150	0.004	0.001	0.002

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Chevy Cavalier	I0206012	6/5/2002	22,613	OE	5	0.004	0.909	0.100	288.3	0.010	0.000	0.000
	I0206016	6/62002	22,633	OE	5	0.004	1.554	0.058	284.8	0.025	0.016	0.000
	I0206017	6/7/2002	22,652	OE	5	0.005	1.073	0.067	287.1	0.008	0.002	0.000
	average					0.004	1.179	0.075	286.7	0.014	0.006	0.000
	stdev					0.001	0.335	0.022	1.8	0.009	0.008	0.000
	I0206024	6/13/2002	22,760	OE	30	0.009	1.958	0.138	281.6	0.022	0.023	0.001
	I0206029	6/14/2002	22,779	OE	30	0.010	3.305	0.101	281.9	0.036	0.036	0.000
	average					0.010	2.63	0.120	281.8	0.029	0.029	0.001
	stdev					0.001	0.95	0.026	0.2	0.010	0.009	0.001
	I0206057	6/25/2002	22,954	OE	150	0.016	2.613	0.130	291.7	0.037	0.035	0.004
	I0206058	6/26/2002	22,973	OE	150	0.013	2.048	0.163	291.1	0.031	N/A	N/A
	average					0.015	2.33	0.147	291.4	0.034	0.035	0.004
	stdev					0.002	0.40	0.023	0.5	0.004	N/A	N/A
	I0206068	6/28/2002	23,126	Aged	5	0.007	2.863	0.108	296.4	0.041	0.039	0.000
	I0207003	7/2/2002	23,153	Aged	5	0.004	1.927	0.058	283.1	0.026	0.018	0.001
	average					0.006	2.40	0.083	289.8	0.033	0.028	0.000
	stdev					0.002	0.66	0.035	9.4	0.010	0.015	0.000
	I0207009	7/3/2002	23,254	Aged	30	0.014	2.483	0.082	278.9	0.034	0.037	0.001
	I0207017	7/10/2002	23,288	Aged	30	0.008	1.311	0.098	277.1	0.023	0.021	0.001
	average					0.011	1.90	0.090	278.0	0.028	0.029	0.001
	stdev					0.004	0.83	0.011	1.3	0.008	0.012	0.000
	I0207021	7/11/2002	23,419	Aged	150	0.020	2.097	0.139	277.1	0.040	0.032	0.004
	I0207024	7/12/2002	23,438	Aged	150	0.024	3.078	0.131	266.8	0.039	0.033	0.004
	average					0.022	2.588	0.135	271.9	0.040	0.033	0.004
	stdev					0.003	0.694	0.006	7.3	0.000	0.001	0.000

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR - NH_3 US06 g/mi	FTIR - N_2O US06 g/mi
2001 Chevy Silverado	I0207038	7/17/2002	8,507	OE	5	0.039	0.784	0.061	484.8	0.022	0.022	0.000
	I0207040	7/18/2002	8,526	OE	5	0.043	0.949	0.067	490.5	0.034	0.031	0.000
	average					0.041	0.867	0.064	487.7	0.028	0.027	0.000
	stdev					0.003	0.12	0.004	4.1	0.008	0.006	0.000
	I0207043	7/23/2002	8,634	OE	30	0.059	0.934	0.103	475.5	0.072	0.072	0.002
	I0207044	7/24/2002	8,653	OE	30	0.049	0.782	0.082	474.9	0.056	0.059	0.001
	average					0.054	0.858	0.093	475.2	0.064	0.066	0.001
	stdev					0.007	0.11	0.015	0.5	0.011	0.009	0.001
	I0207046	7/25/2002	8,784	OE	150	0.073	1.164	0.143	477.3	0.130	0.133	0.006
	I0207047	7/26/2002	8,803	OE	150	0.071	1.130	0.144	482.6	0.127	0.124	0.006
	I0207050	7/30/2002	8,830	OE	150	0.072	1.109	0.151	481.8	0.137	0.121	0.006
	average					0.072	1.134	0.146	480.6	0.131	0.126	0.006
	stdev					0.001	0.028	0.004	2.9	0.005	0.006	0.000
	I0208001	8/1/2002	8,972	Aged	5	0.031	1.023	0.088	474.4	0.091	0.120	0.000
	I0208003	8/2/2002	8,991	Aged	5	0.034	1.190	0.086	474.3	0.116	0.138	0.001
	I0208007	8/6/2002	9,018	Aged	5	0.034	1.112	0.098	470.8	0.127	0.138	0.002
	average					0.033	1.108	0.091	473.2	0.111	0.132	0.001
	stdev					0.002	0.084	0.006	2.1	0.018	0.010	0.001
	I0208008	8/8/2002	9,134	Aged	30	0.044	1.305	0.206	468.0	0.218	0.233	0.007
	I0208009	8/9/2002	9,153	Aged	30	0.046	1.227	0.168	472.4	0.196	0.218	0.008
	I0208012	8/13/2002	9,210	Aged	30	0.045	1.318	0.169	473.8	0.177	0.200	0.004
	average					0.045	1.283	0.181	471.4	0.197	0.217	0.006
	stdev					0.001	0.049	0.022	3.0	0.021	0.016	0.002
	I0208013	8/14/2002	9,301	Aged	150	0.076	1.575	0.418	471.5	0.225	0.217	0.026
	I0208014	8/15/2002	9,320	Aged	150	0.069	1.643	0.394	478.3	0.208	0.215	0.017
	average					0.073	1.609	0.406	474.9	0.216	0.216	0.021
	stdev					0.005	0.05	0.017	4.8	0.012	0.001	0.007

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2000 Jeep	I0206005	6/5/2002	29,704	OE	5	0.045	7.325	0.034	512.2	0.221	0.224	0.006
Grand Cherokee	I0206014	6/6/2002	29,723	OE	5	0.045	4.499	0.046	509.8	0.290	0.257	0.006
	average					0.045	5.91	0.040	511.0	0.255	0.240	0.006
	stdev					0.000	2.00	0.008	1.7	0.049	0.023	0.000
	I0206022	6/13/2002	29,830	OE	30	0.053	11.328	0.09	525.2	0.167	0.160	0.017
	I0206025	6/14/2002	29,849	OE	30	0.047	4.337	0.097	523.2	0.296	0.265	0.014
	average					0.050	7.83	0.094	524.2	0.231	0.212	0.015
	stdev					0.004	4.94	0.005	1.4	0.092	0.074	0.002
	I0206031	6/15/2002	29,979	OE	150	0.062	6.802	0.329	521.5	0.214	0.130	0.054
	I0206048	6/19/2002	30,005	OE	150	0.088	9.172	0.331	519.2	0.302	0.268	0.044
	I0206056	6/25/2002	30,057	OE	150	0.117	16.367	0.259	512.0	0.331	0.395	0.034
	average					0.089	10.78	0.306	517.6	0.282	0.264	0.044
	stdev					0.028	4.98	0.041	4.9	0.061	0.133	0.010
	I0207002	7/2/2002	30,226	Aged	5	0.015	3.787	0.026	489.7	0.187	0.164	0.002
	I0207006	7/3/2002	30,245	Aged	5	0.014	3.588	0.013	486.8	0.136	0.139	0.003
	I0207014	7/10/2002	30,271	Aged	5	0.018	6.367	0.018	486.7	0.216	0.190	0.002
	average					0.016	4.581	0.019	487.7	0.162	0.152	0.002
	stdev					0.002	1.550	0.007	1.7	0.036	0.018	0.000
	I0207022	7/11/2002	30,372	Aged	30	0.056	1.751	0.166	483.4	0.203	0.197	0.019
	I0207025	7/12/2002	30,391	Aged	30	0.039	4.344	0.116	462.8	0.212	0.197	0.015
	average					0.048	3.048	0.141	473.1	0.207	0.197	0.017
	stdev					0.012	1.834	0.035	14.6	0.006	0.000	0.003
	I0207035	7/16/2002	30,528	Aged	150	0.095	12.165	0.308	487.9	0.194	0.153	0.055
	I0207037	7/17/2002	30,547	Aged	150	0.099	12.143	0.300	491.4	0.210	0.185	0.044
	average					0.097	12.15	0.304	489.7	0.202	0.169	0.050
	stdev					0.003	0.02	0.006	2.4	0.011	0.023	0.007

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Buick LeSabre	I0203016	3/8/2002	20,565	OE	5	0.004	0.210	0.014	344.0	0.011	0.000	0.000
	I0203020	3/12/2002	20,593	OE	5	0.005	0.561	0.012	349.7	0.036	0.012	0.000
	average					0.005	0.386	0.013	346.8	0.023	0.006	0.000
	stdev					0.001	0.248	0.001	4.101	0.018	0.009	0.000
	I0203031	3/14/2002	20,695	OE	30	0.006	0.258	0.030	340.2	0.031	0.021	0.003
	I0203040	3/19/2002	20,721	OE	30	0.007	0.245	0.020	340.1	0.021	0.016	0.001
	average					0.007	0.252	0.025	340.2	0.026	0.018	0.002
	stdev					0.001	0.009	0.007	0.078	0.007	0.003	0.001
	I0203048	3/21/2002	20,824	OE	150	0.011	0.724	0.066	343.7	0.040	0.033	0.011
	I0203051	3/22/2002	20,843	OE	150	0.011	0.804	0.055	337.5	0.041	0.031	0.007
	average					0.011	0.764	0.061	340.6	0.040	0.032	0.009
	stdev					0.000	0.057	0.008	4.387	0.001	0.001	0.003
	I0202051	2/22/2002	20,164	Aged	5	0.009	0.912	0.037	349.1	0.102	0.104	0.004
	I0202054	2/26/2002	20,190	Aged	5	0.009	1.709	0.099	355.0	0.100	0.099	0.005
	average					0.009	1.311	0.068	352.0	0.101	0.102	0.005
	stdev					0.000	0.564	0.044	4.172	0.001	0.003	0.001
	I0202063	2/28/2002	20,292	Aged	30	0.011	1.118	0.084	347.0	0.068	0.069	0.011
	I0203002	3/1/2002	20,310	Aged	30	0.009	0.994	0.071	343.1	0.076	0.084	0.011
	average					0.010	1.056	0.078	345.1	0.072	0.076	0.011
	stdev					0.001	0.088	0.009	2.758	0.006	0.010	0.000
	I0203006	3/5/2002	20,411	Aged	150	0.023	2.957	0.292	351.5	0.093	0.101	0.037
	I0203009	3/6/2002	20,430	Aged	150	0.021	2.901	0.284	362.9	0.100	0.109	N/A
	average					0.022	2.929	0.288	357.2	0.097	0.105	0.037
	stdev					0.001	0.040	0.006	8.025	0.005	0.006	N/A

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Dodge Neon	I0203021	3/12/2002	19,067	OE	5	0.004	5.495	0.028	278.9	0.044	0.024	0.000
	I0203024	3/13/2002	19,086	OE	5	0.002	3.842	0.038	275.6	0.025	0.014	0.000
	average					0.003	4.669	0.033	277.2	0.034	0.019	0.000
	stdev					0.001	1.169	0.007	2.317	0.014	0.007	0.000
	I0203046	3/21/2002	19,378	OE	30	0.006	9.171	0.041	286.1	0.049	N/A	N/A
	I0203050	3/22/2002	19,398	OE	30	0.004	4.879	0.047	281.9	0.030	0.017	0.000
	average					0.005	7.025	0.044	284.0	0.039	0.017	0.000
	stdev					0.001	3.035	0.004	2.945	0.013	N/A	N/A
	I0203030	3/14/2002	19,187	OE	150	0.009	4.615	0.072	272.3	0.047	0.036	0.002
	I0203034	3/15/2002	19,206	OE	150	0.010	4.144	0.076	268.9	0.046	0.030	0.003
	I0203039	3/19/2002	19,233	OE	150	0.021	9.241	0.106	285.2	0.064	0.039	0.003
	average					0.013	6.000	0.085	275.5	0.052	0.035	0.003
	stdev					0.007	2.817	0.019	8.611	0.010	0.005	0.001
	I0202043	2/20/2002	18,634	Aged	5	0.009	8.182	0.049	287.8	0.048	0.036	0.000
	I0202046	2/21/2002	18,654	Aged	5	0.006	7.111	0.028	284.8	0.034	0.019	0.000
	average					0.008	7.647	0.039	286.3	0.041	0.028	0.000
	stdev					0.002	0.757	0.015	2.111	0.010	0.011	0.000
	I0202050	2/22/2002	18,752	Aged	30	0.010	7.266	0.056	279.9	0.030	0.031	0.007
	I0202053	2/26/2002	18,778	Aged	30	0.009	8.368	0.082	296.1	0.028	0.020	0.000
	average					0.010	7.817	0.069	288.0	0.029	0.025	0.003
	stdev					0.001	0.779	0.018	11.45	0.002	0.008	0.005
	I0202062	2/28/2002	18,875	Aged	150	0.038	9.373	0.088	286.2	0.045	0.046	0.001
	I0203001	3/1/2002	18,895	Aged	150	0.019	5.957	0.050	277.6	0.035	0.022	0.001
	I0203008	3/5/2002	18,922	Aged	150	0.040	10.873	0.091	286.8	0.074	0.063	0.000
	average					0.032	8.734	0.076	283.5	0.051	0.044	0.001
	stdev					0.012	2.519	0.023	5.172	0.021	0.020	0.001

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Toyota Camry	I0203007	3/5/2002	22,946	OE	5	0.008	4.133	0.039	319.2	0.157	0.106	0.002
	I0203010	3/6/2002	22,515	OE	5	0.009	5.548	0.032	317.1	0.178	0.124	0.001
	average					0.009	4.841	0.036	318.2	0.168	0.115	0.002
	stdev					0.001	1.001	0.005	1.500	0.014	0.013	0.000
	I0203017	3/8/2002	22,614	OE	30	0.021	7.305	0.070	316.6	0.180	0.115	0.003
	I0203022	3/12/2002	22,642	OE	30	0.027	8.081	0.072	319.4	0.179	0.113	0.003
	I0203026	3/13/2002	22,660	OE	30	0.020	6.996	0.083	309.7	0.144	0.094	0.005
	average					0.023	7.461	0.075	315.3	0.167	0.107	0.004
	stdev					0.004	0.559	0.007	4.978	0.020	0.011	0.001
	I0203041	2/19/2002	22,779	OE	150	0.033	4.675	0.143	308.2	0.115	0.072	0.008
	I0203045	2/20/2002	22,798	OE	150	0.032	4.933	0.121	304.2	0.114	N/A	N/A
	average					0.033	4.804	0.132	306.2	0.115	0.072	0.008
	stdev					0.001	0.182	0.016	2.869	0.001	N/A	N/A
	I0201046	1/31/2002	22,055	Aged	5	0.020	9.259	0.054	331.2	0.179	0.172	0.002
	I0202001	2/1/2002	22,074	Aged	5	0.009	4.844	0.027	315.9	0.077	0.074	0.000
	I0202008	2/5/2002	22,100	Aged	5	0.009	3.897	0.034	317.8	0.098	0.097	0.001
	average					0.013	6.000	0.038	321.6	0.118	0.114	0.001
	stdev					0.006	2.862	0.014	8.353	0.054	0.051	0.001
	I0202016	2/7/2002	22,199	Aged	30	0.035	8.190	0.069	321.8	0.135	0.102	0.004
	I0202018	2/8/2002	22,217	Aged	30	0.021	4.512	0.064	321.8	0.152	0.124	0.002
	average					0.028	6.351	0.067	321.8	0.144	0.113	0.003
	stdev					0.010	2.601	0.004	0.014	0.012	0.015	0.002
	I0202036	2/14/2002	22,310	Aged	150	0.079	12.189	0.179	323.1	0.103	0.084	0.007
	I0202037	2/15/2002	22,329	Aged	150	0.053	7.550	0.160	313.1	0.113	0.075	0.006
	I0202057	2/27/2002	22,355	Aged	150	0.053	9.054	0.152	310.2	0.107	0.081	0.008
	average					0.062	9.598	0.164	315.5	0.107	0.080	0.007
	stdev					0.015	2.367	0.014	6.778	0.005	0.004	0.001

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Chrysler Sebring	I0205020	5/8/2002	19,808	OE	5	0.012	21.78	0.017	376.6	0.114	0.144	0.000
	I0205023	5/9/2002	19,827	OE	5	0.007	15.05	0.022	374.2	0.125	0.102	0.000
	average					0.010	18.41	0.020	375.4	0.119	0.123	0.000
	stdev					0.004	4.76	0.004	1.759	0.007	0.030	0.000
	I0205027	5/10/2002	19,928	OE	30	0.019	17.26	0.064	371.9	0.141	0.140	0.000
	I0205031	5/14/2002	19,954	OE	30	0.016	16.74	0.067	373.0	0.135	0.130	0.000
	average					0.018	17.00	0.066	372.4	0.138	0.135	0.000
	stdev					0.002	0.37	0.002	0.801	0.004	0.007	0.000
	I0205039	5/16/2002	20,087	OE	150	0.022	13.26	0.177	380.2	0.096	N/A	N/A
	I0205040	5/17/2002	20,106	OE	150	0.016	10.67	0.098	375.4	0.105	0.084	0.000
	I0205044	5/21/2002	20,132	OE	150	0.025	13.81	0.086	376.5	0.134	0.108	0.000
	average					0.021	12.58	0.120	377.4	0.112	0.096	0.000
	stdev					0.005	1.68	0.049	2.506	0.020	0.017	0.000
	I0205051	5/23/2002	20,275	Aged	5	0.018	22.82	0.078	377.9	0.136	0.120	0.000
	I0205054	5/24/2002	20,295	Aged	5	0.007	12.93	0.055	378.3	0.085	0.078	0.000
	I0205060	5/29/2002	20,321	Aged	5	0.010	14.06	0.035	380.5	0.069	0.074	0.000
	average					0.012	16.60	0.056	378.9	0.097	0.090	0.000
	stdev					0.006	5.41	0.022	1.376	0.035	0.025	0.000
	I0205065	5/30/2002	20,421	Aged	30	0.022	16.62	0.124	367.9	0.077	0.107	0.000
	I0205066	5/31/2002	20,440	Aged	30	0.015	15.21	0.093	375.0	0.113	0.092	0.000
	average					0.019	15.92	0.109	371.4	0.095	0.100	0.000
	stdev					0.005	0.997	0.022	5.020	0.026	0.010	0.000
	I0206004	6/4/2002	20,578	Aged	150	0.065	19.937	0.154	376.3	0.102	0.089	0.000
	I0206011	6/5/2002	20,597	Aged	150	0.035	12.668	0.162	368.6	0.137	0.135	0.000
	I0206015	6/6/2002	20,616	Aged	150	0.038	12.331	0.147	366.9	0.163	0.135	0.000
	average					0.046	14.979	0.154	370.6	0.134	0.120	0.000
	stdev					0.017	4.297	0.008	5.018	0.030	0.027	0.000

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Acura 3.2CL	I0205061	5/29/2002	20,648	OE	5	0.006	7.487	0.106	346.6	0.079	0.072	0.000
	I0206010	6/5/2002	20,715	OE	5	0.006	5.635	0.125	342.9	0.055	0.045	0.000
	I0206013	6/6/2002	20,734	OE	5	0.005	7.901	0.163	342.0	0.059	0.051	0.000
	average					0.006	7.008	0.131	343.8	0.064	0.056	0.000
	stdev					0.001	1.207	0.029	2.5	0.013	0.014	0.000
	I0206023	6/13/2002	20,863	OE	30	0.023	8.067	0.039	332.8	0.067	0.058	0.000
	I0206027	6/14/2002	20,883	OE	30	0.024	8.094	0.096	338.0	0.111	0.088	0.000
	average					0.024	8.08	0.068	335.4	0.089	0.073	0.000
	stdev					0.001	0.02	0.040	3.7	0.031	0.021	0.000
	I0206049	6/19/2002	21,017	OE	150	0.048	11.33	0.279	334.4	0.144	0.111	0.004
	I0206055	6/25/2002	21,071	OE	150	0.098	13.28	0.143	334.8	0.183	0.140	0.006
	average					0.073	12.31	0.211	334.6	0.163	0.125	0.005
	stdev					0.035	1.38	0.096	0.3	0.028	0.020	0.001
	I0206064	6/27/2002	21,216	Aged	5	0.007	15.603	0.062	360.2	0.114	0.142	0.000
	I0206069	6/28/2002	21,236	Aged	5	0.005	11.983	0.043	348.0	0.087	0.121	0.000
	average					0.006	13.79	0.053	354.1	0.101	0.131	0.000
	stdev					0.001	2.56	0.013	8.6	0.019	0.015	0.000
	I0207005	7/2/2002	21,339	Aged	30	0.015	7.572	0.149	322.9	0.122	0.118	0.001
	I0207007	7/3/2002	21,359	Aged	30	0.017	7.049	0.247	324.6	0.080	0.086	0.002
	average					0.016	7.31	0.198	323.7	0.101	0.102	0.002
	stdev					0.001	0.37	0.069	1.2	0.030	0.023	0.001
	I0207015	7/9/2002	21,493	Aged	150	0.071	8.184	0.085	330.1	0.113	0.096	0.008
	I0207016	7/10/2002	21,513	Aged	150	0.084	14.051	0.101	324.5	0.131	0.116	0.008
	I0207020	7/11/2002	21,533	Aged	150	0.081	12.823	0.13	319.9	0.102	0.097	0.009
	average					0.079	11.686	0.105	324.8	0.115	0.103	0.008
	stdev					0.007	3.094	0.023	5.1	0.015	0.011	0.001

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Ford Windstar	I0202024	2/12/2002	21,675	OE	5	0.014	1.082	0.039	442.1	0.072	0.072	0.000
	I0202029	2/13/2002	21,695	OE	5	0.013	0.865	0.038	445.9	0.066	0.072	0.000
	average					0.014	0.974	0.039	444.0	0.069	0.072	0.000
	stdev					0.001	0.153	0.001	2.658	0.004	0.000	0.000
	I0202047	2/21/2002	21,790	OE	30	0.020	2.210	0.097	442.5	0.066	0.063	0.002
	I0202049	2/22/2002	21,810	OE	30	0.017	1.988	0.067	437.9	0.055	0.056	0.001
	average					0.019	2.099	0.082	440.2	0.060	0.059	0.002
	stdev					0.002	0.157	0.021	3.315	0.008	0.005	0.001
	I0202056	2/26/2002	21,907	OE	150	0.024	1.609	0.172	439.7	0.078	0.082	0.012
	I0202058	2/27/2002	21,927	OE	150	0.024	1.812	0.129	431.5	0.077	0.088	0.007
	average					0.024	1.711	0.151	435.6	0.077	0.085	0.010
	stdev					0.000	0.144	0.030	5.761	0.001	0.004	0.004
	I0201036	1/25/2002	21,261	Aged	5	0.017	7.535	0.067	449.9	0.129	0.145	0.001
	I0201041	1/29/2002	21,287	Aged	5	0.024	8.295	0.082	458.4	0.152	0.185	0.001
	average					0.021	7.915	0.075	454.1	0.140	0.165	0.001
	stdev					0.005	0.537	0.011	6.000	0.016	0.029	0.000
	I0201045	1/31/2002	21,383	Aged	30	0.038	9.504	0.188	448.7	0.162	0.189	0.007
	I0202002	2/1/2002	21,402	Aged	30	0.037	11.771	0.118	446.4	0.134	0.162	0.004
	average					0.038	10.638	0.153	447.5	0.148	0.176	0.006
	stdev					0.001	1.603	0.049	1.626	0.019	0.020	0.002
	I0202009	2/5/2002	21,498	Aged	150	0.027	2.661	0.340	445.5	0.097	0.101	0.022
	I0202011	2/6/2002	21,512	Aged	150	0.020	1.690	0.329	445.0	0.100	0.108	0.015
	I0202014	2/7/2002	21,536	Aged	150	0.027	3.457	0.276	440.0	0.121	0.117	N/A
	average					0.025	2.603	0.315	443.5	0.106	0.109	0.019
	stdev					0.004	0.885	0.034	3.013	0.013	0.008	0.005

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR - NH_3 US06 g/mi	FTIR - N_2O US06 g/mi
2000 Honda Accord EX	I0204042	4/17/2002	12,361	OE	5	0.003	1.011	0.005	308.6	0.003	0.000	0.000
	I0204045	4/18/2002	12,380	OE	5	0.006	0.524	0.006	315.3	0.000	0.000	0.000
	I0204051	4/19/2002	12,400	OE	5	0.004	1.402	0.006	313.5	0.009	0.000	0.000
	average					0.004	0.979	0.006	312.5	0.004	0.000	0.000
	stdev					0.002	0.440	0.001	3.454	0.004	0.000	0.000
	I0204056	4/23/2002	12,508	OE	30	0.004	1.128	0.005	319.9	0.010	0.002	0.000
	I0204060	4/24/2002	12,528	OE	30	0.008	1.206	0.005	312.4	0.004	0.004	0.000
	average					0.006	1.167	0.005	316.1	0.007	0.003	0.000
	stdev					0.003	0.055	0.000	5.301	0.004	0.002	0.000
	I0204069	4/26/200	12,659	OE	150	0.004	1.893	0.012	311.2	0.014	0.009	0.001
	I0204075	4/30/200	12,686	OE	150	0.004	0.248	0.010	310.0	0.001	0.000	0.000
	I0205007	5/2/2002	12,712	OE	150	0.004	0.253	0.008	309.4	0.005	0.000	0.000
	average					0.004	0.798	0.010	310.2	0.007	0.003	0.000
	stdev					0.000	0.948	0.002	0.885	0.006	0.005	0.000
	I0204011	4/4/2002	11,958	Aged	5	0.003	0.922	0.012	313.8	0.005	N/A	N/A
	I0204015	4/5/2002	11,977	Aged	5	0.003	0.340	0.004	307.7	-0.001	0.000	0.000
	average					0.003	0.631	0.008	310.7	0.002	0.000	0.000
	stdev					0.000	0.412	0.006	4.277	0.004	N/A	N/A
	I0204019	4/9/2002	12,078	Aged	30	0.004	0.344	0.008	311.7	0.001	0.000	0.000
	I0204023	4/10/2002	12,098	Aged	30	0.002	0.556	0.007	311.4	0.002	0.000	0.000
	average					0.003	0.450	0.008	311.6	0.002	0.000	0.000
	stdev					0.001	0.150	0.001	0.187	0.001	0.000	0.000
	I0204028	4/11/2002	12,198	Aged	150	0.004	1.041	0.012	310.2	0.006	0.005	0.001
	I0204029	4/12/2002	12,217	Aged	150	0.002	1.404	0.011	315.5	0.018	0.012	0.000
	average					0.003	1.223	0.012	312.9	0.012	0.009	0.000
	stdev					0.001	0.257	0.001	3.783	0.008	0.005	0.001

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Nissan Sentra	I0205062	5/29/2002	7,112	OE	5	0.002	3.492	0.002	326.6	0.004	0.005	0.000
	I0205064	5/30/2002	7,113	OE	5	0.003	1.996	0.005	329.8	0.004	0.000	0.000
	I0205069	5/31/2002	7,132	OE	5	0.002	1.75	0.003	326.4	0.009	0.000	0.000
	average					0.002	2.413	0.003	327.6	0.005	0.002	0.000
	stdev					0.001	0.943	0.002	1.9	0.003	0.003	0.000
	I0206032	6/15/2002	7,243	OE	30	0.002	3.726	0.004	329.6	0.028	0.023	0.000
	I0206062	6/27/2002	7,291	OE	30	0.002	6.832	0.004	331.4	0.030	0.035	0.000
	I0206067	6/28/2002	7,345	OE	30	0.002	6.129	0.005	331.5	0.030	0.044	0.000
	average					0.002	5.562	0.004	330.8	0.030	0.034	0.000
	stdev					0.000	1.629	0.001	1.1	0.001	0.011	0.000
	I0207004	7/2/2002	7,446	OE	150	0.002	3.878	0.005	310.9	0.024	0.013	0.000
	I0207039	7/17/2002	7,472	OE	150	0.002	3.274	0.006	318.2	0.029	0.018	0.000
	I0207041	7/19/2002	7,507	OE	150	0.002	4.513	0.009	317.3	0.031	0.015	0.000
	average					0.002	3.888	0.007	315.4	0.028	0.015	0.000
	stdev					0.000	0.620	0.002	4.0	0.004	0.002	0.000
	I0205021	5/8/2002	6,592	Aged	5	0.003	3.846	0.002	329.5	0.019	N/A	N/A
	I0205022	5/9/2002	6,611	Aged	5	0.003	4.545	0.003	325.5	0.015	0.003	0.000
	I0205026	5/10/2002	6,631	Aged	5	0.003	4.069	0.003	327.3	0.016	0.008	0.000
	average					0.003	4.153	0.003	327.4	0.017	0.006	0.000
	stdev					0.000	0.357	0.001	1.973	0.002	0.003	0.000
	I0205029	5/14/2002	6,733	Aged	30	0.002	2.868	0.003	325.3	0.015	0.005	0.000
	I0205035	5/15/2002	6,733	Aged	30	0.003	5.862	0.002	323.1	0.034	0.037	0.000
	I0205045	5/21/2002	6,810	Aged	30	0.003	3.482	0.005	319.4	0.021	0.010	0.000
	average					0.003	4.071	0.003	322.6	0.023	0.017	0.000
	stdev					0.001	1.581	0.002	2.985	0.010	0.017	0.000
	I0205049	5/22/2002	6,911	Aged	150	0.002	3.712	0.019	321.7	0.031	0.022	0.000
	I0205050	5/23/2002	6,930	Aged	150	0.002	4.101	0.014	321.1	0.039	N/A	N/A
	I0205055	5/24/2002	6,950	Aged	150	0.003	3.269	0.018	324.1	0.023	0.020	0.000
	average					0.002	3.694	0.017	322.3	0.031	0.021	0.000
	stdev					0.001	0.416	0.003	1.597	0.008	0.001	0.000

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2000 VW Bora	I0204021	4/9/2002	7,479	OE	5	0.012	0.878	0.026	293.2	0.025	0.029	0.000
	I0204026	4/11/2002	7,516	OE	5	0.014	0.711	0.131	295.6	0.016	0.005	0.007
	average					0.013	0.795	0.079	294.4	0.020	0.017	0.003
	stdev					0.001	0.118	0.074	1.679	0.007	0.017	0.005
	I0204071	4/26/2002	7,880	OE	30	0.020	1.039	0.082	295.4	0.056	0.055	0.008
	I0204076	4/30/2002	7,703	OE	30	0.015	0.630	0.008	271.8	0.031	0.027	0.000
	average					0.018	0.835	0.045	283.6	0.044	0.041	0.004
	stdev					0.004	0.289	0.052	16.68	0.018	0.020	0.006
	I0205025	5/10/2002	7,918	OE	150	0.022	0.896	0.013	277.5	0.049	0.051	0.000
	I0205030	5/14/2002	7,945	OE	150	0.028	0.570	0.020	273.1	0.050	0.043	0.000
	I0205034	5/15/2002	7,964	OE	150	0.027	0.661	0.008	275.8	0.055	0.049	0.000
	average					0.026	0.709	0.014	275.5	0.051	0.048	0.000
	stdev					0.003	0.168	0.006	2.203	0.003	0.004	0.000
	I0202032	2/13/2002	6,863	Aged	5	0.007	1.374	0.041	303.7	0.010	0.007	0.000
	I0202055	2/26/2002	6,908	Aged	5	0.011	3.409	0.066	321.4	0.060	0.045	0.000
	average					0.009	2.392	0.054	312.5	0.035	0.026	0.000
	stdev					0.003	1.439	0.018	12.466	0.035	0.027	0.000
	I0203028	3/13/2002	7,100	Aged	30	0.018	0.364	0.196	292.6	0.012	0.006	0.013
	I0203029	3/14/2002	7,108	Aged	30	0.006	0.600	0.052	275.0	0.020	0.020	0.000
	I0203047	3/21/2002	7,170	Aged	30	0.007	0.641	0.066	293.3	0.018	N/A	N/A
	I0203053	3/22/2002	7,185	Aged	30	0.006	0.642	0.052	290.3	0.017	0.021	0.000
	average					0.009	0.562	0.092	287.8	0.016	0.016	0.004
	stdev					0.006	0.133	0.070	8.654	0.003	0.008	0.007
	I0203057	3/26/2002	7,288	Aged	150	0.064	2.473	0.171	301.3	0.070	0.072	0.018
	I0203061	3/27/2002	7,303	Aged	150	0.027	0.430	0.151	292.3	0.021	0.018	0.012
	I0203065	3/28/2002	7,318	Aged	150	0.026	0.463	0.180	292.6	0.020	0.014	0.012
	average					0.039	1.122	0.167	295.4	0.037	0.035	0.014
	stdev					0.022	1.170	0.015	5.098	0.029	0.032	0.003

Appendix H. Detailed US06 Emission Results

Vehicle	Test	Date	Mileage	Catalyst	Fuel	NMHC US06 g/mi	CO US06 g/mi	NO_X US06 g/mi	CO_2 US06 g/mi	TDL - NH_3 US06 g/mi	FTIR -NH_3 US06 g/mi	FTIR -N_2O US06 g/mi
2001 Renault Megane	I0204027	4/11/2002	6,192	OE	5	0.010	1.811	0.020	299.1	0.032	0.037	0.000
	I0204031	4/12/2002	6,216	OE	5	0.008	0.734	0.017	297.9	0.018	0.014	0.000
	I0205041	5/17/2002	6,731	OE	5	0.006	0.838	0.055	281.4	0.024	0.018	0.000
	I0205046	5/21/2002	6,758	OE	5	0.004	0.825	0.024	273.2	0.018	0.008	0.000
	average					0.007	1.052	0.029	287.9	0.023	0.019	0.000
	stdev					0.003	0.508	0.018	12.708	0.007	0.013	0.000
	I0205052	5/23/2002	6,860	OE	30	0.011	0.644	0.015	276.9	0.020	0.009	0.000
	I0205056	5/24/2002	6,911	OE	30	0.004	0.687	0.026	275.1	0.021	0.010	0.000
	average					0.008	0.666	0.021	276.0	0.021	0.010	0.000
	stdev					0.005	0.030	0.008	1.325	0.001	0.001	0.000
	I0205002	5/1/2002	6,493	OE	150	0.030	1.047	0.044	277.8	0.035	0.021	0.000
	I0205008	5/2/2002	6,543	OE	150	0.014	0.792	0.026	275.4	0.031	0.016	0.000
	average					0.022	0.920	0.035	276.6	0.033	0.019	0.000
	stdev					0.011	0.180	0.013	1.739	0.003	0.004	0.000
	I0203012	3/6/2002	5,638	Aged	5	0.007	4.007	0.027	297.5	0.062	0.067	0.000
	I0203015	3/8/2002	5,672	Aged	5	0.003	3.135	0.043	299.2	0.056	0.054	0.000
	average					0.005	3.571	0.035	298.4	0.059	0.061	0.000
	stdev					0.003	0.617	0.011	1.170	0.004	0.009	0.000
	I0203052	3/22/2002	5,823	Aged	30	0.023	1.733	0.093	291.5	0.029	0.035	0.005
	I0203058	3/26/2002	5,861	Aged	30	0.022	0.832	0.051	299.3	0.023	0.029	0.004
	I0203063	3/28/2002	5,883	Aged	30	0.028	1.752	0.094	299.9	0.041	0.039	0.008
	average					0.024	1.439	0.079	296.9	0.031	0.035	0.006
	stdev					0.003	0.526	0.025	4.672	0.009	0.005	0.002
	I0204009	4/4/2002	6,020	Aged	150	0.066	2.549	0.123	294.2	0.036	N/A	N/A
	I0204016	4/5/2002	6,028	Aged	150	0.028	2.155	0.089	292.4	0.014	N/A	N/A
	I0204018	4/9/2002	6,051	Aged	150	0.031	2.198	0.077	289.5	0.036	0.029	0.003
	average					0.042	2.301	0.096	292.0	0.029	0.029	0.003
	stdev					0.021	0.216	0.024	2.350	0.012	N/A	N/A

Appendix I. US06 Statistical Analysis Results

Statistical Analysis for US06 Emissions Results Excluding the European Vehicles

			NMHC	THC	CO	NO_x	NH_3	N_2O
			p-value	p-value	p-value	p-value	p-value	p-value
No Outliers	Logarthmic	Vehicle	0.0155	0.0136	0.0161	0.0130	0.0142	0.0177
		Catalyst age	0.0902	0.0069	0.0825	0.0222	0.0873	0.2419
		Fuel sulfur level	<0.0001	<0.0001	0.0821	<0.0001	0.0043	<0.0001
		Vehicle*Catalyst	0.0290	0.0229	0.0384	0.1018	0.0446	0.2235
		Vehicle*Fuel	0.0021	0.0018	0.2639	0.1713	0.2094	-
		Catalyst*Fuel	0.1778	0.2333	0.1568	0.3720	0.0443	0.1108
	Arithmetic	Vehicle	0.0227	0.0196	0.0136	0.0588	0.0219	0.0940
		Catalyst age	0.0482	0.0092	0.0704	0.0498	0.3205	0.0877
		Fuel sulfur level	0.0001	<0.0001	0.6676	<0.0001	0.0465	0.0044
		Vehicle*Catalyst	0.1550	0.0451	0.2367	0.1515	0.0206	0.0514
		Vehicle*Fuel	0.0027	0.0029	0.1412	0.0670	0.0754	0.0013
		Catalyst*Fuel	0.0070	0.0087	0.3106	0.2015	0.9281	0.0438

Statistical Analysis for US06 Emissions Results Including the European Vehicles

			NMHC	THC	CO	NO_x	NH_3	N_2O
			p-value	p-value	p-value	p-value	p-value	p-value
No Outliers	Logarthmic	Vehicle	0.0099	0.0087	0.0099	0.0085	0.0088	0.0116
		Catalyst age	0.0728	0.0103	0.0267	0.0043	0.1401	0.3766
		Fuel sulfur level	<0.0001	<0.0001	0.2054	<0.0001	0.0012	<0.0001
		Vehicle*Catalyst	0.0400	0.0253	0.0274	0.1507	0.0394	0.2589
		Vehicle*Fuel	0.0029	0.0033	0.1202	0.1590	0.2250	-
		Catalyst*Fuel	0.0954	0.2979	0.0398	0.0968	0.0581	0.0555
	Arithmetic	Vehicle	0.0148	0.0127	0.0079	0.0461	0.0133	0.0768
		Catalyst age	0.0232	0.0058	0.0345	0.0159	0.3041	0.0379
		Fuel sulfur level	<0.0001	<0.0001	0.7656	<0.0001	0.0425	0.0028
		Vehicle*Catalyst	0.1315	0.0339	0.2139	0.1540	0.0142	0.0609
		Vehicle*Fuel	0.0015	0.0018	0.1077	0.0495	0.0670	0.0007
		Catalyst*Fuel	0.0011	0.0013	0.2030	0.0593	0.7954	0.0112

"-" = no interaction

Appendix J. Detailed NEDC Emission Results

						NMHC			CO			NO_x			CO_2			TDL-NH_3			FTIR - NH_3			FTIR - N_2O		
Vehicle	Test	Date	Mileage	Cat.	Fuel S	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC
					ppm	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km
2000 VW Bora	I0204021	4/9/2002	7,479	OE	5	0.367	0.002	0.136	2.504	0.098	0.981	0.135	0.001	0.050	269.9	149.2	193.5	0.023	0.004	0.011	0.007	0.000	0.002	0.015	0.000	0.004
	I0204032	4/12/2002	7,524	OE	5	0.384	0.002	0.142	2.391	0.045	0.907	0.137	0.003	0.052	264.9	148.7	191.4	0.016	0.001	0.006	0.000	0.000	0.000	0.016	0.000	0.005
	I0204038	4/16/2002	7,538	OE	5	0.387	0.001	0.143	3.030	0.039	1.139	0.127	0.001	0.048	262.2	147.8	189.9	0.017	0.001	0.007	0.001	0.000	0.000	0.016	0.000	0.005
	average					0.379	0.002	0.140	2.641	0.061	1.009	0.133	0.002	0.050	265.7	148.6	191.6	0.018	0.002	0.008	0.003	0.000	0.001	0.016	0.000	0.005
	stdev					0.011	0.000	0.004	0.341	0.033	0.118	0.005	0.001	0.002	3.879	0.719	1.822	0.004	0.002	0.002	0.004	0.000	0.001	0.001	0.000	0.000
	I0205006	5/2/2002	7,760	OE	30	0.510	0.003	0.189	3.141	0.045	1.180	0.210	0.026	0.094	248.2	151.7	187.1	0.014	0.001	0.006	0.000	0.000	0.000	0.119	0.000	0.018
	I0205014	5/7/2002	7,793	OE	30	0.440	0.002	0.163	3.248	0.059	1.230	0.132	0.001	0.049	274.4	146.2	193.2	0.017	0.001	0.007	0.002	0.000	0.000	0.048	0.000	0.007
	I0205019	5/8/2002	7,800	OE	30	0.360	0.001	0.133	2.383	0.049	0.909	0.134	0.006	0.053	266.4	148.3	191.8	0.013	0.001	0.005	0.000	0.000	0.000	0.061	0.000	0.009
	average					0.437	0.002	0.162	2.924	0.051	1.106	0.159	0.011	0.065	263.0	148.7	190.7	0.015	0.001	0.006	0.001	0.000	0.000	0.076	0.000	0.011
	stdev					0.075	0.001	0.028	0.471	0.007	0.173	0.044	0.013	0.024	13.420	2.768	3.235	0.002	0.000	0.001	0.001	0.000	0.000	0.038	0.000	0.006
	I0205037	5/16/2002	7,983	OE	150	0.405	0.002	0.150	2.782	0.088	1.078	0.150	0.003	0.057	268.5	155.0	196.7	0.011	0.009	0.010	0.000	0.000	0.000	0.043	0.000	0.006
	I0205042	5/17/2002	7,990	OE	150	0.493	0.004	0.183	3.036	0.047	1.141	0.233	0.011	0.093	266.8	155.1	196.0	0.010	0.004	0.006	0.000	0.000	0.000	0.070	0.000	0.010
	I0205047	5/21/2002	8,004	OE	150	0.393	0.003	0.147	2.691	0.059	1.027	0.171	0.003	0.065	268.6	148.5	192.7	0.010	0.005	0.007	N/A	N/A	N/A	N/A	N/A	N/A
	average					0.431	0.003	0.160	2.836	0.065	1.082	0.185	0.006	0.072	268.0	152.9	195.1	0.010	0.006	0.008	0.000	0.000	0.000	0.057	0.000	0.008
	stdev					0.055	0.001	0.020	0.179	0.021	0.057	0.043	0.005	0.019	0.987	3.758	2.132	0.000	0.003	0.002	0.000	0.000	0.000	0.019	0.000	0.003
	I0202032	2/13/2002	6,863	aged	5	0.449	0.002	0.166	2.933	0.025	1.094	0.172	0.025	0.079	240.4	153.0	185.2	0.015	0.000	0.006	0.005	0.000	0.002	0.020	0.000	0.006
	I0202055	2/26/2002	6,908	aged	5	0.429	0.002	0.160	2.904	0.019	1.081	0.206	0.007	0.080	266.0	150.4	193.0	0.017	0.000	0.006	0.006	0.000	0.002	0.026	0.000	0.008
	average, km					0.439	0.002	0.163	2.918	0.022	1.088	0.189	0.016	0.080	253.2	151.7	189.1	0.016	0.000	0.006	0.005	0.000	0.002	0.023	0.000	0.007
	stdev, km					0.014	0.000	0.005	0.020	0.004	0.009	0.024	0.012	0.001	18.10	1.833	5.543	0.001	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.001
	I0203047	3/21/2002	7,170	aged	30	0.454	0.002	0.168	2.925	0.025	1.089	0.177	0.017	0.076	261.7	148.3	189.9	0.016	0.001	0.006	N/A	N/A	N/A	N/A	N/A	N/A
	I0203053	3/22/2002	7,185	aged	30	0.458	0.002	0.169	3.270	0.017	1.211	0.205	0.048	0.105	262.5	148.5	190.3	0.018	0.000	0.007	0.004	0.000	0.001	0.027	0.000	0.008
	average, km					0.456	0.002	0.168	3.097	0.021	1.150	0.191	0.033	0.091	262.1	148.4	190.121	0.017	0.000	0.006	0.004	0.000	0.001	0.027	0.000	0.008
	stdev, km					0.003	0.000	0.001	0.244	0.005	0.086	0.019	0.021	0.021	0.537	0.129	0.258	0.001	0.000	0.000	N/A	N/A	N/A	N/A	N/A	N/A
	I0203056	3/26/2002	7,281	aged	150	0.419	0.005	0.157	3.070	0.054	1.163	0.182	0.006	0.071	265.8	148.9	191.9	0.019	0.002	0.008	0.003	0.000	0.001	0.032	0.000	0.009
	I0203064	3/28/2002	7,311	aged	150	0.480	0.003	0.178	3.031	0.020	1.125	0.180	0.014	0.075	260.8	149.1	190.1	0.013	0.001	0.005	0.000	0.000	0.000	0.026	0.000	0.008
	average, km					0.449	0.004	0.167	3.050	0.037	1.144	0.181	0.010	0.073	263.3	149.0	191.0	0.016	0.001	0.007	0.002	0.000	0.001	0.029	0.000	0.008
	stdev, km					0.043	0.001	0.015	0.027	0.024	0.027	0.002	0.006	0.003	3.530	0.113	1.285	0.004	0.001	0.002	0.002	0.000	0.001	0.004	0.000	0.001

Appendix J. Detailed NEDC Emission Results

						NMHC			CO			NO_x			CO_2			TDL-NH_3			FTIR - NH_3			FTIR - N_2O		
Vehicle	Test	Date	Mileage	Cat.	Fuel S	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC	ECE	EUDC	NEDC
					ppm	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km
2001 Renault Megane	I0204027	4/11/2002	6,192	OE	5	0.167	0.003	0.063	0.544	0.022	0.213	0.012	0.020	0.017	258.8	153.5	192.1	0.012	0.003	0.006	0.000	0.000	0.000	0.004	0.000	0.001
	I0205033	5/15/2002	6,717	OE	5	0.156	0.003	0.059	0.475	0.035	0.196	0.012	0.009	0.010	237.2	161.3	189.1	0.013	0.010	0.011	0.000	0.002	0.001	0.012	0.002	0.002
	I0205038	5/16/2002	6,724	OE	5	0.194	0.003	0.073	0.654	0.070	0.284	0.010	0.013	0.012	249.1	163.3	194.6	0.017	0.006	0.010	0.000	0.000	0.000	0.008	0.000	0.001
	average, km					0.172	0.003	0.065	0.558	0.042	0.231	0.011	0.014	0.013	248.4	159.3	191.9	0.014	0.006	0.009	0.000	0.001	0.000	0.008	0.001	0.002
	stdev, km					0.020	0.000	0.007	0.090	0.025	0.046	0.002	0.006	0.004	10.838	5.194	2.778	0.003	0.004	0.003	0.000	0.001	0.000	0.004	0.001	0.001
	I0204047	4/18/2002	6,336	OE	30	0.264	0.005	0.100	0.633	0.020	0.245	0.017	0.007	0.011	256.1	153.3	191.0	0.016	0.002	0.007	0.000	0.000	0.000	0.003	0.000	0.001
	I0204052	4/19/2002	6,343	OE	30	0.166	0.002	0.062	0.592	0.026	0.234	0.012	0.025	0.020	254.7	152.9	190.3	0.010	0.004	0.006	0.000	0.000	0.000	0.004	0.000	0.001
	average					0.215	0.004	0.081	0.613	0.023	0.240	0.015	0.016	0.016	255.4	153.1	190.7	0.013	0.003	0.007	0.000	0.000	0.000	0.003	0.000	0.001
	stdev					0.069	0.002	0.026	0.029	0.004	0.008	0.004	0.012	0.006	0.96	0.318	0.511	0.004	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.000
	I0205009	5/3/2002	6,563	OE	150	0.171	0.004	0.065	0.607	0.020	0.236	0.015	0.010	0.012	240.4	151.8	184.3	0.008	0.002	0.007	0.000	0.000	0.000	0.024	0.000	0.004
	I0205015	5/7/2002	6,570	OE	150	0.162	0.004	0.062	0.561	0.010	0.212	0.010	0.013	0.012	259.1	150.5	190.4	0.011	0.001	0.005	N/A	N/A	N/A	N/A	N/A	N/A
	average, km					0.166	0.004	0.064	0.584	0.015	0.224	0.012	0.012	0.012	249.8	151.2	187.4	0.009	0.002	0.006	0.000	0.000	0.000	0.024	0.000	0.004
	stdev, km					0.006	0.000	0.003	0.033	0.007	0.017	0.004	0.002	0.000	13.24	0.854	4.332	0.002	0.001	0.001	N/A	N/A	N/A	N/A	N/A	N/A
	I0203012	3/6/2002	5,638	aged	5	0.193	0.003	0.073	0.797	0.020	0.305	0.018	0.026	0.023	255.8	154.7	191.8	0.052	0.006	0.023	0.027	0.006	0.009	0.005	0.004	0.002
	I0203015	3/8/2002	5,672	aged	5	0.199	0.003	0.075	0.839	0.035	0.330	0.025	0.025	0.025	252.9	155.9	191.4	0.052	0.006	0.023	0.021	0.005	0.007	0.005	0.001	0.002
	average, km					0.196	0.003	0.074	0.818	0.028	0.317	0.021	0.025	0.024	254.4	155.3	191.6	0.052	0.006	0.023	0.024	0.005	0.008	0.005	0.003	0.002
	stdev, km					0.004	0.001	0.001	0.030	0.010	0.018	0.005	0.001	0.001	2.05	0.793	0.233	0.000	0.000	0.000	0.004	0.001	0.001	0.000	0.002	0.000
	I0203052	3/22/2002	5,823	aged	30	0.191	0.003	0.072	0.766	0.020	0.295	0.027	0.014	0.019	250.1	154.3	189.5	0.041	0.005	0.019	0.024	0.007	0.008	0.010	0.003	0.003
	I0203059	3/27/2002	5,869	aged	30	0.171	0.003	0.065	0.730	0.013	0.276	0.018	0.009	0.012	252.9	153.7	190.0	0.031	0.003	0.014	0.012	0.004	0.004	0.007	0.001	0.002
	I0203062	3/28/2002	5,876	aged	30	0.189	0.003	0.071	0.759	0.022	0.292	0.028	0.025	0.026	255.3	153.7	191.0	0.032	0.004	0.014	0.014	0.004	0.005	0.005	0.000	0.001
	average, km					0.184	0.003	0.070	0.752	0.018	0.288	0.024	0.016	0.019	252.8	153.9	190.2	0.035	0.004	0.015	0.017	0.005	0.006	0.007	0.002	0.002
	stdev, km					0.011	0.000	0.004	0.019	0.005	0.010	0.006	0.008	0.007	2.620	0.330	0.729	0.006	0.001	0.003	0.007	0.002	0.002	0.002	0.001	0.001
	I0204016	4/5/2002	6,028	aged	150	0.244	0.006	0.093	0.928	0.030	0.361	0.017	0.017	0.017	255.1	152.7	190.4	0.010	0.008	0.009	N/A	N/A	N/A	N/A	N/A	N/A
	I0204018	4/9/2002	6,051	aged	150	0.157	0.004	0.060	0.717	0.020	0.276	0.012	0.013	0.013	253.8	153.5	190.3	0.020	0.002	0.008	0.000	0.000	0.000	0.004	0.001	0.001
	average, km					0.200	0.005	0.077	0.822	0.025	0.318	0.015	0.015	0.015	254.5	153.1	190.4	0.015	0.005	0.009	0.000	0.000	0.000	0.004	0.001	0.001
	stdev, km					0.062	0.001	0.024	0.150	0.007	0.060	0.003	0.003	0.003	0.91	0.547	0.100	0.007	0.004	0.000	N/A	N/A	N/A	N/A	N/A	N/A