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September 11, 1992

MEMORANDUM

TO: Robert Fairweather
Teresa Gorman
Jeffrey Holmstead
David McIntosh

FROM: Barbara Steakley *BS*

SUBJECT: Vehicle Inspection & Maintenance (I/M) Proposed Rule

Since the debate about the inspection and maintenance (I/M) program under the Clean Air Act Amendments of 1990 continues, Jiffy Lube wanted you to be aware of our position on and concerns about EPA's proposed rule (57 FR 31058 and 57 FR 33287). Therefore, attached for your information and review are Jiffy Lube's comments to EPA regarding the proposal. Additionally, you might be interested to know that a Jiffy Lube franchisee who currently performs emission inspections in North Carolina testified during EPA's two days of hearings on August 12-13.

Jiffy Lube's position, in summary, is to:

- define "test-only operations" as "facilities that conduct vehicle emissions testing but do not engage in the repair of emissions equipment nor perform services which affect emissions;"
- allow states to enact decentralized, "test-and-repair" enhanced BAR90 programs without a 50% emissions penalty or other disincentives;
- recognize that efficient enhanced BAR90 equipment is equivalent to and more cost-effective than the IM240 equipment; and
- consider the potential impact of the decentralized penalty on VOC emissions as it affects SIPs and also the implementation of Maximum Achievable Control Technology (MACT) under title III.

Jiffy Lube would be happy to discuss our comments with you at any time. Please feel free to call Barbara Steakley at 202-331-0212.

Attachments

EPA/CAA/

I + m ~~Ret~~ Reg

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PENNZOIL PLACE • P.O. BOX 2967 • HOUSTON, TEXAS 77252-2967 • (713) 546-8516

August 26, 1992

SAROSH J. H. MANEKSHAW
Director
Environmental, Safety
and Health Affairs

Environmental Protection Agency
The Air Docket
Room M-1500 (LE-131)
Waterside Mall
Attention: Docket No. A-91-75
401 M Street SW
Washington, D.C. 20460

RE: Proposed Rule
I/M Standards
57 FR 33287
July 28, 1992
Docket No. A-91-75

Dear Mr. Tierney:

Pennzoil Company is a natural resources company engaged with its subsidiaries in the production, refining, and sales of petroleum products, and in the production and sale of sulphur. We are also affiliated with more than one thousand quick lube facilities across the nation through our ownership of Jiffy Lube International. We appreciate this opportunity to comment on the Environmental Protection Agency's (EPA) proposed vehicle inspection and maintenance (I/M) standards.

In this proposed regulation, EPA outlines two I/M programs, centralized and decentralized, that states can adopt. However, by unfairly penalizing decentralized programs, EPA essentially forces states to implement centralized programs. EPA must allow states to determine which program best suits their needs when setting a performance standard, in this case, which program fits with the respective state implementation program. EPA should not bias states towards a centralized program.

Pennzoil supports EPA's intent to reduce air emissions from mobile sources. However, as a company that operates stationary sources and owns facilities which perform emissions inspections, we have four areas of concern with the regulations as proposed:

- ♦ The definition of "test-only" facility;
- ♦ The lack of flexibility afforded to the states to implement either a centralized or decentralized program;

- ♦ Test equipment equivalency; and
- ♦ Consistency with other titles of the 1990 Clean Air Act Amendments.

Definition of "Test-only"

In the preamble to the proposal, EPA invites comments on the definition of "test-only." EPA should define "test-only operations" as "facilities that conduct vehicle emissions testing but do not engage in the repair of emissions equipment nor perform services which affect emissions." A breakdown of these types of facilities can be found in Standard Industrial Classification (SIC) 75, subset 7549. By using this definition of "test-only operations," EPA would eliminate the possible conflict of interest created by allowing emissions testing and repair at the same facility. Test facilities that do not engage in emissions repair services have no incentive to falsely fail cars in order to obtain fraudulent emissions repair business or to recommend less costly solutions to remain within the \$450 repair limit. Furthermore, adopting this definition would allow some maintenance facilities which are already conveniently located to the public and which perform services unrelated to emissions systems to conduct emissions testing.

Jiffy Lube International recently contracted with Booz·Allen Hamilton to conduct a study that evaluated the emissions effects of services typically performed at Jiffy Lube outlets. The services included oil change with a new oil filter, addition of fuel additives, air filter replacements, PVC replacements and the combination of these items. Results from the attached Booz·Allen Hamilton study show that there is no emissions impact from these types of services performed at the tested North Carolina Jiffy Lube facilities. Thus, under Pennzoil's proposed limited definition of "test-only operations," similar facilities which perform these types of services should be allowed to perform vehicle emissions testing.

Decentralized System Versus Centralized System

As mandated by the Clean Air Act Amendments of 1990, EPA has proposed regulations to allow states to operate either a centralized or a decentralized I/M program. Decentralized programs may be "test-and-repair" or "test-only." EPA has proposed that centralized programs be limited to "test-only." In keeping with the 1990 Clean Air Act Amendments mandate, EPA should remove any barriers to states choosing either a centralized or decentralized program. If choosing a decentralized program, a state must have the true option of choosing either a "test-only" or "test-and-repair" program. To offer states a truly unbiased choice, EPA should: 1) clearly state that a decentralized "test-only" facility is equivalent to a centralized program; 2) eliminate the requirement that states choosing a decentralized "test-and-repair" program submit a back-up centralized plan; and 3) grant equal emissions credits

for centralized and "test-and-repair" decentralized programs. By clearly stating that decentralized "test-and-repair" facilities are equivalent to such centralized program, EPA will eliminate these two unsupported biases. EPA must give states a true opportunity to decide which program best suits their needs.

While the proposed section 51.353 grants presumed equivalency for centralized and decentralized "test-only" facilities, the preamble language focuses almost exclusively on decentralized "test-and-repair" programs. In order to give states the widest latitude in choosing a program, the final rule and preamble must highlight this equivalency.

Again, to give states the widest latitude in choosing a program, EPA should remove those proposed sections which force states to unnecessarily adopt a centralized program by severely limiting the emissions credits for "test-and-repair" decentralized programs. EPA further discourages these types of decentralized programs by requiring adoption of additional emissions controls to recapture the emissions credits arbitrarily cut by EPA. Limiting emissions credits should apply to all failed programs and not arbitrarily (before the fact) to decentralized "test-and-repair" programs. Such limits are actually penalties and should only be imposed based on program failure rather than decentralized or centralized program design.

EPA is limiting the emissions credits on the basis of a scientifically unsupportable assumption that decentralized "test-and-repair" programs will only attain 50% of the VOC reductions attainable by a centralized program. However, according to the Resources for the Future analysis, "there is virtually no evidence about the actual effectiveness of centralized I&M relative to decentralized I&M." [See the attached letter from Virginia D. McConnell of Resources for the Future to Mort Getman dated July 15, 1992.] The evidence indicates that the allowed credit is based on a series of biased assumptions supporting centralized programs and penalizing decentralized programs.

EPA further drives states toward centralization by requiring states opting to use a decentralized "test-and-repair" network to submit a back-up centralized, "test-only" plan. These requirements further bias the options presented to the states by creating twice the work for states implementing decentralized programs. Sufficient time is not available for states to complete this extra work and then implement the programs successfully. Therefore, EPA has designed decentralized "test-and-repair" networks to fail.

Through these two mechanisms, EPA places onerous burdens on states which deter them from implementing a decentralized, "test-and-repair" network. EPA has essentially dictated the decision for the states by presenting the options in this manner. Under the current EPA proposal, the only seemingly feasible choice for state agencies is to implement a centralized, "test-only" network in order to be able to complete their State Implementation Plans (SIPs) on schedule without any regard for the impact on small businesses. As noted above, decentralized "test-only" programs are also a viable option; however, EPA failed to discuss this option or highlight its existence and acceptability.

While EPA seems to have already made a prejudgment based on assumptions rather than facts, it is imperative that EPA recognize the many advantages of decentralized "test-only" and "test-and-repair" programs. The following listed advantages support giving states a real choice to implement effective decentralized "test-and-repair" and "test-only" programs rather than cost ineffective centralized programs.

Preservation of Small Businesses

One of the key advantages of a decentralized program is that it will preserve opportunities for small businesses that currently conduct emissions inspections. Centralized programs, on the other hand, will drive small businesses from emissions inspection by mandating expensive testing equipment at a small number of hi-tech facilities without cost-effective incremental benefits to air quality. The California Service Station and Auto Repair Association estimates that 21,000 jobs and 9,000 small businesses will be lost in California alone if centralized programs are implemented. North Carolina Jiffy Lube operators would lose 11.7% of their total income resulting in an estimated 20% decrease in their manpower requirements if the state is forced into a centralized system. Loss of these jobs and businesses can be prevented through the implementation of a well constructed decentralized program.

To preserve the opportunity for small businesses to perform inspections, EPA must allow states to use the enhanced BAR90 equipment with pressure and purge test apparatus as an equivalent substitute for IM240 equipment. How is EPA going to compensate small businesses which were forced to abandon a service to their customers when EPA's conceptual centralized program does not meet the Agency's own expectations? Usually, government must have a compelling reason to deny economic livelihood. In this instance, EPA has not provided scientific data to deny I/M participation to small businesses.

EPA assumes that the prototype IM240 equipment is superior to the proven standard BAR90 equipment even though the IM240 has no operating history which can prove its reliability after months or years of continuous service. Yet EPA continues to assume that the centralized IM240 test is 100% effective. As we will discuss later in these comments, the known performance of the enhanced BAR90 equipment is almost as effective as the assumed efficiency of the IM240.

The cost of the IM240 equipment and contract restrictions required by a centralized program will force small business operators to abandon their emissions inspection businesses. Estimates indicate that the IM240 equipment will cost a minimum of \$140,000. Standard BAR90 analyzers, on the other hand, cost only \$14,000 - \$16,000, and the enhanced version costs an additional \$31,000 to \$44,000. In a centralized system, only a few large operators will be able to afford the cost of the IM240 equipment. The lower cost of the enhanced BAR90 equipment, however, will allow small businesses to operate competitive and effective emissions inspection programs.

Demonstration of Decentralized Program Effectiveness

The states of California and North Carolina have demonstrated that emissions reductions can be effectively achieved in a decentralized system. Under California's current I/M program, emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen have been reduced since the conversion to a modern I/M program. The testimony presented at the EPA hearing on August 12, 1992 by the California Service Station and Auto Repair Association estimates that implementation of the new California program has reduced hydrocarbons by 41%, carbon monoxide by 53%, and oxides of nitrogen by 105% over the old program.

Through proper implementation of a decentralized program and enhanced enforcement, North Carolina has reduced nonattainment severity from moderate to marginal in Mecklenburg County. [See the attached letter from Robert F. Hodges, Commissioner of Motor Vehicles, North Carolina, to Mr. Stephen P. Conway dated May 7, 1992.] The North Carolina program is an example of successful covert and overt auditing. Pennzoil strongly supports EPA's inclusion of covert and overt auditing as an enforcement requirement for State Implementation Plan (SIP) approval.

Over the past 18 months, North Carolina covert audits revealed virtually no fraudulent emissions testing throughout the North Carolina decentralized program. [See attached memorandum from Mr. Stephen P. Conway to Ms. Valerie P. Smith dated August 19, 1992.] Specifically, the North Carolina Jiffy Lubes had no violations for improper emissions testing and only five warnings and one probation for improper visual examinations. These statistics demonstrate that fraud is not a pervasive problem in a modern decentralized program. EPA must make decentralized programs a true option and provide a fair chance of success by deleting language which burdens or penalizes such programs.

Existing Infrastructure

In many states, the infrastructure for a modern decentralized inspection network already exists. By utilizing existing facilities, states can minimize costs and disruptions while maintaining a normal inspection routine for consumers. This will significantly improve initial program performance since it minimizes change. On the other hand, implementing a centralized system in an area such as Houston, which currently uses a decentralized system, will require substantial capital investment and force a new infrastructure to be established while maintaining the existing one for vehicle safety inspections. For example, using the EPA data of 20,000 cars per year per bay and 2,700,000 vehicles, Houston will need 135 bays. Applying a \$140,000 to \$250,000 installation cost for the IM240 equipment, the total initial capital investment in the Houston area alone will range from \$19,900,000 to \$37,750,000. The size of this investment places it well out of the range for small business. However, the existing I/M infrastructure can handle this I/M load easily. By upgrading the infrastructure with enhanced BAR90 test equipment, the cost is within the capital investment potential of small business. Moreover, the air

emissions reduction goals of the 1990 Clean Air Act Amendments can be met without causing undue economic harm to small businesses, which continue to provide more than two-thirds of the new jobs in the United States.

Loss of Capital Investment

At the I/M hearings held in Washington, D.C., EPA voiced concern that small businesses would lose their investment in BAR90 equipment if their state agency is forced to adopt a centralized program after the decentralized evaluation period expires. EPA must realize that without this opportunity to prove their continued effective role in I/M programs, small businesses will definitely lose their existing investments. We believe that it is more important for small businesses to have the opportunity to participate in the inspections program. This is especially true since most I/M inspections currently are conducted by small businesses. EPA should consider that, without taking such risks, there is no chance for profit when small businesses are excluded from centralized programs. The decision to take the risk of losing the capital investment should be left to small businesses, and not to EPA.

Proposed Decentralized Program Emissions Reduction Penalty

The 1990 Clean Air Act Amendments require EPA to provide states the option of implementing an equivalent decentralized system. The Resources for the Future analysis of the EPA basis for centralized programs shows that there is no evidence to support the claim that centralized programs will be twice as effective as decentralized programs. EPA, therefore, needs to remove any language from the rule and the preamble which penalizes states which do not implement centralized programs. For example, EPA should remove the language of section §51.353(c) which states that "credits for "test-and-repair" networks...are assumed to be 50% less than those for a "test-only" network for the tailpipe emission test, purge test, evaporative system integrity test, catalyst check, and gas cap check; and 75% less for the evaporative canister checks, PVC check, and air system checks." These assumptions are neither supported by the Resources for the Future analysis, nor has EPA presented any factual test data in the record to support this anecdotal assumption. Thus, reference to differences in equivalency between centralized and decentralized testing should be deleted from the rule and preamble.

In summary, EPA should give states the true opportunity to adopt decentralized programs for the following reasons:

- ♦ To preserve small businesses;
- ♦ To continue to utilize effective, properly implemented modern decentralized programs;

- ♦ To minimize costs by using the existing infrastructure;
- ♦ To allow small businesses to decide whether to take the risk of losing their capital investment; and
- ♦ To offer states a realistic choice by eliminating the penalties for decentralized "test-and-repair" networks.

Effectiveness of Enhanced BAR 90

EPA must acknowledge that the enhanced BAR90 and IM240 are both effective tools which, when used properly, can significantly reduce vehicle emissions and give states the flexibility to choose the equipment which best suits their program. Studies conducted by Atlantic Richfield Company (ARCO) have demonstrated that by enhancing BAR90 equipment with pressure and purge test apparatus, comparable emissions reductions can be achieved at a much more reasonable cost to small businesses and vehicle owners. [See the attached letter from Virginia D. McConnell of Resources for the Future to Mort Getman dated July 15, 1992.] The enhanced BAR90 can also be connected to a computer to determine which cars are tested, failed, retested, and passed within a short time period. The computer system not only alerts enforcement officials to potential fraud, but also identifies the cars that repeatedly fail the test and need to be scrapped. Furthermore, the enhanced BAR90 can be programmed to include engine families so that the concentration readings can be equated to mass flow rate for the pass/fail standards. Studies currently are being performed in Canada to compile these data. In general, ARCO's studies show that "steady state, loaded mode dynamometer testing is as effective in correctly passing or failing cars as the IM240 test for both tailpipe emissions and evaporative canister purging."

The enhancements to the BAR90 mentioned in the above paragraph will require a much smaller investment (\$31,000 - \$44,000) than the IM240 equipment and provide an equivalent determination of compliance. The enhancements will cost operators a maximum of \$4,000 as compared to \$140,000 for the IM240 equipment. Given that the equipment is equally effective and that the costs are so disparate, EPA should allow the use of the enhanced BAR90 test as an equivalent test method.

An analysis conducted by Resources for the Future also indicates that EPA has underestimated the marginal annual and biennial testing costs of the IM240 program. After studying EPA's data, Resources for the Future concluded that there is no evidence that tampering and temporary adjustments to allow vehicles to pass will be reduced in a centralized system. On the contrary, corruption and fraud plagued the New York City cab inspection system despite its

centralized nature. [As presented in testimony by Mr. Mort Getman on August 12, 1992 at the EPA public hearing in Washington D.C. on the I/M proposal.]

Obligation to Coordinate with Other Clean Air Act Amendments Titles

The intent of the Clean Air Act is to achieve the ambient air quality standards as well as to reduce toxic air emissions and acid rain components. Therefore, it is essential in any regulatory action to evaluate the impact of the regulation on other titles of the Clean Air Act. It is also essential that individual regulations consider economic feasibility of the whole program as well as for the individual regulation. In this rulemaking, EPA must consider the potential impact of the decentralized penalty on VOC emissions as it affects other portions of the SIPs and also the implementation of Maximum Achievable Control Technology (MACT) under title III.

The 50% VOC emissions penalty for decentralized programs could force states to implement very stringent emission reduction programs on all VOC sources. These programs which the states must implement to obtain the lost VOC emissions credits could force the states to set a control requirement equivalent to a federal MACT standard before a federal MACT rule is issued under title III. This would result in additional millions of dollars being spent to comply with the federal MACT standards after industry has implemented state MACT guidelines. Moreover, states might prematurely require controls on minor sources, including consumer products, creating another adverse effect on small businesses.

This lack of coordination between the two programs emphasizes the complexity and difficulty in economic implementation of the 1990 Clean Air Act Amendments. EPA must be sensitive to the economic impact that seemingly unrelated regulations can inadvertently have on each other.

Conclusion

Once again, Pennzoil appreciates this opportunity to comment on EPA's inspection and maintenance proposal. I/M programs are an important component of reducing mobile source emissions, the major cause of continuing ozone and carbon monoxide nonattainment in our largest cities and urban areas. However, in order to create and maintain functional and cost effective I/M programs, Pennzoil suggests that EPA:

- ♦ Define "test-only operations" as "facilities that conduct vehicle emissions testing but do not engage in the repair of emissions equipment nor perform services which affect emissions";
- ♦ Allow states to enact decentralized, "test-and-repair" enhanced BAR90 programs without a 50% emissions penalty or other disincentives;

- ♦ Recognize that efficient enhanced BAR90 equipment is equivalent to and more cost effective than the IM240 equipment; and
- ♦ Consider the potential impact of the decentralized penalty on VOC emissions as it affects SIPs and also the implementation of Maximum Achievable Control Technology (MACT) under title III.

We hope that these comments will help EPA develop effective, yet practical, I/M standards.

Yours very truly,

David W. Dunn
for Susan Manderhau

SJHM:ALR/alr

cc: Karen V. Brown, Small Business Ombudsman
401 M. Street, SW
A 149-Q
Washington, D.C. 20460

Eugene J. Tierney
Office of Mobile Sources
Vehicle Emission Laboratory
2565 Plymouth Road
Ann Arbor, MI 48105

State of North Carolina



Division of Motor Vehicles

1100 New Bern Avenue
Raleigh 27697-0001

THOMAS J. HARRELSON
SECRETARY OF TRANSPORTATION

ROBERT F. HODGES
COMMISSIONER OF MOTOR VEHICLES

May 7, 1992

Mr. Stephen P. Conway
CFA Management
Suite 302 East Building
1900 Corporate Boulevard NW
Boca Raton, Florida 33431

Dear Mr. Conway:

Mr. B.M. Cross, Coordinator of North Carolina's I/M Program, has shared with me a copy of your recent letter and the attached comments which you attribute to Mr. Eugene J. Tierney of the U.S. Environmental Protection Agency at a hearing before an Ohio Senate Committee on Environmental and Natural Resources. In view of the critical nature of the comments, I am compelled to respond and set the record straight.

Since we began our North Carolina Analyzer System-90 (NCAS-90) Program, we have received nothing but favorable comments from EPA officials. We have regularly and consistently sought EPA's advice and opinions about our program and have diligently attempted to implement any suggestions for change that the agency has made.

Mr. Tierney is a well-known and respected authority within EPA. He has authored and co-authored several technical reports for EPA, including: "Recommended I/M Short Test Procedures for the 1990's; Six alternatives" (March 1990. EPA-AATSS-I/M 90-3) and "EPA Guidance on Inspection Maintenance" (April 1991 Office of Air and Radiation ARN-443). North Carolina has based much of its I/M Program on these two guidelines.

Although Mr. Tierney admits his strong bias toward centralized testing, it is difficult to understand why he would be as negative as his comments indicate about a decentralized program established and operated under the very guidelines he developed and provided. Allow me to take this opportunity to offer the following responses to the statements you have attributed to Mr. Tierney:

Page Two

Mr. Stephen P. Conway

May 7, 1992

Statement

"Carbon monoxide (CO) reductions may not be sufficient in a decentralized program. These are harder to attain than hydrocarbon (HC) reductions.

Response

If a standard is set for vehicles to pass, they will pass in either a decentralized or centralized program. If the vehicle fails, it will fail at either station. The repair work and reductions will also be the same with either system. As you are aware, excessive CO basically results from a combination of a malfunctioning carburetor main system and/or a maladjusted air/fuel ratio. Usually a carburetor adjustment will correct the problem. We have found since we began CO and HC standards that it is more difficult to reduce the HC of failed vehicles than the CO. The basic question is, who will be attempting to repair the vehicles that were failed in a centralized program? It will be essentially the same mechanics who are now repairing vehicles under the decentralized approach!

Statement

"Decentralized programs have problems with the initial test being done properly and fraud is as much as 50% in decentralized programs."

Response

In a letter sent to North Carolina Governor James G. Martin in March of 1987, EPA Regional Administrator Jack E. Ravan advised, "Programs using computerized analyzers have experienced considerable success. Quality control problems are relieved and improper testing is almost entirely overcome." I am not sure why EPA is reversing its stance regarding computerized analyzers. I do know that our program is working and I think that the addition of computerized analyzers has improved our program. North Carolina has been successfully receiving approximately 120,000 records per month from approximately 800 emission inspection stations spread across four counties since July, 1991.

Statement

"North Carolina doesn't have any covert inspections or audits."

Page Three
Mr. Stephen P. Conway
May 7, 1992

Response

In the last quarter of the 1991 calendar year, North Carolina Division of Motor Vehicles Inspectors conducted 189 undercover investigations or covert audits. Out of these investigations, none of the stations failed to conduct an emissions test. During 1991, DMV Inspectors conducted an average of 58 undercover emissions inspections a month. Although some stations performed poor safety inspections, not one station failed to conduct the emissions test or performed a fraudulent test. Mr. Tierney is apparently misinformed on both counts.

Statement

"Under a decentralized system there are problems with conflicts of interest because of mechanics."

Response

The foregoing statement assumes that the mechanics at the stations would not fail one of their friends. The NCAS-90 analyzer does away with the ability to pass a vehicle which has been failed. Once the computer determines a vehicle failed on the sampling test, it prints a Rejection Receipt. If a mechanic attempts to remove the hose, the computer will sense a sample dilution and stop the test.

Mechanics do not know if a vehicle has passed or failed during testing. The response we have received from mechanics is generally one of relief. They believe the NCAS-90 has eliminated the "buddy system" pressure. Since the computer does the passing or failing of vehicles, and the mechanic cannot alter the results, they know it is impossible to "help a buddy out."

Statement

"North Carolina has a lot of problems with BAR-90 Analysis."

Response

Naturally, there are some problems. Every new system requires a period of fine tuning, adjustment and debugging. For example, EPA is currently installing an interoffice computerized communications package. The programmers are anticipating a two year period before the system can be effective. Would it be fair to say that the system is full of problems? The computer experts say no.

Page Four
Mr. Stephen P. Conway
May 7, 1992

Statement

"The North Carolina system is full of problems."

Response

DMV has installed a system which currently includes 789 locations and serves 1,227,421 vehicles. This system is being used by people with no prior computer skills and sometimes with minimal education. Without proper training and monitoring, the system could be doomed from the outset. Fortunately, North Carolina has committed the necessary resources and effort to establish the training and monitoring levels required to insure success. Given these measures, together with additional assistance from the North Carolina Division of Environmental Management and the North Carolina Department of Transportation's Management Information Services, we are confident that our state's I/M Program will prove as effective as a comparable centralized program, once all of the elements have been implemented and the start-up problems have been eliminated. We consider it unfair and technically premature for Mr. Tierney to severely criticize or condemn a program of this magnitude in its first six months of existence. Under these circumstances, it is reasonable to conclude that the comments attributed to Mr. Tierney have been misconstrued and/or taken out of context.

Statement

"A program like North Carolina's costs more because of equipment costs."

Response

EPA recently endorsed the I/M 240 system and is said to be in the process of making it mandatory in some non-attainment areas. This is very controversial in terms of cost effectiveness, and practical alternatives are therefore being sought by some states. The machinery for a single bay of this centralized program alone costs approximately \$140,000. A conservative cost of the total cost for a single bay is \$250,000. The four North Carolina counties in operation at this time would need at least four stations of ten bays each. By July 1993, seven additional counties will be added to the program, and each would require a minimum of three ten-bay stations. Total cost to the taxpayers of North Carolina would exceed \$92.5 million. This estimate does not include the cost to motorists in terms of additional time and inconvenience, fuel consumed in traveling to and from the more distant centralized stations, and travel to and from repair facilities whenever they fail inspection.

Page Five
Mr. Stephen P. Conway
May 7, 1992

Most decentralized systems across the nation do not presently combine safety inspections with the I/M Program. Unless this is done, still more costs would be incurred as a result of travel to separate locations for different inspections. The average NCAS-90 analyzer costs only \$12,000. Established business firms purchase these machines from competing vendors, minimizing the indirect cost ultimately passed along to motorists in the form of higher inspection fees. There is no burden placed on the North Carolina taxpayer to purchase or maintain the machines.

Now, permit me to respond to your questions addressed to Mr. Cross:

Q. Why did North Carolina choose a decentralized system?

A. Aside from the cost factors previously mentioned, North Carolina has operated a decentralized safety inspection system since 1968. Because of this existing system, we were able to incorporate the I/M Program without major delays. Even under ideal conditions, a centralized program would take several years to implement.

When DMV formulated the new NCAS-90, we investigated other states that were involved in I/M programs, in addition to considering the guidelines and recommendations that EPA had set forth. Since California has been the innovator and leader in emission sampling for nearly twenty years, we chose to adopt a program similar to theirs.

Q. How many inspection stations do you have in your current four-county program and how many cars do you serve?

A. Currently, there are 789 emissions inspection stations serving a total of 1,227,421 registered vehicles.

Q. Is there really much of a problem with tampering and fraud today?

A. When the first I/M Program was started in North Carolina in the early 1980's, on the heels of successive OPEC oil production cutbacks which created fuel shortages, we discovered many vehicles that had been tampered with and which had missing emissions components. Since about 1983-84, tampering has declined dramatically. If devices are removed or tampered with on later year vehicle models, performance is reduced rather than enhanced. On still newer vehicles, tampering is virtually non-existent.

Page Six
Mr. Stephen P. Conway
May 7, 1992

I believe I have adequately addressed the fraud issue in the foregoing information. Although I am not so naive as to think that it does not exist, I am convinced that North Carolina has made and continues to make great progress in discouraging tampering and fraud in the program since I/M testing began ten years ago. Furthermore, preliminary data strongly indicates that our program is working to the extent that overall tampering and fraud have been curtailed significantly. In fact, even while using a manual analyzer program that EPA disdained, the air quality in Mecklenburg County improved from moderate to marginal during the 1980's; and attainment for Carbon Dioxide (the only pollutant our program was failing vehicles for at the time) was achieved in Mecklenburg County.

I also want to point out that, by continuing with the decentralized approach and enhancing effectiveness by using a network of state-of-the-art computerized analyzers, North Carolina is creating readily-available jobs across the state, and is enabling small businesses to continue to operate in these times of economic difficulty by minimizing the additional investment required to continue participating in an I/M Program. Aside from such a positive effect on small businesses, such an approach maximizes the number of locations in the state offering I/M inspections locally.

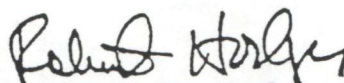
I believe that North Carolina has made and continues to make significant progress since it began I/M testing, and that program improvement and modernization efforts currently underway and planned in the future will eventually make our decentralized program a virtual showcase for the nation. In any event, I would hope that "off-the-cuff" remarks made during unsworn testimony would not be permitted to discredit a program that is making an extraordinary and successful good faith effort to reduce air pollution caused by automotive emissions.

North Carolina does not intend to allow unproved statements such as those alleged to stand unchallenged. We are by copy of this letter informing the Ohio Senate and Mr. Tierney that we would appreciate his providing us any valid data the latter may have to support the remarks attributed to him before the Senate Committee. Mr. E.C. Bristle of the DMV Enforcement Section has already contacted Mr. Tierney about the remarks in question. It is my understanding that Mr. Tierney feels that many of the comments attributed to him were taken out of context.

Page Seven
Mr. Stephen P. Conway
May 7, 1992

I am enclosing additional information requested by you in regard to the National I/M Program Implementation Summary. Thank you for allowing us this opportunity to respond to your letter regarding the North Carolina I/M Program. Please do not hesitate to let us know when the Division may be of assistance in the future.

Sincerely yours,


Robert F. Hodges

RFH/BMC:vm

Enclosure

cc: Secretary Thomas J. Harrelson
Mr. William W. Cobey, Jr., Secretary, Department of
Environment, Health and Natural Resources
Mr. Alan Klimek, Division of Environmental Management
Mr. Eugene J. Tierney, Environmental Protection Agency
Senator Gary C. Suhadolnik, Ohio State Senate

EXCERPTS FROM TESTIMONY OF MR. EUGENE TIERNEY

- a) Carbon monoxide reduction may not be sufficient in a decentralized program. These are harder to obtain than hydrocarbon reductions.
- b) Decentralized programs have problems with the initial test being done properly and that fraud is as much as 50% in decentralized programs.
- c) Under a decentralized system there are problems with conflicts of interest because of mechanics.
- d) North Carolina has a lot of problems with the BAR 90 analysis.
- e) BAR 90 analysis equipment cannot handle a high volume and there is still a lot of cheating with the BAR 90 equipment.
- f) North Carolina doesn't have any covert inspections or audits.
- g) A program like North Carolina's cost more because of the equipment costs.
- h) The North Carolina system is full of problems.

Question from Stephen P. Conway to Mr. Cross:

- 1. Why did North Carolina choose a decentralized system?
- 2. How many inspection stations do you have in your current 4 county program and how many cars do you serve?
- 3. Is there really much of a problem with tampering and fraud today?

**LUCOR, INC.**

902 Clint Moore Road • Suite 100, Building 4 • Boca Raton, FL 33487
(407) 241-0142 • (800) 255-9374

M E M O R A N D U M

TO: Valerie Smith, Barbara Steakley, Jerry Conway
FROM: Stephen P. Conway
SUBJ: Jiffy Lube Violations of the I/M program in
North Carolina
DATE: August 19, 1992

I completed the task of gathering violations of improper testing in our stores in North Carolina which had significant experience with the program. These stores in a period of 18 months performed more than 50,000 inspections. They were all audited covertly on more than one occasion. Over that 18 month period, the following violations occurred:

- *3 warnings for failure to check the unleaded gas restrictor.
- *1 warning for failure to check PVC valve and EGR.
- *1 warning and probation of an inspector for failure to check PVC valve and EGR.

Most of these violations were the result of 2 licensed inspectors laziness the inspectors for the North Carolina program feel very comfortable with Jiffy Lube. Most stores had no violations.



July 15, 1992

Mort Getman
SAVER, Inc.
166 Washington Avenue
Albany, New York 12210

Dear Mort:

Winston Harrington and I have now finished revisions on our paper "Cost-Effectiveness of Enhanced Motor Vehicle Inspection and Maintenance Programs," which we originally released as a Resources for the Future discussion paper in April of this year. We revised the data used as input to both the emission reduction and the cost models based on many helpful responses to our April draft. We discussed the data at length with the EPA Office of Mobile Sources (Gene Tierney and David Brezinski), and we obtained additional information from Sierra Research and from the California Air Resources Board. Systems Control was also provided information on the methods and costs of setting up IM240 inspection lanes. Based on this input, we have revised the data used in our models and we have generated new cost-effectiveness results. Although the revisions to the model were extensive, the basic findings presented in that paper have not changed in a qualitative way at all, and policy conclusions that might follow from those results are also unchanged. Hence, we do not plan a further revision of that discussion paper at this time.

However, we are currently extending the analysis to look at the importance of some of the underlying assumptions of the EPA Mobile Models. The focus of our current effort is to complete a journal paper which will include the model and results of the April draft as well as these extensions. We will send you a draft of this paper as soon as it is available.

Let me summarize our findings about the economic issues surrounding enhanced I&M based on our work to date:

1) One of the basic findings of the April draft of our paper was that the marginal costs of VOC reduction from the tailpipe component of the IM240 test were high. That is, the additional emission reduction resulting from moving to this more effective test is very small and comes at a high additional cost. Our revised analysis still finds this to be the case, and I attach the revised tables and graph to give you an idea of the magnitude of the numbers. The marginal costs of the IM240 tailpipe test are even higher than in the earlier draft for both annual and biennial testing. The pressure and purge tests still look quite cost effective if EPA's assumptions are right about failure rates and repair effectiveness of evaporative system repairs.

These revised estimates are all based on data from their EPA's February 1992 draft document I/M Costs, Benefits, and Impacts Analysis. It has been very difficult for us to determine what data the EPA OMS used and how they used them to estimate the various components of the cost effectiveness analysis. It is not at all clear from the I/M draft document (cited above). Through extensive effort and many discussions with staff at OMS, we believe we are using the basic underlying emissions data that they are using in their analysis. We still do not understand why there appears to be so much difference between our estimates and theirs, particularly of the marginal emission reduction achievable (additional beyond the 2500 idle) through the IM240 tailpipe test. A brief perusal of the numbers on the percent of excess emissions identified by successive tailpipe tests on either page 34 of the text or for the more recent data from the Hammond test lane in Appendix H shows that the additional emission reductions from the IM240 over the other tests are not as large as the results of EPA modeling suggests.

There may be other ways to explain the large marginal emission reduction found by EPA for the IM240. Drivers may be able to respond differently to the tests. For example, if drivers can fix vehicles to pass the other tests like the 2500 idle or the loaded mode test but they cannot do the same for the IM240 then the IM240 would of course look relatively better. However, that is not what EPA's data from their Indiana test lane show - and we have based our analysis on their published data, since it is the only data available. It is also our understanding that their analysis is also based on their published data.

2) In general, however, we believe that the behavioral responses to any of these tests need to be assessed. States, drivers and mechanics will respond to the both the direct and indirect costs built into the tests and their enforcement. For example, if it is easy to tamper and there are no associated penalties (as is the case in most states), then we would expect a lot of emission equipment tampering. Or, if there are easy, inexpensive, temporary adjustments that allow vehicles to pass, then drivers or mechanics are likely to make them. Finally, the higher the cost of repairs, the more likely are drivers to scrap car an old car earlier than they otherwise would.

The evidence is that these responses are very important in determining the true costs and emission reduction potential of I&M programs. In fact, these responses may well dominate the quality or type of test used in terms of cost effectiveness. These responses may also vary a great deal under different test regimes. If the cost of compliance to an IM240 test is much higher because, for

example, it is much more difficult to do a "quick fix" on the vehicle, then there will be more avoidance of the test through dropped or changed registration or there may be earlier scrappage. The point is that the full costs and emission reduction potential of any program depend critically on many factors, the most important of which may not be the quality of the laboratory test. And, each program needs to be examined for its indirect incentives. It is unlikely that any program is free of them and 100% effective.

3) Our frustration with the "black box" nature of the MOBILE models has led us in our more recent extensions of this work to look at some of the underlying assumptions in the model. We have looked at the critical issue of how vehicles emission equipment deteriorates over time, or how vehicles move from clean to dirty. EPA modeling efforts have assumed a very simple structure to this process that may not accurately reflect the empirical evidence about this process. We explore different assumptions about the underlying nature of this process and the results show that these assumptions may have important implications for the emission reduction potential of I&M programs.

We have also extended our analysis to look at the performance of an I&M program if an I&M test is better at identifying certain types of vehicles. This also has an important impact on the cost and emission reduction potential from an I&M program and on the type of test that is used.

4) Our focus in current research efforts, as in the earlier draft, is more on centralized testing, than on a comparison of centralized vs. decentralized testing. Although there are a number of critical technical and economic issues related to centralized vs. decentralized testing, we did not feel we had enough data on relative test effectiveness or on enforcement cost and effectiveness to do a careful analysis. We see three economic issues that are central to this debate over inspection and repair location:

a) There is a trade-off between motorist convenience and the cost of more centralized inspection locations, as we show in our first paper. The convenience issue becomes particularly important under the \$450 waiver limit. If inspection and repair is separated, drivers could incur considerable costs before the waiver limit is reached if they must travel between inspection and repair sites repeatedly. There may also be some of the wrong incentives if inspection and repair are done together - mechanics rigging vehicles to pass. However, if there were some enforcement against the latter, it would be less frequent.

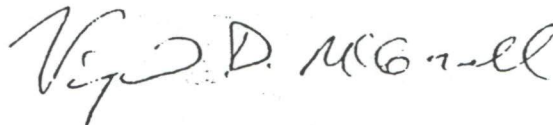
b) There is virtually no evidence about the actual effectiveness of centralized I&M relative to decentralized I&M. The EPA audit of the late 1980s does not discuss the effectiveness of any centralized programs, instead it focuses only on about five decentralized programs and their various violations. The two types of programs must be evaluated on an equal footing. Instead, decentralized programs are presumed to be half as effective as centralized programs, and centralized programs are assumed to achieve 100% of the MOBILE models predicted emission reduction. While there is some evidence that decentralized programs have been less effective, there is no evidence that decentralized programs are equal to each other in

effectiveness and that this effectiveness is exactly half that of centralized programs. The state of Maryland's centralized I&M program has been touted as one of the best in the country, but I was told by the head of the Maryland program just recently that, to his knowledge, there had never been a review of the actual performance of the program.

c) In fact, enforcement efforts, program design and effectiveness of decentralized I&M varies substantially across states. Program effectiveness in terms of reducing emissions will vary directly with expenditures on enforcement. As more is spent on such enforcement efforts as covert audits, fines for non-compliance, and roadside surveys, program effectiveness will rise whether the program is centralized or decentralized. Decentralized programs do appear to allow more possibilities for avoidance or subversion of the test -- but it is possible, I think, that enforcement efforts could make them as cost effective as centralized programs. It is continually an issue that can only be settled with hard empirical evidence evaluating the true effectiveness of both centralized and decentralized programs.

Again, I will send you our new paper when we have completed a draft for distribution. Please continue to keep me informed of any information related to I&M issues. I look forward to talking with you soon.

Yours truly,

A handwritten signature in dark ink, appearing to read "Virginia D. McConnell". The signature is fluid and cursive, with the first name "Virginia" being more prominent and the last name "McConnell" following in a similar style.

Virginia D. McConnell

**STATISTICAL ANALYSIS OF THE EFFECT
ON LIGHT DUTY VEHICLE EMISSIONS
OF FOUR TYPES OF SERVICES
PERFORMED AT JIFFY LUBE LOCATIONS
IN THE RALEIGH, NORTH CAROLINA AREA**

FINAL REPORT

Submitted to:

**Mr. Steve Conway, President
Carolina Lubes, Inc.
Boca Raton, Florida**

August 24, 1992

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EXECUTIVE SUMMARY

This report presents the results of a statistical analysis of the impact on vehicle emissions of certain automobile services provided by Jiffy Lube stations in Raleigh, North Carolina. The analysis uses data gathered by station managers under actual conditions at six Jiffy Lube outlets following a protocol developed by Booz•Allen & Hamilton Inc. Owners of almost 512 vehicles volunteered to participate in the three week data gathering phase, and more than 450 of these ultimately provided data that passed quality control checks.

The services analyzed in this report include oil change in which a new filter was installed, PCV valve replacement, air filter replacement, addition of a fuel additive to the gas tank, and all four series combined. In addition, a control group was created that had their emissions tested twice with no services provided between the first and second emissions tests. Test data was gathered data from ten vehicles at each of the six stations involved in the testing to assess whether there were any differences in the test equipment between stations.

Key dependent variables in the analysis were emissions of HC, CO, and CO₂. Fifteen cases were analyzed, that is, each emission type by each service type. As shown in Exhibits ES-1, ES-2, and ES-3, none of the fifteen cases showed a statistically significant effect on emissions at the 95% confidence level.

Certain caveats must be noted, however. First, the sample design called for 100 observations for each service type and, as the Exhibits reveal, in two cases (PCV and Combination), sampling fell short of the desired cases. Second, the sample was not randomly drawn. Customers were selected on the basis of the services they requested when they entered the store, how busy the store was at the time, and the customer's agreeing to participate. Analysis of the participants' characteristics, however, does not reveal any serious deviation from typical customers. The third caveat is that, based on the initial emissions test results, vehicles participating in each group (oil change, PCV, etc.) were not the same and the Combination group in particular differed from the others. Despite these limitations, the results strongly suggest that the performance of the automotive services examined in this study do not have a significant impact on the emissions test readings using the BAR90 test equipment.

Exhibit ES-1
Test for Before/After Mean Differences for HC *

Types of Service	Number of Cases	Before Mean	Before Standard Deviation	After Mean	After Standard Deviation	Before/After Correlation	T-Test Result
Emissions Test Only	48	3.45	1.16	3.41	1.15	0.853	NS
Oil Change	107	3.35	1.25	3.48	1.30	0.793	NS
PCV	48	3.80	1.11	3.66	1.08	0.799	NS
Air Filter	95	3.99	1.10	3.95	1.11	0.842	NS
Fuel Additive	90	3.63	1.17	3.62	1.18	0.783	NS
Combination	66	4.02	1.36	4.07	1.30	0.796	NS
TOTAL SAMPLE **	406	3.72	1.22	3.74	1.22	0.807	NS

NS = Not Significant at $P \leq .05$

Sig = Significant at $P \leq .05$

* Analysis performed using transformed data.

** Excludes emissions test only group.

Exhibit ES-2
Test for Before/After Mean Differences for CO *

Types of Service	Number of Cases	Before Mean	Before Standard Deviation	After Mean	After Standard Deviation	Before/After Correlation	T-Test Result
Emissions Test Only	48	1.10	0.28	1.08	0.17	0.742	NS
Oil Change	107	1.07	0.26	1.07	0.23	0.960	NS
PCV	48	1.11	0.24	1.06	0.13	0.715	NS
Air Filter	95	1.12	0.30	1.13	0.30	0.909	NS
Fuel Additive	90	1.09	0.28	1.10	0.29	0.896	NS
Combination	66	1.22	0.46	1.21	0.52	0.671	NS
TOTAL SAMPLE **	406	1.12	0.32	1.11	0.32	0.806	NS

NS = Not Significant at $P \leq .05$
Sig = Significant at $P \leq .05$

* Analysis performed using transformed data.
** Excludes emissions test only group.

Exhibit ES-3
Test for Before/After Mean Differences for CO₂ *

Types of Service	Number of Cases	Before Mean	Before Standard Deviation	After Mean	After Standard Deviation	Before/After Correlation	T-Test Result
Emissions Test Only	48	2.62	0.17	2.62	0.17	0.959	NS
Oil Change	107	2.70	0.14	2.69	0.15	0.947	NS
PCV	48	2.66	0.16	2.66	0.16	0.935	NS
Air Filter	95	2.61	0.19	2.61	0.19	0.967	NS
Fuel Additive	90	2.68	0.14	2.69	0.13	0.894	NS
Combination	66	2.60	0.19	2.60	0.19	0.901	NS
TOTAL SAMPLE **	406	2.65	0.17	2.65	0.17	0.936	NS

NS = Not Significant at $P \leq .05$
Sig = Significant at $P \leq .05$

* Analysis performed using transformed data.
** Excludes emissions test only group.

I INTRODUCTION

The Clean Air Act Amendments of 1990 (CAAA) statutorily mandated many changes in the nation's efforts to improve air quality. In particular, Subparts 2 and 3 of Part D (CAA §181 through §187) of the Clean Air Act (CAA) contain special provisions for ozone and carbon monoxide non-attainment areas (i.e., areas that have not met National Ambient Air Quality Standards for ozone and carbon monoxide). These provisions include requirements for a variety of measures for reduction of automobile emissions including gasoline vapor recovery, use of clean fuels, and the institution of enhanced inspection and maintenance (I/M) programs for vehicles. The I/M programs are to achieve performance levels equivalent to annual inspections in a centralized testing operation. The provisions that must be implemented in each non-attainment area depend upon the severity of non-attainment.

As part of its implementation of this statute, EPA recently proposed new enhanced I/M program performance standards for ozone and carbon monoxide non-attainment areas based upon the severity of the non-attainment (57 Fed. Reg. 31058 (July 13, 1992) (to be codified at 40 C.F.R. Part 51)). These performance standards establish requirements for the administration of enhanced I/M programs by states and define the technologies and procedures to be employed in the inspection process. All states with non-attainment areas are required to submit an amended State Implementation Plan (SIP) to EPA by November 15, 1992. For states with non-attainment areas of certain severity, the amended SIP must include provisions for compliance with this proposed regulation.

Although the CAA requires enhanced I/M programs to achieve performance levels equivalent to centrally operated and annually performed programs, neither CAA's language nor EPA's performance standard requires states to implement annual, centralized testing. States have flexibility to design their own programs if they can show that their program is as effective as the "model" annual, centralized testing program. Centrally operated inspection stations are typically large volume processing stations equipped with up-to-date technology for measuring vehicle emissions. Some states already use centralized systems. Most states with programs, however, have decentralized systems where many different types of auto repair and maintenance establishments conduct emissions inspections (e.g., service stations, dealerships, major auto service chains). Because policymakers are struggling to determine what factors can make a decentralized program as effective as a centralized one, many policymakers are interested in obtaining more data about the effects of different repair and maintenance services on auto emissions. These policymakers believe that economic factors will drive the behavior of inspection stations. They also believe that stations which provide no repair services affecting emissions may prove as effective as centralized inspection stations.

Many suppliers of these auto repair and maintenance services are interested in becoming (or continuing to be) decentralized inspection stations operating under the new state programs. One of these is Carolina Lubes, Inc. which is a Jiffy Lube franchisee in the Raleigh, North Carolina area.

Carolina Lubes, Inc. contracted Booz•Allen & Hamilton, Inc. to provide statistical analysis of how much tail-pipe emissions, as measured by BAR90 equipment, would change after certain standard, quick lube services are performed. The purpose of the analysis was to ascertain whether these services significantly changed emissions. The specific services analyzed included an oil change, which included a new oil filter, installation of a new PCV valve, replacing the air filter, and adding a special fuel additive to the tank.

Working with Carolina Lubes, Inc. technicians, Booz•Allen & Hamilton designed a protocol, oversaw training in the protocol, conducted on-site reviews during the data gathering, created a data base from the gathered information, and analyzed the data. The work took place between July 10, 1992, and August 19, 1992. Data gathering began on July 27 and continued until August 17, 1992. Slightly more than 500 automobiles volunteered to participate in the study. The methodology employed in the statistical analysis and the findings of the statistical analysis follow.

II METHODOLOGY

Booz•Allen developed the protocol for collecting and inputting data and provided initial training concerning the correct procedures to follow in collecting the data. Carolina Lubes, Inc. presented this protocol to EPA for review. Booz•Allen also performed quality control of the data as it was received, performed data entry, analyzed the data, and prepared a presentation of findings in this report.

1. Questions to Address

Protocol development began with an assessment of the questions needing to be addressed. Although a multitude of questions could be considered, time and resource constraints mandated that only the most pertinent questions be considered. The following questions were determined to have the highest priority:

1. Does providing a new oil filter and oil change affect exhaust emissions?
2. Does providing a new air filter affect exhaust emissions?
3. Does replacement of the PCV valve affect exhaust emissions?
4. Does placement of a special fuel additive in the tank affect exhaust emissions?
5. Do all four of the above services in combination affect exhaust emissions?

To answer these questions, a protocol was developed that would gather enough information to allow a statistically valid assessment to be performed. Based on a power analysis, Booz•Allen statisticians concluded that one hundred observations for each service type would be sufficient. Thus, the protocol called for approximately 550 vehicles to participate in the study. Each of these vehicles was to be tested twice -- once before and then once after servicing. The official "safety and emissions inspection forms" and the Jiffy Lube invoice provided the data for the analysis.

2. Sampling Plan

Exhibit 2-1, on the following page, presents the sampling plan. The first column, labeled "Service that the customer seeks," indicates what the customer wants when he/she enters the store. The second column, labeled "Request made to customer," indicates what the service manager seeks from the customer. The third column, labeled "Number of vehicles needed," lists the number of vehicles which need to be tested for the result to be statistically significant. To encourage participation, Carolina Lubes agreed to offer incentives to potential participants.

EXHIBIT 2-1
Sampling Plan

<u>Service that the Customer Seeks</u>	<u>Request Made to Customer</u>	<u>Number of Vehicles Needed</u>	<u>Incentive Offered</u>	<u>Total Number Approached</u>	<u>Number of Customers Refusing to Participate</u>	<u>Number of Customers Participating</u>
1. Emissions test	Second emissions test	50 (at least five in each site)	\$3 off next visit	58	4	52
2a. Emissions test plus oil change OR 2b. Oil change	2a. Second emissions test 2b. Two emissions tests	100	2a. \$3 off next visit 2b. \$5 off next or current visit	116	1	115
3a. Emissions test plus PVC OR 3b. PVC	3a. Second emissions test 3b. Two emissions tests	100	Free PVC	57	1	55
4a. Emissions test plus air filter OR 4b. Air filter	4a. Second emissions test 4b. Two emissions tests	100	Free air filter	109	2	106
5a. Emissions test plus fuel additive OR 5b. Fuel additive	5a. Second emissions test 5b. Two emissions tests	100	Free fuel additive	108	2	105
6. Any type of service	Two emissions tests Oil change PVC Air filter Fuel additive	100	If they buy one emissions test and an oil change, give them a free PVC, air filter, and fuel additive	75	1	74

These incentives are identified in the fourth column. The last three columns summarize the number of participants and non-participants.

The rows in the table list the different services being tested. The first row is the control group. The control group had two emissions tests performed. The first one was the official North Carolina inspection. The second was an identical test performed shortly after the official test. The results of these tests were printed on standard forms (See Appendix A) and the second test was labeled "Training" test. Rows 2-5 correspond to each of the four services being examined here -- oil change, PCV replacement, air filter replacement, and fuel additive. Row 6 is for the vehicles that had all four types of service performed.

3. Procedures for Data Gathering

A meeting was held at the inception of this study among Carolina Lubes senior management, Jiffy Lube store managers for stores selected to participate in this study, and Booz•Allen representatives. The Booz•Allen representatives instructed the Jiffy Lube store managers in data collection procedures consistent with the data collection protocol.

At each of the six Jiffy Lube stores selected to participate in the study, one emissions testing machine was designated the machine that would be used throughout the study for data collection. Prior to data collection and at the end of data collection, a technician from Bear Automotive Service Equipment Company, the manufacturer of the emission testing equipment, verified that each of these machines was properly calibrated (See Appendix B for copies of the printouts). Each day during the data gathering period the store manager verified that the BAR90 was still functioning properly.¹

The first step in the procedure was to run 10 cars through the BAR90 machines at each of the six sites chosen to participate in the study. The Booz•Allen representatives participated in this portion of the data collection effort. The purpose of this exercise was to determine whether the machines would give a single car the same results on different machines at different times of day, etc. This control group allowed us to understand the variation among machines.

The actual data gathering was conducted as follows. A customer would arrive at the Carolina Lubes facility and request a particular service. The manager would offer the customer the identified incentives to be a participant in the test. For those customers that agreed to participate in the test, an official emissions test would first be performed. Then the required service would be completed and recorded on the Jiffy Lube invoice. Finally another emissions test would be conducted resulting in a second "unofficial training" safety and emissions inspection form. These tests

¹ According to technical staff of Carolina Lubes, the machines will not allow tests to be performed unless the BAR90 is functioning properly based on a calibration test that is performed on the machine every 72 hours. For the purpose of this study, all emissions testing machines were calibrated on a daily basis prior to the collection of data.

would generate three pieces of paper: an official safety and emissions inspection form; a Jiffy Lube Invoice/Receipt; and a "training mode" safety and emissions inspection form (see Appendix A). A cover page was also filled out by the manager identifying the services performed on the vehicle and whether the customer accepted or rejected the invitation to participate in the study. Appendix C provides a copy of this cover page.

Each manager of a participating store would then staple the forms together, place them in a Federal Express envelope, and forward them to Booz•Allen for processing. In addition, each manager was asked to complete a daily summary form that tracked the number of participants for each type of service that he had obtained and identified the contents of the package forwarded to Booz•Allen. Finally, the manager maintained a daily record throughout the project. Copies of these forms are also found in Appendix C.

For the first two days of data collection, a Booz•Allen representative visited each of the participating Jiffy Lube stores to ensure that data collection procedures were consistent with the data collection protocol.

When packages of data arrived at Booz•Allen's offices, the contents were examined and the store manager's summary of the data sets was confirmed. Booz•Allen professional staff reviewed each set of forms one-by-one to confirm that the protocol had been followed and voided those whose forms suggested that deviation from the protocol had occurred. For example, if the manager indicated on the cover page to a data set that the customer sought an oil change and an emissions test, but the invoice indicated that the air filter was also replaced, this data set was voided. This reduced the total usable data sets by 58 participants, about 10% as shown in Exhibit 2-2.

4. Data Entry and Processing

"Clean" vehicle sets of forms were forwarded to the keypunching staff who entered the following data into the computer:

- Vehicle make
- Vehicle year
- Body style
- Odometer reading
- Vehicle Type
- Number of cylinders or engine size (if available)
- RPM reading at time of test
- HC reading (ppm)
- CO (%)
- CO2 (%)

Data was entered twice and a comparison of the raw data sets performed. After correcting the data set based on this comparison, each variable's distribution

EXHIBIT 2-2
Derivation of Final Number of Cases
Used in Statistical Analysis

	Total Customer Participation	Voiced Because of Quality Problems	In Final Analysis
Emissions Only	54	6	48
Oil Change	115	8	107
PCV	56	8	48
Air Filter Change	107	12	95
Fuel Additive	106	16	90
Combination	74	8	66
TOTAL	512	58	454

was plotted to identify outliers. The sets of forms for these outlier observations were visually re-examined and the accuracy of the outlier was confirmed or the input value corrected. Finally, a visual verification that each computer entry matched its paperwork was conducted.

5. Analysis

Prior to conducting any statistical analyses on the data, the distributions of the key dependent variables in the study (HC, CO, CO₂) were analyzed to determine whether their values were normally distributed. The results of this analysis indicated significant departure from normality (i.e., the standard deviation of the variables were quite high relative to their means). Therefore, the variables were transformed to bring their variances into line. A log transformation was performed on the HC and CO₂ results, while a square root transformation was applied to the CO results. The statistical analyses presented in this report were conducted using the transformed data. Detailed printouts of these results are found in Appendix D. Analyses using the untransformed data are presented in Appendix E.

The key analysis was focused on determining the effect of service on emissions. A paired sample T-Test was performed by condition (type of service) to determine whether there were any true differences in the mean values of each of the key dependent variables before and after a service was performed. The analyses were conducted using a 95% confidence level. In addition, a correlation between the before and after values for each of the variables was computed by condition.

A secondary analysis was conducted to determine whether there were mean differences in the values for HC, CO, and CO₂ across condition. A one-way analysis of variance (ANOVA) procedure was conducted using a 95% confidence level. Follow-up analyses using the Tukey Test were conducted on those variables with significant differences to identify which specific groups had differing mean values.

An ANOVA was also conducted on the 10 car pre-test check of the emissions testing equipment to determine if there were differences in the measures across stores. The reliability of the measurements was also assessed.

All analysis was conducted using SPSS-PC, a statistical software package.

III. FINDINGS

The findings of our analysis are presented in the three sections of this chapter. The first section provides information about the characteristics of the participating vehicle population. The second section provides the results of statistical analyses of the change in vehicle emissions after the different services were performed. The third section highlights caveats and uncertainties in the analysis.

1. Population Characteristics

The purpose of this section is to provide a picture of the vehicles participating in the study. Typical distinguishing characteristics such as year of manufacture, mileage, manufacturer, number of cylinders, and body style combine to provide a picture of participating vehicles.

Participating vehicles average just under six years old and range from less than a year old to more than 38 years old. 332 vehicles were 1986 or later models, 96 were 1981 to 1985 models, and 26 were pre-1981 models. (See Exhibit 3-1.)

Participating vehicles were driven 65,498 miles, on average. Miles driven ranged from fewer than 1,000 to more than 220,000. As implied by Exhibit 3-2, the mileage of the vehicles is normally distributed about the 50,000-70,000 mile category.

39.9% of participating vehicles were 4-door models, 25.4% 2-door models, 12.5% station wagons, and 13.2% trucks. Exhibit 3-3 provides a more detailed breakdown.

The participating vehicles also were diverse in terms of manufacturer. The most common vehicles were Chevrolet (75), Ford (70), Nissan (37), Honda (36), Toyota (29), and Buick (28). (See Exhibit 3-4.)

Finally, most vehicles had four-cylinders. (See Exhibit 3-5.)

2. Findings

2.1. Pre-test of Emissions Equipment at the Six Test Sites

Ten vehicles were each tested at the six stores participating in the study prior to the study data collection procedures. A two-way analysis of variance (ANOVA) between vehicles and stores was conducted to determine if there were any differences in emission test results across stores. The analysis indicated that there were no significant differences between stores in their emission test readings across the 10 vehicles participating in the pre-test. The reliability of the emissions test readings across the six stores was 0.903 for HC, 0.415 for CO, and 0.995 for CO₂, indicating acceptable levels of reliability for HC and CO₂, but not for CO.

2.2. Changes in Emissions

As discussed above, the short time available to gather data combined with our stringent quality control resulted in a smaller sample than desired in the protocol. The sample sizes for each of the five tests and the control group were:

Control group	--	48
Oil Change and lubrication only	--	107
PCV valve replacement	--	48
Air filter	--	95
Fuel additive	--	90
<u>Combination of all 4</u>	--	<u>66</u>
TOTAL	--	454

The inability to obtain more volunteers for the PCV valve replacement and for all four services was also due to the fact that not all models have PCV valves.

2.2.1 Control Group

The Control Group were those vehicles that came into the facility to obtain an emissions test only. These owners allowed us to perform a second test shortly after the first test. The results for these 48 vehicles are shown in Exhibit 3-6. Neither HC, nor CO, nor CO₂ showed any statistically significant difference between the two emissions tests.

2.2.2 Oil change and lubrication only

The second group were those vehicles that sought an oil change. For this group the first emissions test was followed by the oil change and then a second emissions test was performed. One hundred and seven vehicles participated in this sample.

The HC reading actually rose from 53.28 to 60.34 (3.35 to 3.48 after the log transformation) on average between the first and second tests, but was not great enough to be statistically significant at the 95% confidence level.

The CO and CO₂ levels before and after servicing were as expected. The change was not statistically significantly different. (See Exhibit 3-7)

2.2.3 PCV Valve Replacement

Analysis of the "Replacing the PCV valve" group again displayed no statistically significant difference at the 95% confidence level for any of the readings. While the results were not statistically significant for the 48 vehicles in the test, the CO readings analysis was close enough (.052) to raise concerns that the small number of cases limited our ability to detect true differences which may exist. (See Exhibit 3-8)

2.2.4 Air Filter Only

Ninety-five vehicles participated in the air filter only sample. As shown in Exhibit 3-9, the air filter only group produced no statistically significant changes in the emissions reading for HC, CO, or CO₂.

2.2.5 Fuel Additive Only

Again, as presented in Exhibit 3-10, the ninety fuel additive only participants revealed no statistically significantly different readings.

2.2.6 Combination of All Services

Finally, the combination of all services did not result in any statistically significantly different readings. Although the number of observations was not as many as required by the initial protocol (only 66), the results suggest that there are no differences in the before/after emissions tests. (See Exhibit 3-11.)

2.2.7 Overall Analysis

As a final observation we computed t-tests on the entire population (excluding the emissions test only group). There were no statistically significantly different readings as shown in Exhibit 3-12.

3. Caveats and Uncertainties

There are several limitations to broad interpretation of the results of this study. First, vehicles were not randomly assigned to treatment condition (i.e., type of service). Assignment was based on several factors including:

- The type of service requested by the customer;
- How busy a particular store was at a particular time; and
- Whether or not a vehicle had a PCV (if not, the vehicle was ineligible for the PCV and Combination conditions).

Lack of a strict random assignment of vehicles to conditions may have impacted the results. However, due to the time constraints and the voluntary nature of the survey, strict random assignment was not feasible.

A second issue concerns the sample size of several of the conditions. The initial study design parameters indicated 100 vehicles per condition were necessary to have adequate "power" to detect real differences in before and after emissions (i.e., Type II error). The small number of cases in the PCV (48) and Combination (66) groups reduced the power of the study and thus limited our ability to make generalizations regarding the impact of these services on emissions test results.

The third concern derived from the results of a series of one-way variance analyses conducted on each dependent variable (HC, CO, CO₂) by group. This analysis found significant differences in the first emissions test result among the groups, particularly the combination group relative to the others. This indicates that the vehicles assigned to the conditions were not equivalent in terms of their levels of the three dependent variables. This is likely due to the lack of random assignment of vehicles to conditions. Appendix F contains copies of these analyses.

EXHIBIT 3-1
Crosstabulations of Service by Year of Manufacture

	Before 1981	1981 to 1985	1986 to 1992	Total
Emissions Test Only	3	16	29	48
Oil Change	3	14	90	107
PCV	3	10	35	48
Air Filter	4	25	66	95
Fuel Additive	4	14	72	90
Combination	9	17	40	66
TOTAL	26	96	332	454

EXHIBIT 3-2
Crosstabulations of Service by Mileage of the Vehicle

	0 to 10,000	10,001 to 30,000	30,001 to 50,000	50,001 to 70,000	70,001 to 90,000	90,001 to 110,000	Over 110,000	Total
Emissions	1	5	5	12	10	4	5	42
Oil Change	7	23	20	17	21	8	9	105
PCV	0	6	6	13	13	5	5	48
Air Filter	2	15	19	17	13	12	12	90
Fuel Additive	0	12	21	17	14	12	12	88
Combination	1	8	14	13	12	12	5	65
TOTAL	11	69	85	89	83	53	48	438

EXHIBIT 3-3
Frequencies on *Body Style of Vehicle*

	Frequency	Percent
2 Door Hardtop	35	8.9
2 Door Sedan	59	15.0
2 Door	6	1.5
3 Door Sedan	5	1.3
3 Door	1	0.3
4 Door Hardtop	35	8.9
4 Door Sedan	116	29.5
4 Door	6	1.5
5 Door Sedan	3	0.8
Convertible	5	1.3
Coupe	3	0.8
Jeep	1	0.3
Roadster	1	0.3
Sedan	3	0.8
Station Wagon	49	12.5
Truck	52	13.2
Van	13	3.3
TOTAL	393	100.0

EXHIBIT 3-4
Frequencies on Manufacturer of the Vehicle

	Frequency	Percent
Acura	1	0.2
Alfa Romeo	1	0.2
American Motors	1	0.2
Audi	1	0.2
BMW	1	0.2
Buick	28	6.2
Cadillac	7	1.5
Chevrolet	75	16.5
Chrysler	7	1.5
Daihatsu	3	0.7
Datsun	6	1.3
Dodge	19	4.2
Eagle	1	0.2
Ford	70	15.4
GMC	8	1.8
Honda	36	7.9
Hyundai	6	1.3
Isuzu	2	0.4
Lincoln	1	0.2
Mazda	22	4.8
Mercury	8	1.8
Mercedes Benz	3	0.7
Mitsubishi	6	1.3
Nissan	37	8.1
Oldsmobile	22	4.8
Plymouth	12	2.6
Pontiac	19	4.2
Renault	1	0.2
Subaru	5	1.1
Toyota	29	6.4
Volkswagon	10	2.2
Volvo	1	0.2
Other	5	1.1
TOTAL	454	100.0

EXHIBIT 3-5
Frequencies on Number of Cylinders

	Frequency	Percent
Four	249	55.2
Six	129	28.6
Eight	73	16.2
TOTAL	451	100.0

EXHIBIT 3-6
Test for Before/After Mean Differences
for Emissions Test Only Group *

	Number of Cases	Mean Value	Standard Deviation	Correlation	T-Test Result
HC Before	48	3.45	1.16	0.853	NS
HC After	48	3.41	1.15		
CO Before	48	1.10	0.28	0.742	NS
CO After	48	1.08	0.17		
CO ₂ Before	48	2.62	0.17	0.959	NS
CO ₂ After	48	2.62	0.17		

NS = Not Significant at $P \leq .05$
 Sig = Significant at $P \leq .05$

* Analysis performed on transformed data.

EXHIBIT 3-7
Test for Before/After Mean Differences
for Oil Change Only Group *

	Number of Cases	Mean Value	Standard Deviation	Correlation	T-Test Result
HC Before	107	3.35	1.25	0.793	NS
HC After	107	3.48	1.30		
CO Before	107	1.07	0.26	0.960	NS
CO After	107	1.07	0.23		
CO ₂ Before	107	2.70	0.14	0.947	NS
CO ₂ After	107	2.69	0.15		

NS = Not Significant at $P \leq .05$
 Sig = Significant at $P \leq .05$

* Analysis performed on transformed data.

EXHIBIT 3-8
Test for Before/After Mean Differences
for PCV Only Group *

	Number of Cases	Mean Value	Standard Deviation	Correlation	T-Test Result
HC Before	48	3.80	1.11	0.799	NS
HC After	48	3.66	1.08		
CO Before	48	1.11	0.24	0.715	NS
CO After	48	1.06	0.13		
CO ₂ Before	48	2.66	0.16	0.935	NS
CO ₂ After	48	2.66	0.16		

NS = Not Significant at $P \leq .05$
 Sig = Significant at $P \leq .05$

* Analysis performed on transformed data.

EXHIBIT 3-9
Test for Before/After Mean Differences
for Air Filter Only Group *

	Number of Cases	Mean Value	Standard Deviation	Correlation	T-Test Result
HC Before	95	3.99	1.10	0.842	NS
HC After	95	3.95	1.11		
CO Before	95	1.12	0.30	0.909	NS
CO After	95	1.13	0.30		
CO ₂ Before	95	2.61	0.19	0.967	NS
CO ₂ After	95	2.61	0.19		

NS = Not Significant at $P \leq .05$
 Sig = Significant at $P \leq .05$

* Analysis performed on transformed data.

EXHIBIT 3-10
Test for Before/After Mean Differences
for Fuel Additive Only Group *

	Number of Cases	Mean Value	Standard Deviation	Correlation	T-Test Result
HC Before	90	3.63	1.17	0.783	NS
HC After	90	3.62	1.18		
CO Before	90	1.09	0.28	0.896	NS
CO After	90	1.10	0.29		
CO ₂ Before	90	2.68	0.14	0.894	NS
CO ₂ After	90	2.69	0.13		

NS = Not Significant at $P \leq .05$
 Sig = Significant at $P \leq .05$

* Analysis performed on transformed data.

EXHIBIT 3-11
Test for Before/After Mean Differences
for Combination (Oil Change, RCV, Air Filter, Fuel Additive) Group *

	Number of Cases	Mean Value	Standard Deviation	Correlation	T-Test Result
HC Before	66	4.02	1.36	0.796	NS
HC After	66	4.07	1.30		
CO Before	66	1.22	0.46	0.671	NS
CO After	66	1.21	0.52		
CO ₂ Before	66	2.60	0.19	0.901	NS
CO ₂ After	66	2.60	0.19		

NS = Not Significant at $P \leq .05$
 Sig = Significant at $P \leq .05$

* Analysis performed on transformed data.

EXHIBIT 3-12
Test for Before/After Mean Differences
for Overall Analysis Across Groups *

	Number of Cases	Mean Value	Standard Deviation	Correlation	T-Test Result
HC Before	406	3.72	1.22	0.807	NS
HC After	406	3.74	1.22		
CO Before	406	1.12	0.32	0.806	NS
CO After	406	1.11	0.32		
CO ₂ Before	406	2.65	0.17	0.936	NS
CO ₂ After	406	2.65	0.17		

NS = Not Significant at $P \leq .05$
 Sig = Significant at $P \leq .05$

* Analysis performed on transformed data.

IV. CONCLUSIONS

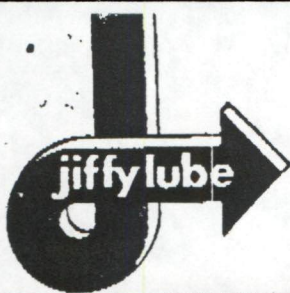
This study addressed the impact of performing automotive services (i.e., oil change, PCV valve, air filter replacement, fuel additive, and combination of all four services) on vehicle emission readings using the BAR90 test equipment. Four hundred and six vehicles participated in the treatment groups, with 48 cases serving as a control group. The results indicated that there were no significant differences in the mean values of HC, CO, and CO₂ before and after receiving the automotive services in any one of the five treatment groups. These findings suggest that the receipt of any one or a combination of the automotive services has little or no impact on the emissions test readings.

As stated earlier, caution should be urged in over-generalization of the results of this study as the methodology used to conduct the study does not represent a pure test of the research questions at issue. Several caveats should be noted including:

- Cars were not randomly assigned to treatment conditions
- The study time frame did not allow for complete data collection for several treatment conditions (e.g., PCV, Combination)
- Differences existed in the emissions test readings between cars across treatments.

Despite these limitations, the results strongly suggest that the performance of the automotive services examined in this study do not have a significant impact on the emissions test readings using the BAR90 test equipment. Future studies should seek to replicate these findings using a more rigid empirical design to further validate the results found in this study.

APPENDIX A



jiffy lube

1305-008654

Jiffy Lube # 1305
5930 GLENWOOD AVENUE
RALEIGH NC 27612

(919) 787-1110

DATE 07/29/92 12:48
INVOICE NO. 8654
TRANSACTION NO. 92072900008654
EMPLOYEE9 JMH JNH JMH

3709 Creekstone Dr
Morrisville, NC 27560

YEAR 1990
MAKE FORD
MODEL TAURUS
ENGINE 6cyl 3.0L FI

LICENSE PLATE NC-DEC7120
ALTERNATE ID
MILEAGE 39103

DATE	MILEAGE	SERVICES
07/29/92	39103	INS

1. Oil
2. Oil Filter
3. Chassis
4. Transmission/Transaxle Fluid Level
5. Differential Fluid Level
6. Brake Fluid Level
7. Power Steering Fluid Level
8. Windshield Washer Fluid Level
9. Battery Water
10. Air Filter
11. Wiper Blades
12. Tire Pressure
13. Interior Floors Vacuumed
14. Exterior Windows Washed

DESCRIPTION	AMOUNT	TOTAL
EMISSION/SAFETY INSP. PASS	1.00	15.40
NC EMISSIONS STICKER	1.00	0.00
FUEL INJECTION CLEANER	1.00	6.00

SUBTOTAL	21.40
WARRANTY	6.00
TOTAL	15.40
CASH	15.40
CHANGE	15.40

Recommend next service on OCTOBER 27, 1992 or 42103 miles.

Thank you for visiting Glenwood Ave. Jiffy Lube #1305

We do North Carolina State Inspections.

D.L. W 8637887

AUTHORIZED & RECEIVED BY

Cardholder acknowledges receipt of goods and/or services in the amount of the total shown hereon and agrees to perform the obligations set forth in the Cardholder's agreement with the issuer.

FILE

Below

STATE OF NORTH CAROLINA
VEHICLE INSPECTION RECEIPT/STATEMENT

SAFETY AND EMISSIONS INSPECTION

Certificate Class: IM	*****	Inspection Fee \$13.00
Certificate Number: 03426907	* APPROVAL *	Certificate Fee \$ 2.40
Date: 07/29/92	*****	Total Fees \$15.40

Make: FORD	Vehicle Type: Light Duty Vehicle
Year: 90	Plate Number: DWC7120
Body Style: 4 DOOR SEDAN	Odometer Reading: 039103
VIN: 1FACP50U5LA261444	Number of Cylinders: 06
County: WAKE	Type of Fuel: Gasoline
Month/Year Previous Inspection: 07/91	Previous Odometer: 000000

Repair Costs \$ 0

***** <u>Safety Equipment</u> Headlights..... PASS Parking Lights..... PASS Tail Lights..... PASS Beam Indicator Light/Switch..... PASS License Plate Light..... PASS Stop Light..... PASS Directional Signals..... PASS Horn..... PASS Windshield Wipers..... PASS Rear View Mirrors..... PASS Foot Brakes..... PASS Emergency Brake..... PASS Steering Mechanism..... PASS Tires..... PASS Exhaust System..... PASS Clearance Lights..... N/A Reflectors..... N/A Window Tint..... N/A	***** <u>Tampering Inspection</u> Catalytic Converter..... PASS Air Injection System..... PASS PCV Valve..... PASS Unleaded Gas Restrictor..... PASS Exhaust Gas Recirculation..... PASS Thermostatic Air Control..... PASS Fuel Evaporation Control..... PASS Oxygen Sensor..... PASS ***** <u>Exhaust Emission Test Results</u> ***** <table border="0" style="width: 100%;"><tr><td style="width: 30%;">Gas</td><td style="width: 30%;">Reading</td><td style="width: 40%;">Standard</td></tr><tr><td>HC (ppm)</td><td>0058</td><td>220</td></tr><tr><td>CO (x)</td><td>00.12</td><td>1.20</td></tr><tr><td>CO2 (x)</td><td>14.8</td><td></td></tr></table> Engine RPM at Reading 071 *****	Gas	Reading	Standard	HC (ppm)	0058	220	CO (x)	00.12	1.20	CO2 (x)	14.8	
Gas	Reading	Standard											
HC (ppm)	0058	220											
CO (x)	00.12	1.20											
CO2 (x)	14.8												

***** Station Number: 20756 Inspection Class: EMISSIONS Inspector Mechanic Number: 0140455	***** Analyzer Number: 01 Ver. B201 Receipt/Statement Numbers: 00001343 *****
---	--

Inspector Mechanic

Owner's Repair Authorization

RETAIN THIS COPY FOR YOUR RECORDS

After

VOID
STATE OF NORTH CAROLINA
VEHICLE INSPECTION RECEIPT/STATEMENT

SAFETY AND EMISSIONS INSPECTION

Certificate Class: VOID ***** Inspection Fee \$ 0.00
Certificate Number: VOID * TRAINING MODE * Certificate Fee \$ 0.00
Date: 07/29/92 ***** Total Fees \$ 0.00

Make: FORD Vehicle Type: Light Duty Vehicle
Year: 90 Plate Number: DWC7120
Body Style: 4 DOOR SEDAN Odometer Reading: 039103
VIN: 1FACP50U5LA261447 Number of Cylinders: 06
County: WAKE Type of Fuel: Gasoline
Month/Year Previous Inspection: 07/91 Previous Odometer: 000000

Repair Costs \$ 0

SAFETY EQUIPMENT
Headlights..... PASS
Parking Lights..... PASS
Tail Lights..... PASS
Beam Indicator Light/Switch..... PASS
License Plate Light..... PASS
Stop Light..... PASS
Directional Signals..... PASS
Horn..... PASS
Windshield Wipers..... PASS
Rear View Mirrors..... PASS
Foot Brakes..... PASS
Emergency Brakes..... PASS
Steering Mechanism..... PASS
Tires..... PASS
Exhaust System..... PASS
Clearance Lights..... N/A
Reflectors..... N/A
Window Tinting..... N/A

TAMPERING INSPECTION
Catalytic Converter..... PASS
Air Injection System..... PASS
PCV Valve..... PASS
Unleaded Gas Restrictor..... PASS
Exhaust Gas Recirculation..... PASS
Thermostatic Air Control..... PASS
Fuel Evaporation Control..... PASS
Oxygen Sensor..... PASS

EXHAUST EMISSION TEST RESULTS
-PASS-
Gas Reading Standard
HC (ppm) 0098 220
CO (%) 00.14 1.20
CO2 (%) 14.8
Engine RPM at Reading 0690

Station Number: 20706 Analyzer Number: 01 Ver. B201
Inspection Class: VOID Receipt/Statement Number: VOID
Inspector/Mechanic Number: 00020012

Inspector/Mechanic

Owner's Repair Authorization

RETAIN THIS COPY FOR YOUR RECORDS

APPENDIX B

only machine

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #1333
ADDRESS: 6304 CAPITOL BLVD
CITY: RALEIGH
COUNTY: 91
PHONE: 919-981-0949
SOFTWARE VERSION #: NONE
STATION NUMBER: 20799
ANALYZER NUMBER: 01

DATE: 07/27/92
TIME: 16:45

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	302	MID:	HC	1201
	CO	N/A		CO	1.00		CO	4.02
	CO2	N/A		CO2	6.00		CO2	12.01
				O2	0.24			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.532

B MACHINE

BEAR GAS ANALYZER AUDIT

Jiffy Lube #1108 4804 Atlantic Ave RAL. N.C. 276
STATION NAME: BEAR AUTOMOTIVE SERVICE EQUIPMENT CORP.
ADDRESS: 2855 WEST JAMES DRIVE
CITY: NEW BERLIN
COUNTY: 91
PHONE: 414-786-5212
SOFTWARE VERSION #: NONE
STATION NUMBER: 20690
ANALYZER NUMBER: 02
DATE: 07/27/92
TIME: 17:19

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	297	MID:	HC	1207
	CO	N/A		CO	1.01		CO	4.04
	CO2	N/A		CO2	6.01		CO2	12.08
				O2	0.15			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.531

DIESEL OIL ANALYZER AUDIT

STATION NAME: JIFFY LUBE
ADDRESS: 5930 GLENWOOD AVE.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-787-1110
SOFTWARE VERSION #: NONE
STATION NUMBER: 20786
ANALYZER NUMBER: 01

DATE: 07/27/92
TIME: 16:42

ON-BURNER (A) GAS VALUES

PROBE:	HC	N/A	LOW:	HC	300	MID:	HC	1199
	CO	N/A		CO	1.01		CO	4.03
	CO2	N/A		CO2	6.03		CO2	12.04
				O2	0.18			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE (B) GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.512

~~REPORT OF ANALYZER OUTPUT~~

STATION NAME: JIFFY LUBE
ADDRESS: 5930 GLENWOOD AVE.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-787-1110
SOFTWARE VERSION #: NONE
STATION NUMBER: 20786
ANALYZER NUMBER: 02

DATE: 07/27/92
TIME: 16:48

ON BOARD CH. GAS VALUES

PROBE:	HC	N/A	LOW:	HC	301	MID:	HC	1195
	CO	N/A		CO	1.01		CO	4.01
	CO2	N/A		CO2	6.00		CO2	12.02
				O2	0.15			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CELL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.511

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE
ADDRESS: 3925 WESTERN BLVD.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-851-9767
SOFTWARE VERSION #: NONE
STATION NUMBER: 20692
ANALYZER NUMBER: 01

DATE: 07/27/92
TIME: 16:17

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	302	MID:	HC	1200
	CO	N/A		CO	1.07		CO	4.13
	CO2	N/A		CO2	6.06		CO2	12.07
				O2	0.14			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.500

BEAR

BEAR GAS ANALYZER AUDIT

STATION NAME: ... FY LUBE #197

ADDRESS: ... ON 2470

CITY:

STATE:

PHONE: ...

SOFTWARE VERSION #: NONE

STATION NUMBER: 100.2

ANALYZER NUMBER: 08

DATE: 2/7/79

TIME: 11:17

ON BOARD CAL. GAS VALUES

PROBE:	HC	N/A	LOW:	HC	298	MID:	HC	1196
	CO	N/A		CO	1.01		CO	4.02
	CO2	N/A		CO2	6.01		CO2	12.01
				O2	20.14			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL. GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.00		CO2	12.00
	O2	20.9			

SENCH P.E.F. 12.519

BEAR®

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #856

ADDRESS: 1809 NEW BERN AVE.

CITY: RALEIGH

COUNTY: 91

PHONE: 919-755-1108

SOFTWARE VERSION #: NONE

STATION NUMBER: 20665

ANALYZER NUMBER: 01

DATE: 07/27/92

TIME: 15:27

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	302	MID:	HC	1203
	CO	N/A		CO	1.01		CO	4.00
	CO2	N/A		CO2	6.01		CO2	12.03
				O2	0.14			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.016

BEAR GAS ANALYZER AUDIT

STATION NAME: JUFFY LUBE #856
ADDRESS: 1809 NEW BERN AVE.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-755-1108
SOFTWARE VERSION #: NONE
STATION NUMBER: 20665
ANALYZER NUMBER: 02

DATE: 07/27/92
TIME: 15:41

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	355	MID:	HC	1282
	CO	N/A		CO	1.02		CO	4.07
	CO2	N/A		CO2	6.06		CO2	12.11
				O2	0.33			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.509

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #188
ADDRESS: 3915 NORTH DUKE STREET
CITY: DURHAM
COUNTY: 31
PHONE: 919-471-0890
SOFTWARE VERSION #: NONE
STATION NUMBER: 12769
ANALYZER NUMBER: 01

DATE: 07/27/92
TIME: 12:57

ON BOARD CEL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	296	MID:	HC	1196
	CO	N/A		CO	1.00		CO	4.01
	CO2	N/A		CO2	5.98		CO2	11.96
				O2	0.24			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.523

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #188
ADDRESS: 3915 N. DUKE ST.
CITY: DURHAM
COUNTY: 31
PHONE: 919-471-0890
SOFTWARE VERSION #: NONE
STATION NUMBER: 12769
ANALYZER NUMBER: 02

DATE: 07/27/92
TIME: 12:00

ON BOARD CAL. GAS VALUES

PROBE:	HC	N/A	LOW:	HC	289	MID:	HC	1202
	CO	N/A		CO	1.00		CO	4.01
	CO2	N/A		CO2	5.99		CO2	11.99
				O2	0.12			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL. GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.508

CALIBRATION GAS LIMITS

LOW RANGE VALUES

<u>Emission:</u>		<u>Allowable Range:</u>
HC	ppm	294 - 395
CO	%	0.98 - 1.02
CO2	%	5.9 - 6.1

MID RANGE VALUES

<u>Emission:</u>		<u>Allowable Range:</u>
HC	ppm	1176 - 1224
CO	%	3.92 - 4.08
CO2	%	11.8 - 12.2

STATE INSPECTION DIAGNOSTIC FUNCTION ANALYZER MAINTENANCE UTILITIES/ STATE AUDIT

CALIBRATION GAS BOTTLE VALUES

	LOW	HIGH
CO2 (CARBON DIOXIDE)	: 6.00 %	12.00 %
CO (CARBON MONOXIDE)	: 1.00 %	4.00 %
HC (PROPANE)	: 0300 ppm	1200 ppm
O2 (OXYGEN)	: 20.90 %	

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #1333
ADDRESS: 6304 CAPITOL BLVD
CITY: RALEIGH
COUNTY: 91
PHONE: 919-981-0949
SOFTWARE VERSION #: NONE
STATION NUMBER: 20799
ANALYZER NUMBER: 01

DATE: 08/11/92
TIME: 14:47

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	298	MID:	HC	1197
	CO	N/A		CO	1.00		CO	4.00
	CO2	N/A		CO2	6.02		CO2	12.03
				O2	0.23			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.532

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #1108

ADDRESS: 4804 ATLANTIC AVENUE

CITY: RALEIGH

COUNTY: 91

PHONE: 919-876-5825

SOFTWARE VERSION #: NONE

DATE: 08/11/92

STATION NUMBER: 20690

TIME: 14:57

ANALYZER NUMBER: 01

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	300	MID:	HC	1199
	CO	N/A		CO	1.01		CO	4.01
	CO2	N/A		CO2	5.97		CO2	11.98
				O2	0.47			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.516

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #1108
ADDRESS: 4804 ATLANTIC AVENUE
CITY: RALEIGH
COUNTY: 91
PHONE: 919-876-5825
SOFTWARE VERSION #: NONE
STATION NUMBER: 20690
ANALYZER NUMBER: 02

DATE: 08/11/92
TIME: 15:15

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	299	MID:	HC	1197
	CO	N/A		CO	1.00		CO	3.98
	CO2	N/A		CO2	6.00		CO2	11.99
				O2	0.19			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.531

BIER GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE
ADDRESS: 5930 GLENWOOD AVE.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-787-1110
SOFTWARE VERSION 0: NONE
STATION NUMBER: 20786
ANALYZER NUMBER: 01

DATE: 08/11/92
TIME: 15:44

ON LINE ANALYZER VALUES

PROBE:	HC	N/A	LOW:	HC	296	MID:	HC	1197
	CO	N/A		CO	1.02		CO	4.04
	CO2	N/A		CO2	5.99		CO2	12.01
				O2	0.15			

THE HC VALUES ARE SHOWN AS PROPANE

NOISE CH. GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.512

BENCH GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE
ADDRESS: 5930 GLENWOOD AVE.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-787-1110
SOFTWARE VERSION: NONE
STATION NUMBER: 20786
ANALYZER NUMBER: 02

DATE: 08/11/92
TIME: 15:51

ON BOARD CAL GAS VALUES

PROBE:	HC:	N/A	LOW:	HC:	303	MID:	HC:	1207
	CO	N/A		CO	1.01		CO	4.03
	CO2	N/A		CO2	6.00		CO2	12.00
				O2	0.15			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.511

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE
ADDRESS: 3925 WESTERN BLVD.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-851-9767
SOFTWARE VERSION #: NONE
STATION NUMBER: 20692
ANALYZER NUMBER: 01

DATE: 08/11/92
TIME: 12:28

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	300	MID:	HC	1198
	CO	N/A		CO	1.02		CO	4.03
	CO2	N/A		CO2	6.05		CO2	12.10
				O2	0.14			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.500

BEAR GAS ANALYZER AUDIT

STATION NAME: LURE #187
ADDRESS: 3925 W. TERN BLVD
CITY: FOLSOM
COUNTY: 91
PHONE: 919-851-9767
SOFTWARE VERSION #: NONE
STATION NUMBER: 20692
ANALYZER NUMBER: 02

DATE: 08/11/92

TIME: 12:29

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	306	MID:	HC	1213
	CO	N/A		CO	1.03		CO	4.08
	CO2	N/A		CO2	6.17		CO2	12.36
				O2	0.14			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	5.0		CO2	12.0
	O2	0.9			

BENCH P.E.F. = 0.619

BEAR GAS ANALYZER AUDIT

STATION NAME: JFY 10P AREA
ADDRESS: 809 WELBURN AVE.
CITY: DALLAS
COUNTY: DALLAS
PHONE: 972-755-1148
SOFTWARE VERSION #: NONE
STATION NUMBER: 80605
ANALYZER NUMBER: 11

DATE: 08/11/92
TIME: 13:57

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	300	MID:	HC	1193
	CO	N/A		CO	1.00		CO	3.99
	CO2	N/A		CO2	6.01		CO2	12.01
				O2	0.14			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	120	MID:	HC	1193
	CO	1.00		CO	3.99
	CO2	6.01		CO2	12.01

BENCH D.E.F. = 0.04

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #856
ADDRESS: 1809 NEW BERN AVE.
CITY: RALEIGH
COUNTY: 91
PHONE: 919-755-1108
SOFTWARE VERSION #: NONE
STATION NUMBER: 20665
ANALYZER NUMBER: 02

DATE: 08/11/92
TIME: 14:14

ON BOARD CAL GAS VALUES

PROBE:	HC	N/A	LOW:	HC	292	MID:	HC	1188
	CO	N/A		CO	1.01		CO	4.01
	CO2	N/A		CO2	6.01		CO2	12.01
				O2	0.34			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.509

HEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #188
ADDRESS: 3915 N. DUKE ST.
CITY: DURHAM
COUNTY: 31
PHONE: 919-471-0890
SOFTWARE VERSION #: NONE
STATION NUMBER: 12769
ANALYZER NUMBER: 02

DATE: 08/11/92
TIME: 09:16

ON BOARD DIE GAS VALUES

PROBE:	HC	N/A	LOW:	HC	301	MID:	HC	1206
	CO	N/A		CO	0.99		CO	3.99
	CO2	N/A		CO2	5.70		CO2	11.56
				O2	0.18			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL. GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.508

BEAR GAS ANALYZER AUDIT

STATION NAME: JIFFY LUBE #188
ADDRESS: 3915 NORTH DUKE STREET
CITY: DURHAM
COUNTY: 31
PHONE: 919-471-0890
SOFTWARE VERSION #: NONE
STATION NUMBER: 12769
ANALYZER NUMBER: 01

DATE: 08/11/92
TIME: 09:11

ON INCH CAL. GAS VALUES

PROBE:	HC	N/A	LOW:	HC	296	MID:	HC	1196
	CO	N/A		CO	1.00		CO	4.02
	CO2	N/A		CO2	5.95		CO2	11.93
				O2	0.24			

THE HC VALUES ARE SHOWN AS PROPANE

BOTTLE CAL. GAS VALUES

LOW:	HC	300	MID:	HC	1200
	CO	1.00		CO	4.00
	CO2	6.0		CO2	12.0
	O2	20.9			

BENCH P.E.F. = 0.523

APPENDIX C

NOTE: Remember to mark on Emissions Report whether emissions test was performed "before" or "after" repair service is performed.

Date: _____

Initials: _____

(✓)	Service that Customer Seeks	Request Made to Customer	Incentive Offered	Accepted		If Rejected		
				Accepted	Rejected	Make	Year	Mileage
	Emissions Test Only	Second "Training" Emissions Test	\$3 Off Next Visit					
	Oil Change Only	Two "Training" Emissions Tests	\$5 Off Next Visit					
	Oil Change plus Emissions Test	Second "Training" Emissions Test	\$3 Off Next Visit					
	PVC Only	Two "Training" Emissions Tests	Free PVC					
	PVC plus Emissions Test	Second "Training" Emissions Test	Free PVC					
	Air Filter Only	Two "Training" Emissions Tests	Free Air Filter					
	Air Filter plus Emissions Test	Second "Training" Emissions Test	Free Air Filter					
	Fuel Additive Only	Two "Training" Emissions Tests	Free Fuel Additive					
	Fuel Additive plus Emissions Test	Second "Training" Emissions Test	Free Fuel Additive					
	Any Type of Service	Two Emissions Tests, Oil Change, PVC, Air Filter, Fuel Additive	Free PVC, Air Filter, Fuel Additive, Emissions Test or One Oil Change, or Combination of the Above					

When you have finished this form:

- If customer accepted, staple this page to invoice and copy of two emissions reports.
- If customer rejected, staple this page to invoice and single emissions report (if performed).

COVER PAGE FOR DAILY SUBMISSION OF DATA SETS

STORE _____

DATE _____

FULL NAME _____

Please enter the number of data sets collected by type:

Emissions Test Only _____

Oil Change Only _____

Oil Change plus Emissions Test _____

PVC Only _____

PVC plus Emissions Test _____

Air Filter Only _____

Air Filter plus Emissions Test _____

Fuel Additive Only _____

Fuel Additive plus Emissions Test _____

Any Type of Service _____

APPENDIX D

Paired samples t-test: HCBEFL
HCAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFL	48	3.4536	1.157	.167
HCAFTL	48	3.4146	1.153	.166

(Difference) Mean	Standard Deviation	Standard Error	• • • •	2-Tail Corr. Prob.	• • • •	t Value	Degrees of Freedom	2-Tail Prob.
.0390	.626	.090	•	.853	.000	.43	47	.668

Paired samples t-test: COBEFL
COAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFL	48	1.0964	.278	.040
COAFTL	48	1.0753	.172	.025

(Difference) Mean	Standard Deviation	Standard Error	• • • •	2-Tail Corr. Prob.	• • • •	t Value	Degrees of Freedom	2-Tail Prob.
.0210	.189	.027	•	.742	.000	.77	47	.445

Paired samples t-test: CO2BEFL
CO2AFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFL	48	2.6217	.168	.024
CO2AFTL	48	2.6230	.171	.025

(Difference) Mean	Standard Deviation	Standard Error	• • • •	2-Tail Corr. Prob.	• • • •	t Value	Degrees of Freedom	2-Tail Prob.
-.0013	.049	.007	•	.959	.000	-.19	47	.853

Paired samples t-test: HCBEFL
HCAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFL	107	3.3510	1.248	.121
HCAFTL	107	3.4789	1.301	.126

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.	
-.1279	.822	.079	°	.793	.000	°	-1.61	106	.110

Paired samples t-test: COBEFL
COAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFL	107	1.0693	.260	.025
COAFTL	107	1.0727	.225	.022

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.	
-.0034	.077	.007	°	.960	.000	°	-.46	106	.645

Paired samples t-test: CO2BEFL
CO2AFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFL	107	2.6960	.144	.014
CO2AFTL	107	2.6870	.145	.014

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.	
.0090	.047	.005	°	.947	.000	°	1.96	106	.052

Paired samples t-test: HCBEFL
HCAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFL	48	3.8021	1.110	.160
HCAFTL	48	3.6571	1.076	.155

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.1449	.693	.100	°	.799	.000	1.45	47	.154

Paired samples t-test: COBEFL
COAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFL	48	1.1095	.244	.035
COAFTL	48	1.0589	.132	.019

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0506	.176	.025	°	.715	.000	1.99	47	.052

Paired samples t-test: CO2BEFL
CO2AFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFL	48	2.6566	.157	.023
CO2AFTL	48	2.6567	.161	.023

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.0001	.058	.008	°	.935	.000	-.01	47	.991

Paired samples t-test: HCBEFL
HCAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFL	95	3.9915	1.095	.112
HCAFTL	95	3.9462	1.110	.114

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0453	.619	.064	°	.842	.000 °	.71	94	.478

Paired samples t-test: COBEFL
COAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFL	95	1.1236	.300	.031
COAFTL	95	1.1279	.299	.031

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.0044	.127	.013	°	.909	.000 °	-.33	94	.739

Paired samples t-test: CO2BEFL
CO2AFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFL	95	2.6122	.188	.019
CO2AFTL	95	2.6065	.189	.019

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0057	.048	.005	°	.967	.000 °	1.14	94	.256

Paired samples t-test: HCBEFL
HCAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFL	90	3.6281	1.168	.123
HCAFTL	90	3.6245	1.179	.124

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail Corr. Prob.	°	t Value	Degrees of Freedom	2-Tail Prob.
.0036	.774	.082	°	.783	.000	°	.04	.965

Paired samples t-test: COBEFL
COAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFL	90	1.0919	.281	.030
COAFTL	90	1.1029	.289	.030

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail Corr. Prob.	°	t Value	Degrees of Freedom	2-Tail Prob.
-.0110	.130	.014	°	.896	.000	°	-.80	.425

Paired samples t-test: CO2BEFL
CO2AFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFL	90	2.6784	.143	.015
CO2AFTL	90	2.6879	.128	.013

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail Corr. Prob.	°	t Value	Degrees of Freedom	2-Tail Prob.
-.0095	.064	.007	°	.894	.000	°	-1.40	.164

Paired samples t-test: HCBEFL
HCAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFL	66	4.0226	1.361	.168
HCAFTL	66	4.0670	1.300	.160

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail °	t Value	Degrees of Freedom	2-Tail Prob.
-.0444	.852	.105	°	.796 .000 °	-.42	65	.674

Paired samples t-test: COBEFL
COAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFL	66	1.2176	.460	.057
COAFTL	66	1.2097	.517	.064

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail °	t Value	Degrees of Freedom	2-Tail Prob.
.0079	.399	.049	°	.671 .000 °	.16	65	.873

Paired samples t-test: CO2BEFL
CO2AFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFL	66	2.6020	.189	.023
CO2AFTL	66	2.5963	.188	.023

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail °	t Value	Degrees of Freedom	2-Tail Prob.
.0056	.084	.010	°	.901 .000 °	.55	65	.585

Paired samples t-test: HCBEFL
HCAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFL	406	3.7248	1.223	.061
HCAFTL	406	3.7372	1.220	.061

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.0124	.760	.038	°	.807 .000	°	-.33	405	.742

Paired samples t-test: COBEFL
COAFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFL	406	1.1159	.315	.016
COAFTL	406	1.1130	.316	.016

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0029	.196	.010	°	.806 .000	°	.30	405	.767

Paired samples t-test: CO2BEFL
CO2AFTL

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFL	406	2.6525	.168	.008
CO2AFTL	406	2.6500	.166	.008

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0025	.060	.003	°	.936 .000	°	.84	405	.403

APPENDIX E

Paired samples t-test: HCBEFORE HC LEVEL OF BEFORE TEST
HCAFTER HC LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFORE	48	60.1458	82.554	11.916
HCAFTER	48	57.1458	77.385	11.170

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
3.0000	33.657	4.858	° ° °	.913	.000	.62	47	.540

Paired samples t-test: COBEFORE CO LEVEL OF BEFORE TEST
COAFTER CO LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFORE	48	.2775	.944	.136
COAFTER	48	.1854	.462	.067

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0921	.734	.106	° ° °	.649	.000	.87	47	.389

Paired samples t-test: CO2BEFOR CO2 LEVEL OF BEFORE TEST
CO2AFTER CO2 LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFOR	48	12.9438	2.218	.320
CO2AFTER	48	12.9667	2.234	.323

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.0229	.639	.092	° ° °	.959	.000	-.25	47	.805

Paired samples t-test: HCBEFORE HC LEVEL OF BEFORE TEST
HCAFTER HC LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFORE	107	53.2804	60.709	5.869
HCAFTER	107	60.3458	62.330	6.026

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-7.0654	37.792	3.654	° ° °	.812	.000	-1.93	106	.056

Paired samples t-test: COBEFORE CO LEVEL OF BEFORE TEST
COAFTER CO LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFORE	107	.2102	.991	.096
COAFTER	107	.2008	.796	.077

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0093	.261	.025	° ° °	.981	.000	.37	106	.712

Paired samples t-test: CO2BEFOR CO2 LEVEL OF BEFORE TEST
CO2AFTER CO2 LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFOR	107	13.9607	1.894	.183
CO2AFTER	107	13.8290	1.893	.183

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.1318	.650	.063	° ° °	.941	.000	2.10	106	.038

Paired samples t-test: HCBEFORE HC LEVEL OF BEFORE TEST
HCAFTER HC LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFORE	48	69.7917	60.023	8.664
HCAFTER	48	60.8750	53.542	7.728

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
8.9167	40.328	5.821	° ° °	.753	.000	1.53	47	.132

Paired samples t-test: COBEFORE CO LEVEL OF BEFORE TEST
COAFTER CO LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFORE	48	.2892	.772	.111
COAFTER	48	.1383	.355	.051

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.1508	.594	.086	° ° °	.672	.000	1.76	47	.085

Paired samples t-test: CO2BEFOR CO2 LEVEL OF BEFORE TEST
CO2AFTER CO2 LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFOR	48	13.4083	2.041	.295
CO2AFTER	48	13.4188	2.100	.303

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.0104	.730	.105	° ° °	.938	.000	-.10	47	.922

Paired samples t-test: HCBEFORE HC LEVEL OF BEFORE TEST
HCAFTER HC LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFORE	95	89.2316	94.273	9.672
HCAFTER	95	86.3684	93.512	9.594

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail °	t	Degrees of Freedom	2-Tail Prob.
2.8632	44.585	4.574	°	°	Value		
			°	Corr. Prob. °			
			°	.887 .000 °	.63	94	.533

Paired samples t-test: COBEFORE CO LEVEL OF BEFORE TEST
COAFTER CO LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFORE	95	.3515	1.068	.110
COAFTER	95	.3604	1.022	.105

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail °	t	Degrees of Freedom	2-Tail Prob.
-.0089	.387	.040	°	°	Value		
			°	Corr. Prob. °			
			°	.932 .000 °	-.23	94	.822

Paired samples t-test: CO2BEFOR CO2 LEVEL OF BEFORE TEST
CO2AFTER CO2 LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFOR	95	12.8505	2.314	.237
CO2AFTER	95	12.7747	2.324	.238

(Difference) Mean	Standard Deviation	Standard Error	°	2-Tail °	t	Degrees of Freedom	2-Tail Prob.
.0758	.641	.066	°	°	Value		
			°	Corr. Prob. °			
			°	.962 .000 °	1.15	94	.252

Paired samples t-test: HCBEFORE HC LEVEL OF BEFORE TEST
HCAFTER HC LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFORE	90	66.9222	92.001	9.698
HCAFTER	90	68.2889	90.084	9.496

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-1.3667	40.410	4.260	° ° °	.902 .000	° ° °	-.32	89	.749

Paired samples t-test: COBEFORE CO LEVEL OF BEFORE TEST
COAFTER CO LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFORE	90	.2704	1.118	.118
COAFTER	90	.2991	1.129	.119

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.0287	.353	.037	° ° °	.951 .000	° ° °	-.77	89	.443

Paired samples t-test: CO2BEFOR CO2 LEVEL OF BEFORE TEST
CO2AFTER CO2 LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFOR	90	13.6978	1.841	.194
CO2AFTER	90	13.8111	1.686	.178

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.1133	.780	.082	° ° °	.906 .000	° ° °	-1.38	89	.172

Paired samples t-test: HCBEFORE HC LEVEL OF BEFORE TEST
HCAFTER HC LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFORE	66	144.9545	295.894	36.422
HCAFTER	66	114.3636	149.653	18.421

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
30.5909	211.501	26.034	° ° °	.736	.000	1.18	65	.244

Paired samples t-test: COBEFORE CO LEVEL OF BEFORE TEST
COAFTER CO LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFORE	66	.6912	1.718	.212
COAFTER	66	.7264	2.154	.265

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
-.0352	1.768	.218	° ° °	.604	.000	-.16	65	.872

Paired samples t-test: CO2BEFOR CO2 LEVEL OF BEFORE TEST
CO2AFTER CO2 LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFOR	66	12.7182	2.414	.297
CO2AFTER	66	12.6409	2.421	.298

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0773	1.011	.124	° ° °	.912	.000	.62	65	.537

Paired samples t-test: HCBEFORE HC LEVEL OF BEFORE TEST
HCAFTER HC LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
HCBEFORE	406	81.5714	142.483	7.071
HCAFTER	406	77.0394	95.529	4.741

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
4.5320	93.375	4.634	° ° °	.761	.000	.98	405	.329

Paired samples t-test: COBEFORE CO LEVEL OF BEFORE TEST
COAFTER CO LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
COBEFORE	406	.3441	1.169	.058
COAFTER	406	.3380	1.217	.060

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0061	.791	.039	° ° °	.781	.000	.16	405	.876

Paired samples t-test: CO2BEFOR CO2 LEVEL OF BEFORE TEST
CO2AFTER CO2 LEVEL OF AFTER TEST

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
CO2BEFOR	406	13.3754	2.143	.106
CO2AFTER	406	13.3367	2.130	.106

(Difference) Mean	Standard Deviation	Standard Error	° ° °	2-Tail Corr. Prob.	° ° °	t Value	Degrees of Freedom	2-Tail Prob.
.0387	.758	.038	° ° °	.937	.000	1.03	405	.304

APPENDIX F

This procedure was completed at 17:40:15

ONEWAY VARIABLES=HCBEFL BY SERVICE (0,5)/RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable HCBEFL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	31.8462	6.3692	4.4552	.0006
Within Groups	448	640.4634	1.4296		
Total	453	672.3096			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 0	48	3.4536	1.1573	.1670	3.1176	To	3.7897
Grp 1	107	3.3510	1.2475	.1206	3.1119	To	3.5901
Grp 2	48	3.8021	1.1105	.1603	3.4796	To	4.1245
Grp 3	95	3.9915	1.0947	.1123	3.7684	To	4.2145
Grp 4	90	3.6281	1.1684	.1232	3.3834	To	3.8728
Grp 5	66	4.0226	1.3612	.1676	3.6880	To	4.3572
Total	454	3.6961	1.2182	.0572	3.5838	To	3.8085

Group	Minimum	Maximum
Grp 0	1.9459	6.1862
Grp 1	.0000	6.0210
Grp 2	.6931	5.4972
Grp 3	1.6094	6.3135
Grp 4	.0000	6.6187
Grp 5	1.6094	7.6014
Total	.0000	7.6014

- - - - - O N E W A Y - - - - -

Variable HCBEFL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.

The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
.8455 * Range * $\text{Sqrt}(1/N(I) + 1/N(J))$

(*) Denotes pairs of groups significantly different at the .050 level

		G G G G G G
		r r r r r r
		p p p p p p
Mean	Group	1 0 4 2 3 5
3.3510	Grp 1	
3.4536	Grp 0	
3.6281	Grp 4	
3.8021	Grp 2	
3.9915	Grp 3	*
4.0226	Grp 5	*

This procedure was completed at 17:40:19

ONEWAY VARIABLES=HCAFTL BY SERVICE (0,5) /RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable HCAFTL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	24.3817	4.8763	3.3826	.0052
Within Groups	448	645.8398	1.4416		
Total	453	670.2215			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 0	48	3.4146	1.1535	.1665	3.0797	To	3.7496
Grp 1	107	3.4789	1.3014	.1258	3.2295	To	3.7283
Grp 2	48	3.6571	1.0765	.1554	3.3446	To	3.9697
Grp 3	95	3.9462	1.1096	.1138	3.7202	To	4.1722
Grp 4	90	3.6245	1.1787	.1242	3.3777	To	3.8714
Grp 5	66	4.0670	1.3005	.1601	3.7473	To	4.3867
Total	454	3.7031	1.2164	.0571	3.5909	To	3.8153

Group	Minimum	Maximum
Grp 0	1.3863	6.1291
Grp 1	.0000	5.8749
Grp 2	1.3863	5.4337
Grp 3	1.6094	6.4167
Grp 4	1.0986	6.5468
Grp 5	1.0986	6.8405
Total	.0000	6.8405

----- O N E W A Y -----

Variable HCAFTL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.
The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
.8490 * Range * $\text{Sqrt}(1/N(I) + 1/N(J))$

(*) Denotes pairs of groups significantly different at the .050 level

		G G G G G G
		r r r r r r
		p p p p p p
Mean	Group	0 1 4 2 3 5
3.4146	Grp 0	
3.4789	Grp 1	
3.6245	Grp 4	
3.6571	Grp 2	
3.9462	Grp 3	
4.0670	Grp 5	*

This procedure was completed at 17:40:23

ONEWAY VARIABLES=COBEFL BY SERVICE (0,5)/RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable COBEFL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	.9905	.1981	2.0714	.0679
Within Groups	448	42.8438	.0956		
Total	453	43.8343			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 0	48	1.0964	.2776	.0401	1.0158	To	1.1770
Grp 1	107	1.0693	.2598	.0251	1.0195	To	1.1191
Grp 2	48	1.1095	.2438	.0352	1.0387	To	1.1803
Grp 3	95	1.1236	.3001	.0308	1.0624	To	1.1847
Grp 4	90	1.0919	.2811	.0296	1.0330	To	1.1508
Grp 5	66	1.2176	.4604	.0567	1.1044	To	1.3307
Total	454	1.1138	.3111	.0146	1.0851	To	1.1425

Group	Minimum	Maximum
Grp 0	1.0000	2.6306
Grp 1	1.0000	2.9799
Grp 2	1.0000	2.3749
Grp 3	1.0000	2.8213
Grp 4	1.0000	3.3151
Grp 5	1.0000	3.3151
Total	1.0000	3.3151

- - - - - O N E W A Y - - - - -

Variable COBEFL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.
The value actually compared with Mean(J)-Mean(I) is..
.2187 * Range * Sqrt(1/N(I) + 1/N(J))

(*) Denotes pairs of groups significantly different at the .050 level

		G G G G G G
		r r r r r r
		p p p p p p
Mean	Group	1 4 0 2 3 5
1.0693	Grp 1	
1.0919	Grp 4	
1.0964	Grp 0	
1.1095	Grp 2	
1.1236	Grp 3	
1.2176	Grp 5	*

This procedure was completed at 17:40:27

ONEWAY VARIABLES=COAFTL BY SERVICE (0,5) /RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable COAFTL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	1.0223	.2045	2.2472	.0488
Within Groups	448	40.7592	.0910		
Total	453	41.7814			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 0	48	1.0753	.1724	.0249	1.0253	To	1.1254
Grp 1	107	1.0727	.2250	.0217	1.0296	To	1.1158
Grp 2	48	1.0589	.1321	.0191	1.0205	To	1.0972
Grp 3	95	1.1279	.2986	.0306	1.0671	To	1.1887
Grp 4	90	1.1029	.2891	.0305	1.0424	To	1.1635
Grp 5	66	1.2097	.5168	.0636	1.0826	To	1.3367
Total	454	1.1090	.3037	.0143	1.0810	To	1.1370

Group	Minimum	Maximum
Grp 0	1.0000	1.7944
Grp 1	1.0000	2.7749
Grp 2	1.0000	1.8055
Grp 3	1.0000	2.8018
Grp 4	1.0000	3.3151
Grp 5	1.0000	3.7417
Total	1.0000	3.7417

- - - - - O N E W A Y - - - - -

Variable COAFTL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.

The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
.2133 * Range * $\text{Sqrt}(1/N(I) + 1/N(J))$

(*) Denotes pairs of groups significantly different at the .050 level

		G G G G G G
		r r r r r r
		p p p p p p
Mean	Group	2 1 0 4 3 5
1.0589	Grp 2	
1.0727	Grp 1	
1.0753	Grp 0	
1.1029	Grp 4	
1.1279	Grp 3	
1.2097	Grp 5	*

This procedure was completed at 17:40:31

ONEWAY VARIABLES=CO2BEFL BY SERVICE (0,5)/RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable CO2BEFL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	.6271	.1254	4.6129	.0004
Within Groups	448	12.1812	.0272		
Total	453	12.8084			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 0	48	2.6217	.1681	.0243	2.5729	To	2.6705
Grp 1	107	2.6960	.1444	.0140	2.6683	To	2.7237
Grp 2	48	2.6566	.1567	.0226	2.6111	To	2.7021
Grp 3	95	2.6122	.1885	.0193	2.5738	To	2.6506
Grp 4	90	2.6784	.1435	.0151	2.6484	To	2.7085
Grp 5	66	2.6020	.1888	.0232	2.5556	To	2.6484
Total	454	2.6493	.1682	.0079	2.6338	To	2.6648

Group	Minimum	Maximum
Grp 0	2.3224	2.7912
Grp 1	2.2083	2.8332
Grp 2	2.2824	2.7912
Grp 3	1.8245	2.8094
Grp 4	2.1861	2.8034
Grp 5	2.1748	2.8094
Total	1.8245	2.8332

- - - - - O N E W A Y - - - - -

Variable CO2BEFL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.

The value actually compared with Mean(J)-Mean(I) is..
.1166 * Range * Sqrt(1/N(I) + 1/N(J))

(*) Denotes pairs of groups significantly different at the .050 level

		G G G G G G
		r r r r r r
		p p p p p p
Mean	Group	5 3 0 2 4 1
2.6020	Grp 5	
2.6122	Grp 3	
2.6217	Grp 0	
2.6566	Grp 2	
2.6784	Grp 4	
2.6960	Grp 1	* *

This procedure was completed at 17:40:35

ONEWAY VARIABLES=CO2AFTL BY SERVICE (0,5)/RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable CO2AFTL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	.6790	.1358	5.0979	.0001
Within Groups	448	11.9347	.0266		
Total	453	12.6137			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 0	48	2.6230	.1708	.0247	2.5734	To	2.6726
Grp 1	107	2.6870	.1454	.0141	2.6591	To	2.7149
Grp 2	48	2.6567	.1610	.0232	2.6099	To	2.7034
Grp 3	95	2.6065	.1890	.0194	2.5680	To	2.6450
Grp 4	90	2.6879	.1277	.0135	2.6612	To	2.7147
Grp 5	66	2.5963	.1879	.0231	2.5502	To	2.6425
Total	454	2.6472	.1669	.0078	2.6318	To	2.6626

Group	Minimum	Maximum
Grp 0	2.2925	2.8214
Grp 1	2.2300	2.7973
Grp 2	2.2192	2.7973
Grp 3	1.8405	2.8154
Grp 4	2.2083	2.7973
Grp 5	2.1861	2.8214
Total	1.8405	2.8214

- - - - - O N E W A Y - - - - -

Variable CO2AFTL
By Variable SERVICE TYPE OF SERVICE PERFORMED

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.

The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..

$.1154 * \text{Range} * \text{Sqrt}(1/N(I) + 1/N(J))$

(*) Denotes pairs of groups significantly different at the .050 level

		G G G G G G
		r r r r r r
		p p p p p p
Mean	Group	5 3 0 2 1 4
2.5963	Grp 5	
2.6065	Grp 3	
2.6230	Grp 0	
2.6567	Grp 2	
2.6870	Grp 1	* *
2.6879	Grp 4	* *

This procedure was completed at 17:40:39

RECODE STORE (187=1)(188=2)(856=3)(1108=4)(1305=5)(1333=6).
ONEWAY VARIABLES=HCBEFL BY STORE (1,6)/RANGES=TUKEY/STATISTICS=1.
The raw data or transformation pass is proceeding
454 cases are written to the uncompressed active file.

- - - - - O N E W A Y - - - - -

Variable HCBEFL
By Variable STORE

STORE NUMBER

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	12.7872	2.5574	1.7372	.1247
Within Groups	448	659.5224	1.4721		
Total	453	672.3096			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	95	3.8470	1.2163	.1248	3.5992	To	4.0948
Grp 2	68	3.5895	1.4656	.1777	3.2347	To	3.9442
Grp 3	91	3.8448	1.0635	.1115	3.6233	To	4.0662
Grp 4	98	3.7433	1.0146	.1025	3.5399	To	3.9467
Grp 5	91	3.4083	1.3287	.1393	3.1316	To	3.6850
Grp 6	11	3.7832	1.2653	.3815	2.9332	To	4.6332
Total	454	3.6961	1.2182	.0572	3.5838	To	3.8085

Group	Minimum	Maximum
Grp 1	1.0986	6.6187
Grp 2	.6931	7.6014
Grp 3	1.6094	6.8211
Grp 4	1.6094	6.1821
Grp 5	.0000	6.4968
Grp 6	1.7918	5.3033
Total	.0000	7.6014

- - - - - O N E W A Y - - - - -

Variable HCBEFL
By Variable STORE STORE NUMBER

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.

The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
 $.8579 * \text{Range} * \text{Sqrt}(1/N(I) + 1/N(J))$

No two groups are significantly different at the .050 level

This procedure was completed at 17:40:45
ONEWAY VARIABLES=HCAFTL BY STORE (1,6) /RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable HCAFTL
By Variable STORE

STORE NUMBER

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	16.1548	3.2310	2.2130	.0520
Within Groups	448	654.0668	1.4600		
Total	453	670.2215			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	95	3.9690	1.1881	.1219	3.7270	To	4.2110
Grp 2	68	3.5011	1.3867	.1682	3.1654	To	3.8367
Grp 3	91	3.7500	1.1205	.1175	3.5166	To	3.9834
Grp 4	98	3.7887	.9514	.0961	3.5980	To	3.9795
Grp 5	91	3.4627	1.3733	.1440	3.1767	To	3.7487
Grp 6	11	3.4935	1.4830	.4471	2.4972	To	4.4898
Total	454	3.7031	1.2164	.0571	3.5909	To	3.8153

Group	Minimum	Maximum
Grp 1	1.3863	6.5468
Grp 2	.6931	6.4167
Grp 3	1.3863	6.8405
Grp 4	1.6094	6.2036
Grp 5	.0000	6.1738
Grp 6	.6931	5.2679
Total	.0000	6.8405

- - - - - O N E W A Y - - - - -

Variable HCAFTL
By Variable STORE STORE NUMBER

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.
The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
 $.8544 * \text{Range} * \text{Sqrt}(1/N(I) + 1/N(J))$

No two groups are significantly different at the .050 level

This procedure was completed at 17:40:48

ONEWAY VARIABLES=COBEFL BY STORE (1,6)/RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable COBEFL
By Variable STORE STORE NUMBER

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	.4080	.0816	.8418	.5206
Within Groups	448	43.4263	.0969		
Total	453	43.8343			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	95	1.1591	.3906	.0401	1.0795	To	1.2386
Grp 2	68	1.1285	.3325	.0403	1.0480	To	1.2090
Grp 3	91	1.1228	.3108	.0326	1.0581	To	1.1875
Grp 4	98	1.0846	.2534	.0256	1.0339	To	1.1354
Grp 5	91	1.0799	.2649	.0278	1.0247	To	1.1350
Grp 6	11	1.0973	.2108	.0636	.9557	To	1.2390
Total	454	1.1138	.3111	.0146	1.0851	To	1.1425

Group	Minimum	Maximum
Grp 1	1.0000	3.3151
Grp 2	1.0000	2.9799
Grp 3	1.0000	2.8213
Grp 4	1.0000	2.7893
Grp 5	1.0000	3.3151
Grp 6	1.0000	1.7234
Total	1.0000	3.3151

- - - - - O N E W A Y - - - - -

Variable	COBEFL	
By Variable	STORE	STORE NUMBER

Multiple Range Test

Tukey-HSD Procedure

Ranges for the .050 level -

4.05	4.05	4.05	4.05	4.05
------	------	------	------	------

The ranges above are table ranges.

The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is.. $.2202 * \text{Range} * \text{Sqrt}(1/N(I) + 1/N(J))$

No two groups are significantly different at the .050 level

This procedure was completed at 17:40:52

ONEWAY VARIABLES=COAFTL BY STORE (1,6) /RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable COAFTL
By Variable STORE

STORE NUMBER

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	.4198	.0840	.9094	.4747
Within Groups	448	41.3616	.0923		
Total	453	41.7814			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean	
Grp 1	95	1.1460	.3406	.0349	1.0766 To	1.2153
Grp 2	68	1.1457	.4404	.0534	1.0391 To	1.2523
Grp 3	91	1.1109	.2762	.0290	1.0534 To	1.1684
Grp 4	98	1.0741	.2080	.0210	1.0324 To	1.1158
Grp 5	91	1.0798	.2572	.0270	1.0262 To	1.1334
Grp 6	11	1.0994	.2108	.0635	.9578 To	1.2410
Total	454	1.1090	.3037	.0143	1.0810 To	1.1370

Group	Minimum	Maximum
Grp 1	1.0000	3.3151
Grp 2	1.0000	3.7417
Grp 3	1.0000	2.6058
Grp 4	1.0000	2.8018
Grp 5	1.0000	3.2156
Grp 6	1.0000	1.7234
Total	1.0000	3.7417

- - - - - O N E W A Y - - - - -

Variable COAFTL
By Variable STORE STORE NUMBER

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.
The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
 $.2149 * \text{Range} * \text{Sqrt}(1/N(I) + 1/N(J))$

No two groups are significantly different at the .050 level

This procedure was completed at 17:40:56

ONEWAY VARIABLES=CO2BEFL BY STORE (1,6)/RANGES=TUKEY/STATISTICS=1.

- - - - - O N E W A Y - - - - -

Variable CO2BEFL
By Variable STORE STORE NUMBER

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	.1249	.0250	.8821	.4929
Within Groups	448	12.6835	.0283		
Total	453	12.8084			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean	
Grp 1	95	2.6359	.1660	.0170	2.6021	To 2.6697
Grp 2	68	2.6602	.1768	.0214	2.6174	To 2.7030
Grp 3	91	2.6485	.1729	.0181	2.6125	To 2.6845
Grp 4	98	2.6298	.1694	.0171	2.5958	To 2.6637
Grp 5	91	2.6746	.1583	.0166	2.6416	To 2.7076
Grp 6	11	2.6682	.1642	.0495	2.5579	To 2.7785
Total	454	2.6493	.1682	.0079	2.6338	To 2.6648

Group	Minimum	Maximum
Grp 1	2.1861	2.7973
Grp 2	2.1748	2.8094
Grp 3	1.8245	2.8332
Grp 4	2.2192	2.8034
Grp 5	2.1748	2.7973
Grp 6	2.3418	2.7850
Total	1.8245	2.8332

- - - - - O N E W A Y - - - - -

Variable CO2BEFL
By Variable STORE STORE NUMBER

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.

The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
 $.1190 * \text{Range} * \text{Sqrt}(1/N(I) + 1/N(J))$

No two groups are significantly different at the .050 level

This procedure was completed at 17:41:00

ONEWAY VARIABLES=CO2AFTL BY STORE (1,6)/RANGES=TUKEY/STATISTICS=1.

----- O N E W A Y -----

Variable CO2AFTL
By Variable STORE STORE NUMBER

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	5	.1460	.0292	1.0489	.3883
Within Groups	448	12.4678	.0278		
Total	453	12.6137			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	95	2.6229	.1760	.0181	2.5871	To	2.6588
Grp 2	68	2.6650	.1576	.0191	2.6269	To	2.7032
Grp 3	91	2.6402	.1765	.0185	2.6034	To	2.6769
Grp 4	98	2.6399	.1641	.0166	2.6070	To	2.6728
Grp 5	91	2.6716	.1560	.0164	2.6391	To	2.7041
Grp 6	11	2.6676	.1696	.0511	2.5537	To	2.7815
Total	454	2.6472	.1669	.0078	2.6318	To	2.6626

Group	Minimum	Maximum
Grp 1	2.1633	2.7912
Grp 2	2.2300	2.8214
Grp 3	1.8405	2.7973
Grp 4	2.2083	2.7973
Grp 5	2.1861	2.8214
Grp 6	2.3125	2.7850
Total	1.8405	2.8214

- - - - - O N E W A Y - - - - -

Variable CO2AFTL
By Variable STORE STORE NUMBER

Multiple Range Test

Tukey-HSD Procedure
Ranges for the .050 level -

4.05 4.05 4.05 4.05 4.05

The ranges above are table ranges.
The value actually compared with $\text{Mean}(J) - \text{Mean}(I)$ is..
 $.1180 * \text{Range} * \text{Sqrt}(1/N(I) + 1/N(J))$

No two groups are significantly different at the .050 level

Issue 1A: Use of Emission Credits from Other Programs

No upfront trading of emission credits.

States that are "close" to performance standard after audit may adjust their I/M programs to meet performance standard.

- Adjustments include expanding program by covering greater number of model years, heavier trucks, etc.
- Adjustments could also include:
 - Cash for clunkers
 - remote sensor or other on-road programs
 - tax for {old cars or high emitting cars}
- Performance measured using on-road audits (no role for Mobile 4.1/5.0 in determining compliance)

* No "Trading" allowed using emission credits from:

- alternative fuels
- low emission vehicles
- stationary sources

Preamble
and rule

Issue 1B: Default Credit for a Decentralized "Test and Repair" Program

No default discount upfront if State adopts a back-up "test-only" program.

States may adjust their decentralized "test and repair" program if audit/program evaluation shows they are "close" to the Environmental Protection Agency's (EPA) performance standard.

- Performance measured using on-road audits (no role for Mobile 4.1/5.0 in determining compliance)
- Adjustments may include: expanding program by covering additional model years, adding heavier trucks
- Adjustments may also include:
 - Cash for clunkers
 - remote sensor or other on-road programs
 - tax for clunkers

EPA would retain assumptions of compliance rate of 98 percent/waiver rate of 1 percent in deriving performance standard, but request comment on compliance rate of 95 percent and waiver rate of 5 percent.

* No "trading" allowed using emission credits from:

- alternative fuels
- low emission vehicles
- stationary sources

* EPA would retain the requirement for a mandatory back-up program based on "test-only"

* No agreement on appropriate "discount" rate for "test and repair" program if State fails to adopt a back-up "test-only" program.

*Preamble
and rule*

Issue 2: Regulation of the Auto Repair Sector

- * No agreement on Federal requirement for States to set up (1) comprehensive training and certification programs and (2) monitoring and performance evaluation for auto mechanics performing emission-related repairs.
- * [Under EPA's proposal, repairs performed by anyone other than mechanics certified under these programs would not qualify for a waiver, regardless of the amount spent.]

Issue 3: Certification Short Test

- * No agreement on establishment of in-use recall enforcement of the certification short test.

Affidavit

- * No agreement reached

Inspection and Maintenance

The Environmental Protection Agency's (EPA) draft proposal sets out the requirements for enhanced Inspection and Maintenance (I/M) programs, as required by Section 182 of the 1990 Clean Air Act Amendments (CAAA). The draft proposal would also revise some of the requirements for the basic I/M program. Over a week ago, OIRA provided EPA with a list of concerns (with suggested resolutions). We have resolved some of those concerns and others appear to be amenable to resolution through further technical discussions. Of the issues where we have reached agreement, the most important is an agreement to set out the ARCO test as an alternative to the transient test developed by (I/M 240), provide a discussion of the merits of each test, and present an EPA schedule for further testing of the ARCO approach before promulgation of a final rule. The preamble discussion will also clearly indicate that EPA will consider the ARCO test in setting a performance standard even if further testing suggests some shortfall in the ARCO test vis a vis I/M 240. Although we have reached an agreement in principle on this important aspect of the enhanced I/M program, three important issues remain to be resolved.

Issue 1: Flexibility Under EPA's Performance Standard

In the draft I/M proposal, EPA deliberately seeks to restrict the flexibility available to States in designing their I/M program in order to force States in designing their I/M program in order to

force States to adopt high performance, centralized I/M programs. This position is directly contrary to the Administration's repeated statement that it would seek to encourage the adoption of flexible, emission trading alternatives (where allowed by statute) in an effort to minimize the cost of the Clean Air Act. There are two key elements to this issue: (1A) the use of emission credits from other innovative programs to augment the performance of a State-designed I/M program and (1B) the appropriate discount factors to use to reflect the reduced effectiveness of a decentralized test and repair program.

Issue 1A: Use of Emission Credits from Other Program

EPA's draft proposal would prohibit the use of credits generated in other programs as a way of meeting the performance standard for I/M programs. Instead, States must show that I/M programs submitted as part of State Implementation Plans will meet EPA's I/M performance standard. Further, I/M programs that fail an audit in later years must be modified so that they will meet the performance standards; States that adopt a "test-and-repair" program are required to adopt a back-up "test only" program that would be automatically triggered by any failure of a subsequent audit.

OIRA has suggested that States ought to be able to use emission reduction credits from other programs to offset a shortfall in

the I/M program both upfront as a part of an initial program or as an off-set to make up for a failure (as measured by an audit in subsequent years) in one or more elements of their I/M program. This approach would allow States to use emission credits generated from such programs as: (1) "cash-for-clunkers," (2) remote sensor programs, (3) alternative fuel programs, (4) adoption of California's vehicle standards; and (5) reductions in stationary source emissions.

EPA argues that while it generally supports these innovative programs, they should not be used as a substitute for a stringent I/M program. The essence of EPA's argument is that a stringent, centralized I/M program yields low-cost emission reductions that reduce the need for higher cost controls on stationary sources. EPA believes that States should not be given the option of using low-cost emission reductions from innovative programs like "cash-for-clunkers" as a way of meeting the "low-cost" I/M standard; these credits should be used instead to replace high cost controls on stationary sources. Thus, EPA claims a prohibition on trades using emission credits generated by other programs will reduce the overall cost of implementing the Act. EPA also claims that since the Act requires an I/M standard, this approach would violate the Act since it would allow States to meet the I/M standard through means other than I/M *per se*.

Recommendation: Allow States to use emission credits generated by such innovative programs as "cash-for-clunkers" in meeting EPA's I/M performance standard. The Administration and EPA have repeatedly stated that we would seek to provide flexibility and take advantage of emission trading opportunities in order to minimize the costs of the Clean Air Act. There does not seem to be a good reason to reject this flexibility in setting up the I/M program.

Issue 1B: Discounting a Decentralized "Test and Repair" Program

EPA's draft proposal allows States to establish decentralized "test and repair" programs if States can demonstrate that they will have performance levels "equivalent" to that of a centralized, annual I/M program (where testing facilities are legally and contractually separated from repair facilities). However, EPA would establish default "discount" factors for the effectiveness of decentralized test and repair programs vis a vis centralized I/M programs that are so large that EPA effectively prohibits the adoption of such programs by the States. EPA argues that its review of the data supports discount factors for decentralized test and repair programs ranging from 50 percent to as much as 75 percent.¹

¹For most elements of the I/M program, EPA would set the default value for the discount of 50 percent, but for some elements the default value would be 75 percent. EPA would apply a lower discount for a test and repair program where States are able to show (using existing audit data) that their current test

OIRA's review suggests that EPA discount factors of 50 percent to 75 percent are much larger than can be justified on the basis of currently available data. Indeed, EPA's report evaluating the effectiveness of alternative I/M networks concludes throughout the nation that while it is difficult to quantify the differences between centralized and decentralized systems, "...decentralized programs may be 20 percent to 40 percent less effective than centralized (programs)."² Since the enforcement and management provisions for EPA's draft I/M program appear to be substantially more stringent than the current provisions of any State I/M program, OIRA believes that the discount factor should not exceed 30 percent.

Recommendation: Propose adopting default discount factors in the range of 10 percent to 30 percent for decentralized test and repair programs, and ask for comments.

Issue 2: Regulation of the Auto Repair Sector

EPA's draft proposal would require a comprehensive regulation of the auto repair industry including: (1) a certification and training program for auto mechanics and (2) a monitoring (report

and repair program is achieving a higher level of performance.

²EPA, I/M Network Type: Effects on Emission/Reductions Cost, and Convenience, p.1.

card) system to provide a continuing evaluation of auto mechanic performance.

EPA argues that the regulation of the auto repair industry is necessary in order to obtain the full effectiveness (and benefits) of the I/M program. Without an effective repair program, EPA believes that the I/M program will lose important but unquantifiable emission reductions that EPA otherwise expects to obtain from the program. Further, EPA believes that such regulation is needed to reduce the potential for a "negative" public reaction to the I/M program arising from dissatisfaction and frustration on the part of those motorists who find that their vehicles cannot pass the I/M test even after making costly repairs. EPA staff report that there is widespread support from the auto repair industry (dealers) and States for a Federal regulatory program.

OIRA believes that Federal regulation of the auto repair industry and Federally-mandated certification of auto mechanics represents a completely unnecessary intervention into this sector of commerce. Such an intervention appears to go beyond any direct mandate of the statute. OIRA believes that EPA's program should establish a clear I/M performance standard (with the testing requirements necessary to implement the standard). Market forces will operate to assure that the auto repair industry responds to provide an effective repair program. Under the statute,

motorists must incur repair costs in excess of \$450 before their vehicles are eligible for a waiver. This substantial cost alone will be sufficient to assure "good" performance by the auto repair industry--there is no justification for Federally-mandated licensing of auto mechanics.

Recommendation: Delete the regulatory provisions (and the accompanying preamble language) that would establish Federal regulation of the auto repair industry.

**Issue 3: Enforcement of the Certification Short Test through
EPA's In-Use Recall Program**

Section 206(a)(4)(A) of the Clean Air Act requires that EPA establish, as part of its vehicle certification program, a test "capable of determining whether model year 1994 and later model year light-duty vehicles and light-duty trucks, when properly maintained and used, will pass" I/M tests. This provision was adopted to reduce the number of "false" failures resulting from such extraneous factors as high temperatures and the length of waiting period prior to performing the I/M test.

EPA's draft proposal would require all vehicles to certify by showing that they will pass I/M tests within an envelope of "reasonable worst-case" conditions. However, EPA also proposes that compliance with the certification short test be enforced

through EPA's recall program. Under the proposal, any engine family which is shown to fail I/M tests at any point within the envelope of conditions defined in the rule, is subject to recall by the agency.

OIRA is concerned that using the recall program to enforce this certification test creates broad liability that is likely to lead to both extensive testing and the adoption of unnecessary design safeguards by the manufacturer in order to avoid recall problems. It is also unclear whether this requirement provides any significant benefits warranting the substantial additional costs of this program. Finally, it is not clear that EPA has the legal authority to enforce the certification short test through the recall program.

EPA argues that without the recall provisions it would be required to establish an extensive set of testing requirements to satisfy the statutory provisions for a short test. However, EPA has broad discretion under the statute to define "conditions reasonably likely to be encountered in the conduct of I/M programs" in such a way that unnecessary testing is minimized without resorting to the use of recall provisions.

Recommendation: Delete the regulatory provisions (and the accompanying preamble language) establishing in-use recall enforcement of the certification short test.

CAA / I + m

DRAFT

**Evaluation of Enhanced Inspection Techniques
On State-of-the-Art Automobiles**

*Kenneth L. Boekhaus
Brian K. Sullivan
Charles E. Gang*

ARCO Products Company

April 27, 1992

DRAFT

Executive Summary

The objective of this test program was to evaluate enhanced Inspection/Maintenance (I/M) test alternatives that would be as effective as EPA's proposed IM240, but be much more cost effective.

This test program evaluated the viability of an (I/M) test using enhanced I/M equipment, including a steady state dynamometer.

The results of this program demonstrate that steady state dynamometer testing is as effective in correctly Passing/Failing cars as the IM240 test for both tailpipe emissions and evaporative canister purging. More work is needed to define an enhanced I/M test program utilizing steady state dynamometer testing. The tailpipe tests now used in California BAR90 I/M testing, (idle and 2500 rpm/no load), are not effective with state-of-the-art vehicles.

Testing done at Southwest Research Institute compared two steady state dynamometer tests with the current BAR90 test and EPA's proposed IM240 test. The EPA's Federal Test Procedure (FTP), the test used to certify new vehicle compliance with emission standards, was used as the baseline for all testing.

Tests were conducted on five 1992 model cars certified to California emissions standards. Each car was tested "as received" and again with each of five malfunctions introduced to the vehicle. Malfunctions were designed to be representative of problems experienced in the real world but not detectable by the engine control module. Great care was taken to make the malfunctions realistic. The malfunctions included two levels of oxygen sensor degradation, EGR failure, partial catalyst degradation and slight engine misfire.

For tailpipe emissions, the efficiency of each test in determining pass/fails (defined by the FTP results) were compared. One of the steady state tests was essentially equivalent to the IM240 test in passing/failing cars for each regulated pollutant at two different hurdles--the California certification standards and 150% of the California certification standard. At both hurdles, the steady state test had fewer "false failures" than did the IM240 test.

For these five cars the steady state test was just as effective as the IM240 test for evaluating canister purging. In fact, the 2500 rpm/no load test was effective in testing canister purging for four of the five cars. We believe that a steady state test can be used to test canister purging on all cars.

Two of the five test cars exceeded the California certification standards as received. At the conclusion of the testing these two cars were sent to the factory authorized dealer for repair. The dealership could not find any fault with either car. This clearly demonstrates the need to keep the inspection and repair in balance and integrated. A super high tech test will not benefit air quality unless the repair stations can match the technology of the test.

DRAFT

Conclusions

1. An enhanced IM program utilizing steady state exhaust emission testing is as effective in identifying cars needing repair as is the EPA's proposed IM240 test. Because the cost of the IM240 equipment is four times that of an enhanced I/M test, the enhancement I/M test is far more cost effective.
2. Canister purging can be tested as effectively in an enhanced I/M test as in an IM240 test.
3. The current BAR90 exhaust emissions test conditions of idle and 2500 rpm/no load are not effective in identifying malfunctions in state-of-the-art automobiles.
4. The ASM5015 test condition is effective in identifying malfunctions for HC, CO and NOx and should be included in any enhanced I/M test developed.
5. Further development work is needed to develop one or more other steady state test conditions to supplement the ASM5015 test.
6. The IM240 test correlates better with the FTP test in predicting absolute emissions levels than does the ASM5015 test. With one or more additional steady state test conditions, steady state testing would likely correlate as well as the IM240 test.

Enhanced I/M Program
ARCO Products Company and USEPA
401 M Street, SW -- West Tower
Washington, D.C.
May 6, 1992

- **ARCO's Position on Enhanced I/M Program**
Ed Reilly... Senior VP, Marketing
- **ARCO's Interest in Enhanced I/M Program**
Jim White... Mgr, Environ Legs & Regs
- **Major Enhanced I/M Issues**
Ken Boekhaus... Project Manager
- **ARCO's Enhanced BAR 90 Emissions Testing**
Ken Boekhaus
- **Integration vs Segregation of Inspection & Repair**
Jim White
- **Wrap Up and Further Discussion**
Ed Reilly

Enhanced I/M Program
ARCO Products Company and USEPA
401 M Street, SW -- West Tower
Washington, D.C.
May 6, 1992

**ARCO Position on
Enhanced Vehicle Inspection & Maintenance**

- ARCO supports enhanced I/M programs and maintains that the intent can be attained at much less cost and with much less impact on small I/M related businesses.
- ARCO is very concerned about "high tech" inspections with "low tech" maintenance or repair.
- ARCO thinks that the separation of inspections from repairs would be a major mistake.
- ARCO further observes that near term I/M program enhancements are interim between today's programs and the next generation of on-board diagnostics.

Enhanced I/M Program
ARCO Products Company and USEPA
401 M Street, SW -- West Tower
Washington, D.C.
May 6, 1992

ARCO recommends the following:

- Enhanced I/M program guidelines should specify a realistic inspection and repair technology standard that will detect high and gross emitting vehicles.
- Enhanced I/M guidelines should not mandate segregated inspection and maintenance based on the past performance of older less effective I/M programs.
- The USEPA should specify automotive technician training and require certification.
- The USEPA should provide a clearinghouse for information on the latest technological advances in vehicle systems and emission control systems diagnostics.

Enhanced I/M Program
ARCO Products Company and USEPA
401 M Street, SW -- West Tower
Washington, D.C.
May 6, 1992

ARCO's Interest in Enhanced I/M Program

- Commitment to Cleaner Air... a common cause
- Working for real emission reductions
- ARCO represents major stationary sources
- ARCO SMOGPROS® smog check franchise

Enhanced I/M Program
ARCO Products Company and USEPA
401 M Street, SW -- West Tower
Washington, D.C.
May 6, 1992

ARCO's Interest in Enhanced I/M Program

SMOGPROS® Statistics...

SMOGPROS average 3 licensed technicians

SMOGPROS investments:

- \$60,000 equipment (inspection/repair)
- \$20,000 franchise
- \$10,000 computer system
- \$100,000 to \$400,000 goodwill

New ARCO training facility and "patented" table top & engine diagnostics training program

SMOGPROS has 1% of the CA smog check facilities and is performing 7% of the total smog checks.

California Licensed Smog Check Facilities

Early 1991

<u>Oil Companies ...</u>		<u>Totals</u>
ARCO (SMOGPROS® 112)	224	
BP	45	
Chevron	438	
Exxon	160	
Mobil	138	
Shell	367	
Texaco	108	
Unocal	527	2,007
<u>Independents ...</u>		
Tuneup Masters	105	
Econo Lube n Tune	82	
Quality Tune Up	45	
Firestone Tires	117	
Goodyear Tires	22	
Pep Boys	23	
Others	67	461
<u>Car Dealers ...</u>		1,307
<u>Major Retailers ...</u>		
Sears	49	
Montgomery Ward	19	68
<u>Other I/M Facilities ...</u>		3,751
 Grand Total		 7,594
 Mid-1992 Total (SMOGPROS® 133)		 8,837
		+16%

Arguments for Integrated Inspection and Maintenance

Central Issues

- Vehicle fails inspection, is not repaired, then no emission reduction benefit.
- Integrated I/M facility more likely to afford both the inspection & repair equipment.
- An integrated I/M facility is more likely to comply with the I/M program than "repair only" facilities because of the larger investment in personnel and equipment.
- Integrated I/M facility programs will minimize the time and maximize the convenience factor for consumers.

Arguments for Integrated Inspection and Maintenance

Consumer Issues -- Proper Diagnostics and Repair

- NOx emissions may increase when HC and CO emission repairs are performed. The probability of this happening can only be minimized at integrated I/M facilities.
- Many causes of inspection failures are easily, quickly and cheaply repaired on-the-spot.
- An inspection including a dynamometer may have to reject vehicles for safety reasons. An integrated I/M facility can repair worn components and proceed with the inspection without further inconvenience to the consumer.

Arguments for Integrated Inspection and Maintenance

Personnel and Equipment Utilization

- Integrated I/M facilities are likely to bring more employment stability to I/M programs and avoid undesired job displacement.
- Integrated I/M facilities will better utilize inspectors, automotive technicians, and inspection/repair equipment.
- The larger the investment the more likely the participants are to take a professional approach and follow the requirements and intents of the I/M program.

Arguments for Integrated Inspection and Maintenance

Statistical Bias

- Majority of data used to demonstrate a need for segregated I/M comes from decentralized I/M program audits lacking effective enforcement and/or have minimal inspection station investment.
- There is little centralized after-inspection audit data.
- Under-the-hood visual inspections account for most defaults within the CA I/M program. To compare such default rates with other I/M programs that do not have such inspections and/or do not monitor their effectiveness does an injustice to the more effective CA program.
- With high-tech inspection and low-tech segregated repair, auto technicians may unnecessarily repair/replace everything associated with the failure to assure their customer's vehicle can pass the retest.

Segregated I/M Customer Ping-Pong Effect.

- A. Failed vehicles will have a minimum of...
3 trips
- B. Vehicles rejected for safety reasons ...
3 trips
- C. If repair limit exceeds waiver limit ...
4 trips
- D. If retest fails, minimum of...
5 trips
- E. If referee station deems that proper repair is not made...
6 to 7 trips
- F. If repair of one emission problem causes another ...
Innumerable trips

Segregated I/M Customer Ping-Pong Effect.

A. Failed vehicles will have a minimum of...	3 trips
1. Original inspection test ...	fails...
2. Vehicle goes to separate repair facility ...	repair made ...
3. Retest ...	passes.
B. Vehicle is rejected for safety reasons ...	3 trips
1. Inspection refused (worn tire, hose, and/or belt)...	vehicle rejected...
2. Vehicle goes to separate repair facility ...	repair made ...
3. Original inspection test ...	passes.
C. If repair limit exceeds waiver limit ...	4 trips
1. Original inspection test...	fails...
2. Vehicle goes to separate repair facility ...	repair made up to \$450...
3. Retest ...	fails...
4. Vehicle goes to referee station...	waiver granted.
D. If retest fails, minimum of...	5 trips
1. Original inspection test...	fails...
2. Vehicle goes to separate repair facility ...	repair made ...
3. Retest ...	fails...
4. Vehicle goes to separate repair facility ...	additional repair made ...
5. Retest...	passes.
E. If referee station deems that proper repair is not made...	6 to 7 trips
1. Original inspection test...	fails...
2. Vehicle goes to separate repair facility ...	repair made up to \$450...
3. Retest ...	fails...
4. Referee station determines problem not repaired...	waiver denied...
5. Vehicle goes to separate repair facility ...	identified repair made...
6. Retest ...	passes ... and if not...
7. Vehicle goes to referee station...	waiver granted.
F. If repair of one emission problem causes another to fail...	Innumerable trips
1. Original inspection test...	fails HC or CO...
2. Vehicle goes to separate repair facility ...	repair made...
3. Retest ...	fails NOx...
4. Vehicle goes to separate repair facility ...	additional repair made...
5. Retest...	fails HC or CO...
6. Vehicle goes to separate repair facility ...	additional repair made...
5. Retest...	fails NOx, etc, etc, etc....

EVALUATION OF ENHANCED
INSPECTION TECHNIQUES ON STATE-OF-THE-ART
AUTOMOBILES

Ken Boekhaus
ARCO Products Company
May 6, 1992

I/M ISSUES

- **TEST PROCEDURE**
- **CENTRALIZED VS. DECENTRALIZED**
- **SEPARATION OF INSPECTION AND MAINTENANCE**

TEST OBJECTIVE

To evaluate the viability and cost effectiveness of an enhanced I/M test relative to the proposed I/M 240 test

CONCLUSIONS

- Steady State Dyno Test is Equivalent to IM240 for I/M Testing:
 - Tailpipe Emissions
 - Canister Purging
- ASM5015 is best condition tested for HC, CO & NO_x
- More Development Needed to Define Steady State Dyno Test for Late Model Cars, Especially to Define Additional Test Conditions
- Idle and 2500 rpm Tests Are Not Useful For High Tech Cars

TESTS USED

- FTP
- IM240
- BAR90
 - 2500 rpm/No Load
 - Idle
- Acceleration Simulation Modes
 - ASM5015 (50% of 3.4 mph/sec - 15 mph)
 - ASM2535 (25% of 3.4 mph/sec - 35 mph)
- Canister Purging
 - All Except FTP

TEST CARS

1992 California Certified:

Chevrolet Caprice	5.0L	V-8
Chevrolet Lumina	3.1L	V-6
Nissan Maxima	3.0L	V-6
Toyota Corolla	1.6L	L-4
Toyota Camry	2.2L	L-4

CONDITIONS TESTED

- As Received (Baseline)
- Mild Ignition Misfire
- EGR Malfunction
- Deteriorated Catalyst
- Deteriorated Oxygen Sensor
- Failed Oxygen Sensor

TEST RESULTS

PASS/FAIL EFFICIENCY

@ California 1992 Certification Standard

	<u>HC</u>	<u>CO</u>	<u>NOx</u>
IM240	99% 1 FF	100% 2 FF	98% 5 FF
Steady State (ASM 5015)	99% 2 FF	92% 0 FF	98% 1 FF

FF = False Failure or Error of Commission

TEST RESULTS

PASS/FAIL EFFICIENCY

@ 150% of California 1992 Certification Standard

	<u>HC</u>	<u>CO</u>	<u>NOx</u>
IM240	95% 0 FF	100% 1 FF	91% 2 FF
Steady State (ASM 5015)	97% 2 FF	100% 2 FF	100% 2 FF

FF = False Failure or Error of Commission

TEST RESULTS

CARS FAILED

	<u>FTP</u>	<u>IM240</u>	<u>Steady State (ASM5015)</u>
@ CA. STD.	24	26 0 FF 2 FF	22 2 FP 0 FF
@ 1-1/2 x CA. STD.	20	17 4 FP 1 FF	19 2 FP 1 FF

FF = False Failure or Error of Commission
FP = False Pass or Error of Omission

EQUIPMENT COST ESTIMATE

<u>ITEMS</u>	<u>IM240</u>	<u>ENHANCED I/M TEST</u>
Metering System	\$ 400	\$ 400
Flow Sensor	1,600	1,600
Dynamometer	45,000	17,000
Analyzers	95,000	19,000*
Driver's Aid	<u>3,000</u>	<u>-0-</u>
TOTAL	\$145,000	\$38,000

* BAR 90 Analyzers = \$13,000
NO_x Upgrade = 6,000
\$19,000

CONCLUSIONS

- Steady State Dyno Test is Equivalent to IM240 for I/M Testing:
 - Tailpipe Emissions
 - Canister Purging
- ASM5015 is best condition tested for HC, CO & NO_x
- More Development Needed to Define Steady State Dyno Test for Late Model Cars, Especially to Define Additional Test Conditions
- Idle and 2500 rpm Tests Are Not Useful For High Tech Cars



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 19 1991

OFFICE OF
AIR AND RADIATION

FROM: William G. Rosenberg *Kate Frazee*
Assistant Administrator
for Air and Radiation

TO: Bob Grady
Art Fraas
Jeff Holmstead
Nancy Mitchell
Teresa Gorman

Enclosed for your information is a Public Information Document discussing EPA staff's preliminary thoughts on a regulation that would require certain air pollution sources to install and operate enhanced monitoring and compliance equipment, pursuant to 702(b) of the Clean Air Act. The purpose of this document is to provide the public insights into our early thoughts on implementing these requirements and to provide a catalyst for a productive discussion during a public meeting we will hold this Thursday, August 22, 1991, in Washington (J.W. Marriott beginning at 8:30 A.M). You or any of your staff are welcome to attend the meeting.

AUG-15-1991 17:03 FROM EPA OAR OAQPS SSCD

TO

4757155 P.03

PUBLIC INFORMATION DOCUMENT:

ENHANCED MONITORING AND COMPLIANCE CERTIFICATION

Air Docket Number: A-91-52

U.S. ENVIRONMENTAL PROTECTION AGENCY

AUGUST 1991

August 1991

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August 1991

PUBLIC INFORMATION DOCUMENT:ENHANCED MONITORING AND COMPLIANCE CERTIFICATIONI. Introduction

The U.S. Environmental Protection Agency ("EPA") is in the process of developing regulations for enhanced monitoring and compliance certification ("EM/CC") pursuant to § 702(b) of the Clean Air Act Amendments of 1990. The EPA must promulgate EM/CC rules within two years after enactment of the Amendments (by November 15, 1992). The EPA currently intends to publish proposed rules in February 1992 and promulgate final rules in November 1992. The EPA has established a workgroup, consisting of EPA, State and local officials, to assist in the development of the EM/CC rules.

To obtain the views of the general public on the issues raised by the EM/CC rulemaking, EPA has decided to hold a public meeting to discuss the general regulatory approach the Agency is currently considering. This public information document is being provided to assist members of the public in understanding the general approaches being considered and the issues that must be resolved in developing the EM/CC rules. This document does not reflect a final or official position of EPA.

II. Background and Purpose

Pursuant to § 702(b) of the Clean Air Act Amendments of 1990, EPA must promulgate regulations that will require certain stationary sources of air pollution to install and operate enhanced monitoring systems and to submit compliance certifications. Section 702(b) amends § 114(a) of the Clean Air Act (the "Act") by adding a new subsection (3) that provides, in part, "The Administrator shall in the case of any person which is the owner or operator of a major stationary source, and may, in the case of any other person, require enhanced monitoring and submission of compliance certifications. Compliance certifications shall include (A) identification of the applicable requirement that is the basis of the certification, (B) the method used for determining the compliance status of the source, (C) the compliance status, (D) whether compliance is continuous or intermittent, (E) such other facts as the Administrator may require . . ."

In addition, related provisions under Title V of the Act specify that operating permits must include requirements on monitoring and compliance certification. Section 503(b)(2) states that permitted sources must certify compliance "no less frequently than annually." Section 504(c) requires that each permit must set forth "monitoring, compliance certification and reporting requirements to assure compliance with the permit terms and conditions." Finally, § 504(b) permits the Administrator to promulgate appropriate test methods and monitoring requirements.

To implement these statutory provisions, EPA intends to require each major source to submit an annual compliance certification and, where violations are discovered, quarterly monitoring reports detailing any deviations from applicable requirements of the Act. To ensure that these reports contain accurate and timely information, the rules will also require "enhanced monitoring," as provided in the statute. The EPA intends to adopt criteria for

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enhanced monitoring that will ensure that an affordable, effective self-monitoring system exists at each major source for each affected emissions unit and pollutant. The minimum criteria in the regulation will require that the monitoring system provide a reasonable assurance that every period of noncompliance with the applicable emissions limitation or standard will be identified. To accomplish this result, the monitoring system must provide, where available, a direct measurement of emissions or, if direct measurement is not economically or technologically available, then the most reliable compliance data on the most frequent basis that is reasonable, taking into account the feasibility of the system at a specific unit.

The key structural elements of EPA's current approach to this rulemaking are discussed in greater detail below; it should be noted that the current approach is still a preliminary conceptual position that does not reflect a final EPA position. Following the discussion of the current approach, this document outlines a number of issues on which EPA particularly invites comment.

III. Discussion of the Structural Elements of the Rulemaking

A. Applicability

As currently envisioned, the EM/CC regulations will apply to every major stationary source that is subject to the operating permit requirements under Title V, including all sources defined as "major" under proposed 40 CFR § 70.2(r). These include hazardous air pollutant sources under § 112(a)(1), sources included under § 302(j), and sources defined as "major" under Part D of Title I of the Act. In order to concentrate regulatory efforts on the most significant air quality concerns, EPA currently intends that the regulations apply only to the pollutants for which the source is classified as "major." The rules thus would apply only those emissions units at the source that emit such pollutants.

B. Implementation through Permitting Programs

As discussed in further detail below, EPA plans to allow for a flexible approach in selecting the appropriate enhanced monitoring system at each source. To allow for this flexibility, EPA intends to implement these regulations primarily through the operating permit program under proposed 40 CFR Parts 70 and 71. The regulations will require all operating permit applications for existing sources to include proposed enhanced monitoring systems that satisfy the selection criteria included in these regulations. Where an approvable enhanced monitoring system does not already exist at the time of the application, the application will have to include a proposed compliance plan to design, install, test and begin operating an approvable system as expeditiously as practicable.

If the applicant is a new source, EPA intends to require that a preconstruction permit application cover the selection, design, installation and testing requirements, and that the operating permit application cover the operation and maintenance requirements. The EPA believes that adopting EM/CC requirements in preconstruction permits is appropriate for two reasons. First, the source and Permitting Authority should agree on the enhanced monitoring system prior to construction of the source. Second, including the EM/CC requirements in

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preconstruction permits will allow for conversion to an operating permit administratively, as contemplated by Part 70.

In either case, EPA intends that a Permitting Authority will have to ensure that each operating permit include all necessary and appropriate conditions to comply with EM/CC requirements.

C. Compliance Certifications and Deviation Reports

Under proposed 40 CFR Part 70, each source must submit an annual compliance certification, submit monitoring results at least semiannually, and report deviations promptly. In order to provide further guidance on how a major source must meet those requirements with respect to those emissions limits or standards applicable to a "major" pollutant, EPA intends to specify in these regulations the details of the compliance certification process.

Under proposed Part 70, the owner or operator of a source subject to regulations must certify compliance to the Permitting Authority at least annually with all applicable requirements under the Act. The EM/CC rules will mandate that a major source must base its certification on enhanced monitoring -- but only with respect to the emissions limit or standard applicable to the "major" pollutant being monitored. The EPA anticipates that the EM/CC rules will specify in detail the information to be provided in a compliance certification and will provide a sample form to be used.

In addition, as part of the certification process, the owner or operator must submit quarterly deviation reports based on the results of enhanced monitoring -- but only if there are actual deviations. These reports will be similar to excess emissions reports currently submitted under the NSPS program and would be separated by emissions unit and monitoring system. The EPA considers that these reports would include the following types of information:

- the number and duration of deviations from the standard that are documented by the enhanced monitoring system.
- the reasons for deviations and the corrective/preventive actions taken in response.
- the number and duration of incidents during which the monitoring system was not operating or was producing invalid data and the reasons, corrective action and preventive action taken.
- basic source identification.
- total operating time of the emissions unit during the reporting period.

The term "deviations" is intended to include any excess emissions or any other deviation from a required limit, including measurements below the limit if the limit is a minimum standard -- e.g., a minimum incinerator combustion temperature limit. A deviation could also be a failure to observe a required work practice -- e.g., failure to wet down a surface area, or to repair a leaking seal at a bulk terminal.

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The EPA believes that deviations should be reported regardless of whether they are in violation of the standards. For example, if excess emissions are believed to be exempt under startup, shutdown, maintenance, and malfunction regulations, these deviations would be reported with an indication that the source believes them to be exempt. This is necessary, in part to ensure that the certification of compliance does not omit any period of noncompliance based on an interpretation made solely by the source, and in part to help the agency ensure that proper action was taken to minimize excess emissions. The requirement to report excess emissions that are believed to be exempt is also consistent with EPA's longstanding policy on the reporting of exceedances under 40 CFR § 60.7.

D. Selection Criteria for Enhanced Monitoring Systems

The EPA intends to adopt enhanced monitoring system selection criteria that will ensure that a monitoring method is used that is sufficiently reliable and timely to show whether an affected unit is operating in compliance with the applicable emissions limit or standard. A wide range of monitoring methods are available that can accomplish these goals, including continuous emission monitoring systems ("CEMS's"), continuous process or control system parameter monitoring systems, periodic verification of control system operating conditions using in situ or portable measurement devices; periodic measurement of emissions using reference method techniques; operation and maintenance procedures designed to prevent or identify noncomplying conditions; manual recordkeeping measures; and any combination of these methods.

The selection procedure will be hierarchical in nature, so that the most effective monitoring system for each unit and pollutant is preferred. However, EPA believes that flexibility must be built into the selection procedure to allow for a consideration of the technical and economic feasibility of the monitoring system. To assist Permitting Authorities and to assure that the criteria are applied with general consistency, EPA will publish an enhanced monitoring guideline to support implementation of the EM/CC rules.

The EPA does not intend that the regulations or the guideline will require the use of any specific type of monitoring system, so long as the selected system provides a reasonable assurance that any period of noncompliance with the applicable emissions limit will be identified. In some cases, however, monitoring systems that are already required by another regulation will be deemed to be in compliance with these regulations; for example, SO₂ CEMS for 40 CFR Part 60, Subpart Da electric utility boilers. The pre-approved monitoring requirements will be identified in a section of the rule.

The rule will also include a strong presumption toward the use of an instrumental monitoring system, *i.e.*, either an emissions monitoring system or a process or parameter monitoring system, when an add-on control system is necessary for compliance. However, if no control system is needed, then EPA believes that non-instrumental monitoring will often be the most appropriate enhanced monitoring method. In addition, the regulations will allow for a consideration of the likelihood that there will be no violation based on the margin of compliance during the initial compliance demonstration. If the likelihood is remote or non-existent, a system that collects data less frequently with a larger margin of error might be appropriate.

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The selection criteria will emphasize the use of an existing monitoring system, so long as the existing system collects sufficiently reliable and timely data and provides a reasonable assurance that the compliance certification provides an accurate indication of the compliance status of an affected unit during the reporting period. The EPA anticipates that some upgrading of existing systems, including improved quality assurance procedures, may be required in many circumstances.

E. Use of Monitoring Data to Certify Compliance

As discussed above, a source will have to rely upon the data from an enhanced monitoring system in submitting compliance certifications and deviation reports. Because a source may be using a process or control system parameter monitoring system that does not directly monitor emission levels, the source's operating permit must include, as an independent permit condition, a source-specific operating parameter standard. The EPA intends to define such conditions as "certification conditions." For example, the permit may include a minimum operating temperature for an incinerator, or a required pressure drop range for a baghouse or scrubber.

The EPA realizes that this requirement may result in new conditions on the operation of a source. However, these conditions should not be more restrictive than the underlying emissions limit, and EPA believes that requiring such a condition where the selected monitoring system cannot be used to directly monitor emissions is justified; without such an additional condition, sources would be required to use direct emissions monitoring techniques -- either CEMS's or frequent stack testing -- where such monitoring may not be cost-effective.

Because the monitoring data will be used to certify compliance, the monitoring system must be subject to appropriate performance specifications, calibration requirements and quality assurance procedures. Where an underlying regulation specifies appropriate procedures, EPA intends to allow a source to use such procedures. The enhanced monitoring guideline will include generic requirements that will apply to other situations.

Where a source submits deviation reports or compliance certifications that show that a source failed to remain in compliance over the reporting period, it is EPA's intent that the permitting agency may institute appropriate enforcement action against the source based on such submissions.

IV. Discussion of Issues

A. Applicability

Issue #1: Should the EM/CC rules apply to all sources required to obtain an operating permit under proposed 40 CFR Part 70, or should they apply only to "major" sources?

Discussion: Section 702(b) of the CAAA requires the Administrator to promulgate rules for enhanced monitoring and compliance certification for major stationary sources, but permits the Administrator to apply such rules to other sources as well. The EPA currently

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intends to apply the EM/CC rules to the statutory minimum of major sources. "Major sources" will include all sources defined as "major" under proposed 40 CFR Part 70.

The proposed Part 70 rules apply to some non-major sources, including all sources that (i) are subject to a NSPS or NESHAP standard, (ii) will become subject to a toxic standard under amended § 112, or (iii) are "affected facilities" subject to the new acid rain program. The EPA invites discussion on whether the EM/CC rules should be made to mirror the Part 70 program, with every source required to obtain a permit under Part 70 required to comply with the EM/CC rules. EPA also invites comment on whether sources used for emissions off-sets under Title I of the Act or other minor sources should be covered by the EM/CC rules.

Issue #2: Should the EM/CC requirements apply to all pollutants subject to regulation or only those pollutants for which the source is major?

Discussion: Section 702(b) does not specify which requirements a major source must certify compliance with. As currently envisioned, the EM/CC rules would apply only to the pollutants for which a source is major; thus, limiting the scope of the rule to the most significant pollutants at each given source. In contrast, the proposed Part 70 rules require that a source must certify compliance with all "applicable requirements relevant to the source, including emissions limitations, standards, or work practices." This requirement would include emissions limits that apply to pollutants for which a source is not major. The EPA invites comments on whether the two rules should have a consistent approach on this issue.

Issue #3: Should the rules exempt, or treat specially, small emissions units, even if those units emit a pollutant for which the source is major?

Discussion: Section 702(b) does not specify which emissions units must be covered by the EM/CC rules. As currently envisioned, the EM/CC requirements would apply to all emissions units at a source. However, the rules are intended to allow a Permitting Authority to respond to specific circumstances. For example, a major source with many small fugitive emissions points could be required to implement a fugitive emissions detection program which may require that the source monitor only a representative sample of its total fugitive emissions points during an applicable period. The EM/CC rules could exempt certain small emissions units from monitoring requirements, such as those emitting less than one ton per year, or the rule could exempt such small emissions units only if they comprise a small percent of the overall emissions loading for the regulated pollutant. The EPA invites comment on these or other alternatives.

B. Implementation through Permitting Programs

Issue #1: To what extent are States precluded under existing regulations from using enhanced monitoring data for enforcement of applicable permit conditions, and how should EPA address this problem?

Discussion: Proposed Part 70 requires that a State permit program must demonstrate the ability to issue permits that assure compliance with each applicable requirement under the Act and to incorporate appropriate monitoring and compliance certification requirements into Part 70 permits (see proposed 40 CFR § 70.4(b)(3)(i)-(ii)). If the EM/CC rules will require

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that a compliance certification be enforceable and be based upon monitoring data, there is a potential that some States will not be able to implement all aspects of the EM/CC rules; some States may not be able to use monitoring data for direct enforcement where non-monitoring methods are specified in a regulation as the sole compliance determination method. The EPA can address this problem through making appropriate changes to existing Federal regulations relied upon by States (i.e., 40 CFR Parts 51, 60 and 61) and then request that the States revise their regulations accordingly. Alternatively, EPA could address this issue in approving State permit programs, or could address it through veto of deficient permits. The EPA invites comment both on the extent to which Permitting Authorities will face this issue and on the alternative methods for addressing the issue.

Issue #2: Should the EM/CC rules attempt to prescribe narrowly the discretion of Permitting Authorities in implementing the EM/CC rules?

Discussion: As currently conceived, the EM/CC rules will provide Permitting Authorities with broad discretion to implement these rules. This approach is consistent with Part 70. The EPA believes that variability in States' programs can be handled through guidance issued after the rules are promulgated. The discretion granted to States could, however, create difficulties in assuring that all sources meet a minimum standard. The EPA invites comment on the extent to which such discretion should be prescribed and the appropriate method of doing so.

Issue #3: Should activities that occur "off-permit" under the operational flexibility allowed for under Part 70 be subject to enhanced monitoring and compliance certification?

Discussion: Under Part 70, sources may make operational changes over the period of the permit, and may thus become subject to a new emissions limit or standard not included in the permit until the permit is renewed. Because the rules as currently conceived will require a Permitting Authority to be involved in the monitor selection process, the EM/CC rules are dependent on the permit application and review process and therefore do not apply independently to off-permit activities. EPA invites comment on whether and how the EM/CC rules should be independently applied to such activities.

Issue #4: How should the EM/CC rules apply to sources that have been issued a final operating permit prior to the effective date of the rules?

Discussion: Because of the anticipated November 1992 promulgation date, some permits may be issued prior to the promulgation of the EM/CC rules. The EM/CC rules could be structured so that they would not apply to a source which has received a final operating permit prior to the effective date of the regulations until the renewal of that permit. Alternatively, the EM/CC rules could remain silent on this issue, in which case the Part 70 approach will apply. The proposed Part 70 rules require Permitting Authorities to reopen permits which expire more than three years after a new, applicable rule is promulgated; for other sources, a new rule applies after the permit is renewed. The EPA invites comment on these two approaches.

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C. Compliance Certifications and Deviation Reports

Issue #1: Should the certification cover some requirements that are not included as permit conditions, such as those in an administrative order?

Discussion: In many cases, requirements in a consent order or agreement entered into after a permit is issued will be the most relevant requirements for certification. In such circumstances, the rule could require certification with both the underlying requirement and the requirement superimposed by the administrative order. The EPA invites comment on whether this approach is warranted.

Issue #2: Should reporting formats be prescribed by the rules?

Discussion: As currently envisioned, the EM/CC rules would include a generic reporting format which would be subject to change by a State so long as the format remained substantially similar. The EPA invites comment on this approach and how much supporting documentation should be required as part of the report, whether there should be multiple formats to suit different source categories, and other issues relating to reporting frequency and content.

D. Selection Criteria for Enhanced Monitoring Systems

Issue #1: Should the EM/CC rules require a source to use a temporary enhanced monitoring system when the primary monitoring system is not working?

Discussion: When a monitor is out for an extended period of time, a source must still be able to collect data in order to certify compliance. However, the installation and maintenance of a temporary instrumental monitor, or the establishment of additional work practices or operation and maintenance protocols could impose a significant cost on a source. The rules could require each source to establish a temporary enhanced monitoring system to be used when the permanent system is out of service for an extended period of time. Such a system need not be redundant, but should produce sufficient substitute data to make a reasonable compliance certification. Alternatively, the rule could specify how much data is required (for example, the number of days a month that a CEMS must provide data) without requiring a backup system; a source would be subject to enforcement for failure to meet the data availability requirement. Finally, the rules could require a backup system only where a source has demonstrated a history of non-compliance with the data availability requirements in its permit. The EPA invites comment on these and other possible approaches.

Issue #2: Will the flexibility of the monitor selection process hinder effective EPA oversight during review of permits?

Discussion: The EPA must review all Title V permits to ensure that Permitting Authorities appropriately include all applicable requirements of the Act in a permit. If the EM/CC rules do not prescribe a monitoring method for a particular source category, it may be difficult for EPA to make a finding that an individual permit contains an inappropriate enhanced monitoring system; this issue is especially important for NSPS sources where nationally consistent minimum requirements currently exist. The regulations or the enhanced

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monitoring guideline could include criteria to assist EPA in determining whether to veto a permit for failure to include appropriate monitoring. The EPA invites comment on this issue.

E. Use of Monitoring Data to Certify Compliance

Issue #1: To what extent should the EM/CC rules require that monitored process or control system parameter conditions be correlated with emissions limits?

Where a source is unable to certify compliance with the emissions limit using an approvable enhanced monitoring system, the currently envisioned approach is to require the Permitting Authority to establish an independent permit condition with which the source can certify compliance (e.g., a temperature limit where a source uses a temperature monitor at an incinerator). The EPA invites comment on whether the EM/CC rules should prescribe that Permitting Authorities adhere to defined correlation requirements in establishing such certification conditions.



**National Association
of Manufacturers**

H. RICHARD SEIBERT, Jr.
Vice President

Resources and Environment Department

August 6, 1991

Mr. William Rosenberg
Assistant Administrator
for Air and Radiation
U. S. EPA
Room 937 West Tower
401 M Street, SW
Washington, D. C. 20460

Docket A-90-33

Dear Mr. Rosenberg:

At the July 25th meeting of the Clean Air Act Advisory Group you solicited comments on the role of monitoring in the voluntary reductions, Title III, and Title I areas. Ms. Eileen Claussen, Director of EPA's office of Atmosphere and Indoor Air Programs, gave a presentation on the merits of continuous emission monitoring (CEMs) or scanning to prevent "paper" reductions which "might not actually take place."

In light of Ms. Claussen's solicitation, it is appropriate that this letter be reviewed for a number of rulemakings. Unfortunately, Ms. Claussen's request for comments had not been made prior to the July 9, 1991 close of comment period for permitting even though it would significantly affect the issue of operating permits. The additional CEM requirement would affect the cost of permitting for initial capital expenses and for frequent re-calibration of equipment due to production line changes.

I request that this letter be placed in the Air Docket for the following rule-makings:

- Title V permitting
- Acid Rain
- Title I Preamble
- Title III early reductions

NAM is very disturbed that the U. S. EPA would try to impose a general monitoring or scanning requirement for the purposes of documenting the voluntary reductions, early reductions, Title I, Title III or even Title V requirements. Congress was very clear in Section 504(b) and (c) as to providing the regulated community with a number of reasonable options instead of requiring continuous emissions monitoring.

NAM would assume that these options would include stack testing, periodic testing, or even other methods such as mass balance calculations and best engineering estimates. Further the Administration's view on CEMs was stated clearly in the written communication between EPA Administrator William Reilly and Mr. Michael Boskin.

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First of all, the NAM believes that the agency has seriously underestimated the financial and technical difficulties in requiring continuous emission monitoring or scanning at all emission points for air toxics, VOCs, and criterial pollutants in industrial and commercial facilities. NAM defers to the Edison Electric Institute to determine the appropriate method of calculating or estimating emissions reductions under the Acid Rain or other control programs in the Act for electric utilities.

Current monitoring technology for organic chemicals cannot accurately read overlapping peaks. For the purposes of air toxics monitoring and even VOC monitoring, a company would have to design, install, and maintain expensive monitoring and scanning systems. These systems would have to be re-calibrated to reflect daily or weekly changes in raw materials, flow dynamics, and other production changes. Title VII's enforcement provisions would in turn require that companies routinely inspect and re-calibrate the equipment systems *on each vent* to avoid incorrect readings which might trigger reporting violations.

A number of member companies have commented that NAM's early estimate of CEMs averaging \$25,000-50,000 for capital expenses, plus the cost of operating the equipment, are too low. Upon reflection, we would argue that the costs, at a minimum, would be approximately \$35,000 *per vent* at each facility.

The number of vents potentially covered range from 1-3 for a small facility and between 200 and 400 large, complex manufacturing facility. It would not be uncommon for a large chemical manufacturing facility to have 500-700 emission points averaging \$35,000-50,000 each. These costs do not consider maintenance, manpower, or indirect costs such as health care benefits for the employee needed to operate and inspect the equipment.

To give you a clearer picture of how we determined these estimates:

GC monitor	\$ 1,000
Mass spec	\$ 20,000
Flow meter	\$ 2,000
UV sensor	\$ 1,000
VPC meter	\$ 10,000
Microprocessor	\$ 1,000

Total	\$ 35,000
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These prices are based upon current market prices and we would assume that some of these prices would reduce as the market recognized economies of scale. But it must be pointed out that many scanning and monitoring devices must be designed since there is no off-the-shelf technology for most chemicals. Even fiber optic technology is not expected to be routinely applicable for many years--perhaps more than a decade. While fiber optic technology might be more cost affordable for individual production line or chemical scanning, NAM reminds the EPA that few factories can afford to be electronically wired for fiber optics due to the enormous costs.

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In the pharmaceutical industry it is common for a factory to utilize as many as 100 solvents in a four or five step production process. These chemical compounds may change throughout the chemical process. At these complex chemical plants, although the amount of individual chemicals emitted may only be a few tons, there may be 10,000 vents at a plant. Because of the processing of toxic or hazardous chemicals, OSHA may prevent companies from manifolding or aggregating the emissions in order to avoid explosions or fires.

OSHA's venting requirements coupled with the new Clean Air Act's proposed monitoring requirements, as described by Ms. Claussen at the July 25th Clean Air Act Advisory Group, would cause companies to spend a great deal of capital on new roofing, new venting, and individual monitoring or scanning at each emission point. One complex chemical plant representative told NAM that they would have to spend \$4 million in scanning and monitoring equipment *in addition to* the costs of new air toxic controls under Ms. Claussen's general description.

These extraordinary costs are simply not reasonable and were never considered when the Act was in Congress. EPA constantly reassured industry that CEMs were not to be required during the legislative process. However, Ms. Claussen argued that CEMs were a likely part of any voluntary reduction or early reduction program as well as a part of the Acid Rain emission trading program. Further, Ms. Claussen's comments left a number of Advisory Group members with the impression that CEMs would be necessary for any stationary source engaged in emission trading under Title I or III.

Surely EPA recognizes that the layering of these CEM and scanning requirements on top of these "market force" trading mechanisms would eliminate the value of early reductions or trading for most companies. The additional cost of \$35,000 for each vent monitor would greatly skew the economic value of trading the pollutant or taking a voluntary reductions of toxics.

It is our hope that you will seriously reevaluate your staff's preliminary opinion that CEMs and other scanning devices are of value to you in your regulatory efforts. We stand ready to discuss this issue with you at your earliest convenience. Theresa Pugh, director, environmental quality, may be reached at (202) 637-3175.

Thank you for reviewing these comments on monitoring issues and ask that they be placed in all appropriate Docket materials for review. A copy of Rep. Dingell's April 25, 1991 letter on continuous emissions monitors and detection of air pollution violations is enclosed.

enclosure

Sincerely yours,

A handwritten signature in black ink, appearing to read "Rich Seibert", written in a cursive style.

Richard Seibert

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cc: The Honorable Charles Bowsher
Comptroller General
General Accounting Office

Mr. Troy Hillier
Policy Analyst
Office of Management and Budget

Ms. Eileen Claussen
Director
Office of Atmospheric and
Indoor Air Programs
U.S. EPA

Honorable John Dingell
Chair
House Energy and Commerce Committee

Honorable Thomas Bliley, Jr.
Ranking Member
Oversight and Investigations Subcommittee
House Energy and Commerce Committee

Honorable Norm Lent
Ranking Member
House Energy and Commerce Committee