

# California Inspection and Maintenance Review Committee

## Reply to “EPA Summary Response to the California Review Committee Report on I/M Effectiveness”

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On March 9, 1995, USEPA released a document entitled "EPA Summary Response to the California I/M Review Committee Report on I/M Effectiveness." The USEPA document is a reply to our February 24, 1995, paper entitled, "An Analysis of the USEPA's 50-Percent Discount for Decentralized I/M Programs." USEPA has told us that this document was not officially released by USEPA and should not be considered its official reply to our report. However, the USEPA's document has achieved wide distribution, and the first fax stamp on our copy indicates that the document originated from Mr. Tierney's office (Maryann Daley, whose name appears on the fax stamp is Mr. Tierney's secretary). Therefore, we are replying to the "EPA Summary Response..." here. We will also respond to any other comments on our Report received from USEPA.

The first part of this document is our response to USEPA. All quotes from the "EPA Summary Response..." are in bold. We refer to our February 24 paper as the "Report."

The second part of this document is a copy of USEPA's response to our Report.

**USEPA** EPA is pleased to note that the Review Committee staff has now agreed with EPA that the existing test-and-repair I/M program in California is suffering from a great loss in effectiveness. Oral comments by Review Committee members themselves indicate their agreement also. There is no reason to suppose that other test-and-repair programs are any better than California's.

**Reply** With this opening paragraph, USEPA tries to deflect our attention from scrutiny of USEPA's science, to evaluation of the effectiveness of California's I/M program. These are two separate issues.

The Report was not designed to evaluate the effectiveness of the California's I/M program in isolation. The Report evaluated whether or not the available data lead us to conclude that decentralized I/M programs have been half as effective as centralized I/M programs. Our review of the data indicated that both centralized and decentralized programs have shown little or no effectiveness in reducing on-road emissions of vehicles. This led us to conclude that there is no basis for discounting decentralized I/M programs relative to centralized I/M programs.

USEPA's assertion that California's I/M program is suffering from "a great loss in effectiveness" implies that USEPA believes that other I/M programs (particularly centralized I/M programs) have been effective. However, on-road and ambient measurements of vehicle emissions indicate that I/M programs, whether centralized or decentralized, have had little or no effect on vehicle emissions. Thus, whether a program is centralized or decentralized appears not to be a significant variable in explaining the success or failure of I/M programs.

**USEPA** The point of this Review Committee report is to attack EPA for an alleged lack of "scientific proof" for a conclusion that is in fact no longer disputed. The actual dispute now revolves around whether test-only I/M programs work. The Review Committee has presented no evidence -- only speculation -- that they do not.

**Reply** The point of the Report is to examine the evidence for USEPA's claim that centralized programs reduce on-road vehicle emissions twice as much as decentralized I/M programs. USEPA's assertion that we have presented "speculation," rather than evidence and substantive analysis, is a considerable misrepresentation of the Report's contents. The Report examines the USEPA's 50-percent discount by evaluating a number of sources of data, including audits, tampering surveys, and studies of on-road and ambient emissions.

By charging that our results are based on "speculation" USEPA avoids making a substantive reply to the analysis we have presented.

**USEPA** EPA strongly disagrees with many of the specific findings and with the methodology used in the report. The paper suffers from factual errors, statements likely to create misunderstanding, and assertions that are based on

**meager or selective evidence but treated as “scientifically proven.” In addition, the paper did not report data made available to the Committee by EPA, that contradicts its conclusions. It also presents simplistic analyses which Review Committee staff admit in a disclaimer should be revised to account for factors pointed out by EPA in meetings held over a month ago.**

**Reply** We asked USEPA to provide us with all of the data it had that it believed supported its 50-percent discount. In mid-January USEPA provided us with its audit reports, tampering surveys, and other studies. We used all of the data available to us at the time with no attempt at selectivity. The "factors" USEPA refers to are based on data from Phoenix that the USEPA did not provide to us until 3 weeks after the February 1 I/M Review Committee meeting. It was therefore not possible to include it in the first draft of the report. We have completed our analysis of the Phoenix data and will present it below.

We included a disclaimer at the beginning of the report to indicate that we would evaluate new data submitted by USEPA and would also perform further analyses on USEPA's tampering data that were suggested by USEPA (analyses that USEPA has not itself performed). Preliminary results of this analysis do not alter the findings of our report.

The assertion that our analysis is simplistic is vague, unhelpful, and lacking in the specific detail necessary to permit a substantive response. If USEPA has specific objections to our methodology, we would appreciate having these objections clearly delineated so that we may address them.

The words "scientifically proven" do not appear in the Report.

**USEPA** **When the effect of I/M is isolated from the decline in tampering rates over time, a clear difference emerges between centralized and decentralized programs, with tampering rates in decentralized programs being about twice those in centralized. The report fails to separate out this effect of the nationwide decline in tampering. This is necessary to distinguish whether I/M programs actually reduced pre-existing tampering.**

**Reply** Figure 1 of the Report summarizes the results of USEPA's tampering surveys between 1985 and 1990.<sup>1</sup> The Figure separates out the effects of vehicle technology, vehicle age, vehicle mileage, and I/M program type. The Figure shows that tampering rates have indeed declined over time as USEPA asserts (for example, newer technology vehicles have lower tampering rates than older technology vehicles when fleets with the same mileage are compared). However, as Figure 1 of the Report also shows, contrary to USEPA's assertion, very little difference exists between I/M program types (or no program at all) once the effects of technology, age, and mileage are accounted for.

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<sup>1</sup> USEPA performed tampering surveys in 1991 and 1992 but has not yet analyzed or published the results. Therefore these surveys were not available when USEPA created its 50-percent discount, and were not available to us when we prepared this report.

**USEPA** The report alleges that the fact that centralized I/M areas have lower tampering rates is due to bias in the recruitment of vehicles. This is based on the false assertion that all surveys in test-only areas were done at test stations. The survey documents make it clear that most surveys in test-only programs were done by roadside pullover.

**Reply** USEPA asserts that it performed most of its tampering surveys of centralized I/M programs by roadside pullover. This is incorrect. In tampering surveys of centralized I/M programs conducted between 1985 and 1990 (USEPA has not released reports on its 1991 and 1992 tampering surveys), USEPA conducted 11 of 16 surveys at centralized test lanes. A total of 69 percent of all cars surveyed in centralized I/M programs were recruited at the test lane. A look at USEPA's own tampering survey reports verifies this. We have the reports and would be happy to provide the relevant pages to interested parties.

USEPA's comment above indicates that USEPA might agree that surveying at the test lane introduces bias that tends to reduce the rate of observed tampering, compared to what would be found on the road.

At least four lines of evidence suggest that surveying cars at the test lane produces bias:

- Motorists who refuse a voluntary tampering check on the road drive cars with emissions that are about 2.5 times higher than the cars of motorists who submit to a tampering inspection (ARB, 1994). This suggests that motorists who refuse a voluntary tampering inspection drive cars that are more likely to be tampered than the average car on the road. That fact that these motorists refused the on-road inspection suggests that they might also be unlikely to submit a tampered car for a scheduled inspection.
- Evidence from Arizona's centralized I/M program indicates that motorists prepare their cars to pass the test without making meaningful repairs that would reduce on-road emissions. The Arizona Auditor General (Arizona Auditor General, 1988) surveyed motorists and mechanics and found the following:
  - "Ninety-three percent of all mechanics indicate they have been asked by customers to simply adjust their vehicle to pass the emission test, rather than conduct the appropriate and needed emissions-related maintenance and repairs.  
"Eighty-eight percent say such requests by customers are either very or somewhat commonplace in the industry."
  - "Ninety-four percent of all mechanics also indicate that they have been asked by customers to re-adjust their vehicles after it has passed the emissions test so that it will run better.  
"Seventy-eight percent say such requests by customers are either very or somewhat commonplace in the industry."

- Of motorists surveyed, 26 percent who failed their initial test said they had their car readjusted back to its original state after passing a retest.

The Auditor General concluded, "it is clear from this data that a significant segment of the driving public attempts to circumvent the emissions testing program."

- Refusal rates in USEPA's surveys of centralized programs were 5.1 percent on the road and 1.8 percent at the test lane. Higher refusal rates on the road might mean that tampering rates are higher on the road than at the test lane. The data presented above lend support to this hypothesis.
- In the Report, we cited the fact that measurements of ambient CO show that Minnesota's centralized, annual I/M program has reduced emissions by about 1 percent (Scherrer and Kittelson, 1994). At the same time, centralized test lane emission test results indicate that CO emissions of cars dropped by 47 percent from the first year to the second year of the Minnesota I/M program.<sup>2</sup> Thus, cars are becoming lower emitting on the day of their emissions inspection, but I/M is not making these cars cleaner on the road. As in Arizona, these data suggest that Minnesota motorists might be learning to make their cars clean on the day of the test without performing repairs that would make them lower emitting on the road.

These results indicate that the cars that arrive for testing are apparently lower emitting and less tampered than cars on the road. Because USEPA performed 69 percent of its tampering inspections (for centralized programs) at centralized test lanes, USEPA's tampering surveys are biased towards showing lower tampering rates in centralized I/M programs than might actually be the case on the road.

**USEPA** The report fails to take into account that most centralized programs at the time of the surveys were designed to only conduct tailpipe emission tests and not perform tampering checks. By contrast, most decentralized programs include extensive tampering checks as well as emission checks.

**Reply** USEPA asserts that decentralized I/M programs have been half as effective as centralized I/M programs. However, USEPA's tampering data show that there is little or no difference in tampering rates between centralized and decentralized I/M programs. We must therefore conclude that, whether or not they checked for tampering, centralized programs have not been any better than decentralized programs in deterring tampering.

Nevertheless, we looked at USEPA tampering surveys from 1985 to 1990 to determine whether or not there was any difference in tampering rates between centralized programs that included an anti-tampering inspection, and centralized programs that did not. We have not corrected the data for age or mileage differences between the vehicles sampled in different I/M programs, following USEPA's methodology when it presents its tampering data. Thus, we are making a comparison on USEPA's own terms. The results are shown in Table 1.

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<sup>2</sup> Personal communication with Huel Scherrer, March 16, 1995.

**Table 1**  
**Average Tampering Rates in Centralized I/M Programs (1985 - 1990)**

Centralized I/M Program Type	Average Tampering Rate
I/M only	18.2%
I/M + Anti-Tampering Inspection	17.0%

The data indicate that there is little difference in tampering rates in centralized I/M programs regardless of whether they included a tampering check.

USEPA's 50-percent discount is based on the USEPA's assessment of the historical effectiveness of centralized and decentralized I/M programs, regardless of what features they included. If the tampering rates show little or no difference between centralized and decentralized programs, then we must conclude that centralized programs did not historically do a better job of reducing tampering than decentralized programs.

**USEPA ...decentralized programs clearly have failed to reduce preexisting tampering, while centralized programs have.**

**Reply** As discussed in the Report, and demonstrated in Figure 1 (page 26) of the Report, both centralized and decentralized I/M programs have had a similarly small effect on tampering when compared with regions that have no I/M program. Thus, the USEPA's statement is incorrect.

**Final Comment on Tampering**

We focus on tampering both because USEPA does, and also because tampering is correlated with higher emissions. It is important to remember, however, that the ultimate goal of I/M programs is to reduce on-road emissions. As we show in the Report, on-road and ambient data strongly suggest that both centralized and decentralized I/M programs have had little or no effect on on-road vehicle emissions. Therefore, regardless of the results of the tampering surveys, the fact remains that we observe little or no difference in on-road emissions reductions between centralized and decentralized I/M programs.

**USEPA EPA found only one instance in which EPA staff made a minor error in reporting the data (regarding New Jersey, which EPA agrees was a poorly-run, state-operated centralized program). This error in no way changes the overall conclusions that come from the extensive data.**

**Reply** We acknowledge that USEPA agrees, in USEPA's response to the Report, that its New Jersey audit found a 66-percent improper test rate, and not the 50-percent rate that it originally reported.

**USEPA** **The report alleges that EPA incorrectly reports a 46% improper test rate for New York in its “Quantitative Assessment” document, while USEPA’s audit report on New York cited a 37% rate. Both numbers are correct. New York’s own investigation found a 46% improper test rate, while EPA’s study found a 37% improper test rate. This distinction was clearly made in EPA reports.**

**Reply** USEPA's I/M assessment document (USEPA, 1993a) is at odds with the above comments. On page six, Figure 2, USEPA reports that New York's own audit found a 42 percent improper *overall* test rate (including emission test and tampering inspection). On the first page of the executive summary (third bullet), USEPA reports a 46 percent improper *emission* test rate, but does not state whether the number came from a state or USEPA audit. Since New York's audit found only a 42 percent improper testing rate, the 46 percent number could not have come out of the New York audit. But, USEPA's own audit of New York's I/M program actually found a 37 percent improper *emission* test rate (NY1990). Thus, the 46 percent number also could not be from USEPA's audit. We do not know which number is wrong, but at least one of them is.

**USEPA** **The report alleges that EPA improperly reported Maryland covert audit results. This is untrue. I/M programs were typically audited more than one time, especially when problems were found. Some states made an effort to correct problems found in the audits. Follow-up audits to determine if those efforts were successful were usually performed. That is the case in Maryland, where the initial audit showed some error -- although not intentional fraud -- in one covert audit. Follow-up covert audits showed that all inspections were done correctly. EPA has given all states the benefit of the doubt by reporting the most recent results of audits. For example, EPA reports California covert audit results of 19% improper testing. Data from early years show improper test rates of 80 % in California. If EPA were to take the Committee’s approach of using outdated audit data, then the results for decentralized program would justify a much large [sic] discount.**

**Reply** We analyzed the USEPA's 1991 Maryland audit data (MD1991a, MD1991b, MD1991c). According to USEPA's "Quantitative Assessments" document (USEPA, 1993a in the Report), this is the most recent covert audit of Maryland's centralized I/M program. It is also the only Maryland audit report that USEPA sent to us in response to our request for the audit data USEPA used to develop its 50-percent discount.

According to two USEPA memos that are part of the audit report, USEPA audited ten centralized test stations, five on June 19 and 20, 1991, and five on June 26 and 27, 1991. The audit results are presented in Table 2. We have the audit report and would be happy to share it with anyone who wishes to check our results.

**Table 2**  
**Results of USEPA's 1991 Covert Audit of Maryland's Centralized Program**

<b>Audit Dates</b>	<b># of improper emission tests</b>	<b># of improper catalyst checks</b>	<b># with improper vehicle ID information</b>
June 19, 20	0	0	1
June 26, 27	2	2	3

**USEPA Review Committee Finding**

**USEPA audits include structural biases against decentralized I/M programs by auditing decentralized program more often and thoroughly than centralized.**

**EPA Response**

**This is false. EPA agrees that covert inspections were not done as frequently in centralized programs but this does not equate to bias. There is a very simple, clear-cut explanation for this that the report chose to ignore. Covert audits were primarily designed to evaluate whether inspectors were properly conducting *visual* inspections of emission control devices.**

**Reply**

USEPA suggests that we found the audits to be biased because audits of decentralized programs were more "thorough." This is a vague term that suggests our analysis is based on judgment rather than data. In fact we found the following:

- Missouri decentralized audit: Inspection stations were targeted for covert audits based on expectation of poor performance, and not at random.
- Georgia decentralized audit: Five of ten stations were audited with a car set up with more subtle tampering than USEPA used in audits of centralized I/M programs. In the Georgia audit, the catalytic converter was removed and replaced with something that looked like a catalytic converter. In audits of centralized programs, the catalytic converter was removed and replaced with a straight pipe.
- Kentucky decentralized audit: Inspection stations properly inspected 4.9 times as many emission control components when compared with centralized programs, but received a worse score on the audit than did centralized programs.
- Arizona centralized audit: The same car was used in all nine audits. After a car fails for the first time in Arizona's I/M program, the I/M computer notes that the car failed, and the reason for failure, on future inspections. Thus, inspectors in Arizona's I/M program had the opportunity to know they were inspecting a failing vehicle.

Our conclusions are thus based on substantive analysis of data, and not on judgment or speculation. USEPA does not address the specific findings above in its reply to the Report.

**USEPA Tailpipe emission tests in centralized programs are fully automated and allow for no inspector discretion.**

**Reply** If emission tests were "fully automated," then there would be no need for personnel to run the tests. Even programs that do not include a visual inspection still have human inspectors performing emission tests.

Tailpipe tests in decentralized programs with computerized analyzers are automated to the same extent as in centralized programs. This does not mean that there is no improper emission testing. We note this to point out that USEPA's conclusions do not follow from the premise that emission testing is to some extent automated in many I/M programs.

USEPA's contention that tailpipe emission tests in centralized I/M programs allow no inspector discretion is incorrect. For example, USEPA's 1991 audit report for Maryland's I/M program states (MD1991a), "many inconsistencies were also observed during the pre-conditioning phase..." The Maryland audit also found that inspectors improperly entered vehicle identification information 40 percent of the time.

**USEPA In a centralized program there are other inspectors, station management, and the public all watching what is going on.**

**Reply** This statement is speculative, and invokes wishful thinking. We evaluated the data relating to USEPA's 50-percent discount. The data do not support USEPA's speculation. For example, the Arizona Auditor General (Arizona Auditor General, 1988) found that among the motorists surveyed, 26 percent who failed their initial emission test had their cars readjusted after passing the post-repair retest.

Let us assume that USEPA is correct, and everyone involved in centralized I/M is trying to make the program effective. We are still left with the fact that measurements of vehicle emissions on the road show that I/M programs have achieved little or no emission reductions, regardless of whether they are centralized or decentralized. Thus, any existence of public scrutiny purported by USEPA has not resulted in effective I/M.

**USEPA** EPA developed written audit procedures in cooperation with the state and local air program administrators which included those managing both kinds of programs and the U.S. General Accounting Office.

**Reply** The fact that USEPA developed written audit procedures is not relevant to our analysis. We have analyzed the results of USEPA's audits as they were performed and presented. As we discuss in the Report, regardless of the existence of written audit procedures, the audits were idiosyncratic, both in their implementation and the reporting of their results.

**USEPA Review Committee Finding**

**USEPA does not have data that could be used to prove I/M emission reductions**

**EPA Response**

**EPA presented mass emission data to the Committee that was collected in the test-only I/M program in Arizona and the test-and-repair I/M program in California (the best examples of each network type). The data clearly show that average emission levels in Arizona are substantially lower than average emission levels in California, despite the fact that California has a more stringent I/M program design in addition to tighter new car standards. The Committee staff have not responded to this data in its report or addressed how it can be that Arizona emission rates are so much lower.**

**Reply** Arizona has a tighter carbon monoxide standard than California (3.4 g/mile vs. 7 g/mile). Hydrocarbon standards are the same. California has a tighter nitrogen oxide standard (0.7 g/mile vs. 1.0 g/mile).

The data referred to above were collected by USEPA in 1994, and were therefore not available when USEPA created its 50-percent discount in its I/M Rule (Federal Register, Part VII, November 5, 1992), and thus could not have provided support for the original creation of the 50-percent discount.

USEPA has recently drawn the following conclusions based on IM240 data from the El Monte pilot study in California, and from cars solicited at centralized test lanes in Phoenix:

**Step 1** Cars arriving for their scheduled I/M inspection in Phoenix, Arizona are lower emitting on IM240 than cars solicited by an offer of free repairs in El Monte, California.

**Step 2** This proves that Arizona's centralized I/M program is more effective than California's decentralized I/M program. Therefore, a discount for decentralized I/M programs is appropriate.

We will now evaluate USEPA's analysis.

**Step 1**

Selection of vehicles is biased against California

USEPA collected its Arizona IM240 data by soliciting cars as they arrived at a centralized test lane for their scheduled I/M inspection.

ARB solicited cars in El Monte with a letter to vehicle owners that included a promise of a free Smog Check certificate, and, for failing vehicles, a free repair and free rental car. The letter also stated that the testing process would take three to four hours. The letter also stated that the owner was required to bring in the car, but did not mention any penalties for failure to comply. All solicited vehicles were due for their Smog Check within the next few months after the solicitation.

As we saw above, in Arizona's I/M program, a significant number of motorists prepare to make their cars lower emitting for their emission test without altering their cars' emissions on the road. Thus, USEPA's Arizona IM240 results probably show lower emissions for Arizona cars than would be observed on the road.

On the other hand, the El Monte recruitment method is likely to have encouraged owners of poorly maintained or broken vehicles to bring their cars in, due to the offer of free repairs and a free rental car. Furthermore, motorists who expected to pass their upcoming Smog Check might have been less willing to go through the hassle of bringing in their cars in because fewer benefits were offered for passing cars.

Thus, due to sampling bias USEPA's comparison was biased in favor of showing lower emissions for Arizona, and higher emissions for California than might actually be the case on the road.

#### USEPA Did Not Correct for Differences in Vehicle Mileage

USEPA did not account for differences in vehicle mileage between the California and Arizona fleets. Because USEPA has not provided us with mileage data for the cars in its Phoenix sample, we can not assess to what extent differences in vehicle mileage might have affected the results.

However, there is reason to believe that the Phoenix vehicles may be driven fewer miles on average than vehicles in California. This is because Phoenix has a substantial population of retirees who spend only the winter months in Phoenix.<sup>3</sup> Lower mileage vehicles are, on average lower emitting than higher mileage vehicles.

#### Are Arizona Cars Cleaner than California Cars?

Below we compare Arizona vehicles with both the El Monte vehicles, and a sample of vehicles recruited for IM240 testing in Sacramento. The Sacramento vehicles were recruited by mailing solicitation letters to the vehicle owners. About 50 percent of the solicited owners brought in their vehicles for testing. No repairs were involved, only an IM240 test. Because

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<sup>3</sup> Elizabeth Deakin, Professor of Transportation and Urban Planning, UC Berkeley. Personal communication, March 17, 1995.

the recruitment procedure did not involve inducements of free repairs, and because the testing process took less than half an hour (rather than three to four hours in the El Monte study) we believe the vehicles obtained are less likely to be biased towards having more high emitters than the on-road fleet. In addition, Mr. Philip Lorang of USEPA stated at the February 1 I/M Review Committee meeting that the Sacramento data set would be a better one to compare with the Phoenix data. The Sacramento data set contains about 3000 IM240 test results for vehicles in the 1983 to 1994 model years.

At our request, USEPA sent us their IM240 data from Arizona in late February. The data set contains IM240 test results for about 1200 vehicles from model years 1983 to 1994.<sup>4</sup> Note that when we compare Sacramento with Phoenix, that the selection of cars in Arizona at the test lane still biases the results most probably in favor of Arizona.

The results of the comparison are presented in Figures 5, 6 and 7. Each figure presents the average emissions by model year for the Phoenix, Sacramento and El Monte Cars. Note that the Sacramento and Phoenix fleets have similar CO emissions, the Sacramento fleet has lower NO<sub>x</sub> emissions, and the Phoenix fleet has lower HC emissions. Note also that the El Monte sample has substantially higher HC and CO emissions than either the Sacramento or Phoenix samples.

Table 3 presents the overall average emissions from the two fleets. To correct for the fact that the two fleets have a different model year distribution, we normalized the Sacramento sample to the Phoenix sample's model year distribution. We calculated average emissions for each fleet by weighting the emissions from each model year by the percentage of vehicles in that model year. Thus, we have compared Phoenix and Sacramento based on fleets of equal model year distribution. USEPA did not provide odometer data for the Phoenix cars, so we could not normalize for differences in mileage between the two fleets. Emissions are positively correlated with mileage so differences between the two fleets would affect the results of this comparison.

Column A gives the average emissions for the Sacramento fleet. Column B gives the emissions from the Sacramento fleet that are above the new car certification standards (the California new car standards are CO: 7 g/mile, HC: 0.41 g/mile, NO<sub>x</sub>: 0.7 g/mile, for the vehicles in this study). Columns C and D give the same information for Phoenix (the Phoenix new car standards are (CO: 3.4 g/mile, HC: 0.41 g/mile, NO<sub>x</sub>: 1.0 g/mile, for the vehicles in this study).

Columns E and F present the difference in emissions between the sample fleets from Sacramento and Phoenix. Column E gives the absolute difference, Column F gives the difference only for emissions above the certification

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<sup>4</sup> USEPA's Phoenix data contain also contain 5 vehicles from 1981 and 2 from 1982. Due to the small samples, we did not compare data from these model year, although USEPA does in its analysis.

standard. This corrects for the fact that the new cars standards for CO and NOx are different in Phoenix and Sacramento.

If we do not correct for the emission standards (and USEPA did not when it presented the data), then Phoenix and Sacramento cars are about the same for CO, the Phoenix cars are cleaner for HC and the Sacramento cars are cleaner for NOx. If the emission standards are taken into account, Sacramento is cleaner for CO, Phoenix is cleaner for HC, and the fleets are the same for NOx.

**Table 3**  
**Emissions Comparison: Phoenix and Sacramento fleets**

(all numbers are in units of grams per mile)

	Sacramento		Phoenix		Sacramento - Phoenix	
	Emissions	Emissions Above Cert. Std..	Emissions	Emissions Above Cert. Std.	Difference in Total Emissions	Difference in Emissions Above Cert Std.
<b>HC</b>	0.55	0.14	0.41	0.00	0.14	0.14
<b>CO</b>	7.16	0.16	7.11	3.71	0.05	-3.55
<b>NOx</b>	0.97	0.27	1.24	0.24	-0.27	0.03
	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>

Thus, USEPA is therefore incorrect when it states that Arizona cars are cleaner than California cars. Furthermore, if the cars in Phoenix were solicited out of the context of their scheduled inspection, their emissions would likely have been higher.

If we were to develop a discount based on USEPA's formulation, we would have to discount centralized I/M programs for their effectiveness on NOx, decentralized programs for HC, and there would be no discount for CO. If we include new car standards, we would discount centralized programs for CO, decentralized programs for HC, and there would be no discount for NOx. We do not advocate either of these methods. In fact, as we discuss in the next section, we believe this type of comparison to be irrelevant to the discussion of I/M effectiveness.

**Step 2**

Even though we found USEPA's assertion that Arizona cars are uniformly cleaner than California cars to be incorrect, the larger issue concerns whether such

comparisons are relevant to an assessment of I/M effectiveness. A great many factors could account for differences in the emissions of cars in different regions. For example:

- Studies of driving behavior have shown that drivers in Phoenix put their cars under high loads less often and drive at slower speeds than drivers in California.<sup>5</sup> Thus, cars in Phoenix might not be subjected to as many stresses that could cause deterioration as are cars in Sacramento.
- The populace of the two cities may differ in their vehicle maintenance behavior.
- Phoenix has a substantial population of retirees who spend only part of the year there. This could mean that cars in Phoenix are driven fewer miles per year, on average, than cars in California. Lower mileage cars are lower emitting on average than higher mileage cars.
- In the mid and late 1980s, Arizona was under threat of federal sanctions and citizens lawsuits for not attaining federal health standards. As a result, USEPA maintained a substantial presence in Arizona when compared to other states.<sup>6</sup> Greater USEPA scrutiny could have resulted in Arizona making greater efforts to reduce vehicle pollution than other states.

There may be many other demographic, meteorological or other differences that could affect vehicle emissions. USEPA defines all differences to be due to I/M network type (and that only when the results favor its position). However, a proper scientific analysis requires accounting for more of the factors that could cause differences in the emissions of vehicles. This is a very difficult task.

Another difficulty with the USEPA's comparison is that there is no baseline from which to measure I/M effectiveness. USEPA's methodology does not tell us if Arizona cars were any higher emitting before I/M than after, and likewise for California.

A better way to assess I/M effectiveness is to perform studies that exclude the many variables that differ from city to city. This can be done by looking at ambient CO levels before and after an I/M program is implemented, or looking at different groups of cars in an I/M program that are at different distances in time from their previous inspection, or, finally, by looking cars in an I/M program, and cars in a nearby region that are not in the I/M program. We discuss this issue in more depth later on in this document.

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<sup>5</sup> Ibid.

<sup>6</sup> Ibid.

**USEPA** EPA presented mass emission data to the Committee that was collected in the test-only I/M program in Arizona and the test-and-repair I/M program in California (the best examples of each network type).

**Reply** USEPA claims Arizona is the "best example" of a centralized I/M program. However, according to USEPA's tampering surveys from 1985 through 1990, Arizona had the highest tampering rate of any centralized I/M program in the country, even though Arizona has one of the few centralized I/M programs that includes a multi-component tampering inspection.<sup>7</sup> USEPA's tampering data are displayed in Table 4.

**Table 4**

**Tampering Rates in Arizona's and California's I/M Programs (1985-1990 Average)**

<b>I/M Program</b>	<b>Tampering Rate</b>
Average Arizona	23.3%
Average Centralized	17.7%
Average California	16.6%

**Source:** USEPA Tampering Surveys, 1985 through 1990.

Furthermore, USEPA's I/M assessment document displays a chart (Figure 3, USEPA, 1993a) showing Maryland to have a lower improper test rate than Arizona. On what criteria, then, does USEPA base its claim that Arizona has the best centralized I/M program?

**USEPA** The Committee staff speculate that test-only I/M might not be working for several possible reasons, and then criticize EPA for not having proven that these reasons are absent. EPA believes that given the evidence that does exist, critics of test-only I/M must put forward valid evidence for such negative speculations themselves.

**Reply** The Report does not speculate about whether I/M programs are effective in reducing emissions; it presents data and analysis. The Report also presents data on how motorists avoid meaningful repairs to their vehicles. Both sets of data contradict USEPA's assertions.

- On-road and ambient data show that I/M programs have had little or no effect on emissions. Thus, even if USEPA is correct that testing is performed properly in centralized I/M programs, it has not made a difference in the effectiveness centralized I/M programs. For example, as discussed in the Report, data from Chicago's I/M program successfully fails high emitting vehicles. However, on-

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<sup>7</sup> Arizona's I/M program did not have a tampering inspection when the 1986 survey was conducted, but did have a tampering inspection when the later surveys were conducted.

road emission studies indicate that these vehicles are not being repaired (Stedman, et al., 1991).

Since the data clearly show that I/M programs have not been effective, the next logical step to take is to try to understand why.

- Data collected by the Arizona Auditor General (Arizona Auditor General, 1988) show that motorists and mechanics frequently circumvent the intent of Arizona's I/M program. USEPA contends that Arizona's centralized program has a low improper-test rate. Regardless of whether this is true, motorists have found other ways to avoid I/M.

The Report goes on to suggest other ways that motorists might avoid I/M and criticizes USEPA for focusing on improper testing, but not investigating other methods by which I/M programs might falter.

### **USEPA Review Committee Finding**

**USEPA bases its 50-percent discount, not on measurements of vehicle emissions but on its audits and tampering surveys of I/M programs. In particular, EPA places great weight on its covert audits of improper testing rates in I/M programs.**

#### **EPA Response**

**Both of these statements are wrong.**

**EPA places far greater weight on measurements of vehicle emissions than on tampering and audit data.**

**EPA relies on actual emission measurements for its estimates of the effectiveness of test-only programs and has had large scale evaluation studies in four different test-only I/M states (MD, IN, AZ, IL).**

**Reply** We requested that USEPA provide us with the data that it uses to support its 50-percent discount. USEPA has produced, and provided to us, two I/M assessment documents:

- "I/M Network Type: Effects On Emission Reductions, Cost, and Convenience" (USEPA, 1991a).
- "Quantitative Assessments of Test-Only and Test-and-Repair I/M Programs" (USEPA, 1993a).

These two documents summarize and analyze data from USEPA's tampering surveys, audits, and special studies.

The first of these documents does not include data on vehicle emissions, yet concludes that decentralized I/M programs "...may be 20-40% less effective than centralized." The results of USEPA's audits and tampering surveys make up the majority of the document. The second document is 22 pages long. Twenty pages are taken up by discussion of USEPA's audits and tampering surveys. Two pages

summarize the results of a "special study" in Portland in the late 1970's and another in California in 1992. These two pages are the only place in the two USEPA documents that discuss direct measurements of vehicle emissions with the purpose of determining emission reductions. If USEPA places greater weight on its measurements of vehicle emissions than on audit and tampering data, one must ask USEPA why virtually all of its two I/M policy documents deal only with USEPA's audit and survey data.

The results of USEPA's "large scale evaluation studies" do not appear in either of USEPA's I/M assessment and policy documents (USEPA, 1991a; USEPA, 1993a). We are not aware of publication of the results of these studies elsewhere, nor did USEPA send us the results of these studies when we requested USEPA's data relating to its 50-percent discount.

The following is the first statement on the 50-percent discount in the executive summary of USEPA's I/M assessment document (USEPA, 1993a): *"For the enhanced I/M rulemaking, EPA used data from over 10,000 covert audits to assess the effectiveness of I/M programs. These results, along with the tampering survey data, form the basis for EPA's 50% effectiveness discount for test-and-repair programs."*

The Report cites this quote as well as the following USEPA statements (USEPA, 1993a):

*"The data EPA has used in making decisions about I/M programs comes from several sources, including national tampering surveys, EPA and state audits, and special studies like the one conducted by the California I/M Review Committee and EPA's study of the Portland, Oregon I/M program. These studies gathered quantitative data on the testing of well over 10,000 vehicles in programs across the country."*<sup>8</sup>

*"...EPA found in audits of I/M programs, that emission testing was done objectively in test-only I/M programs...On the other hand, the data shows that inspectors in test-and-repair programs routinely attempted to get failing cars to pass the initial test...These data led EPA to reduce the emission test credits by 50% in MOBILE5a for test-and-repair programs."*

If USEPA has other data that it considered in developing the 50-percent discount, we would be pleased to receive and review it.

**USEPA** **Particularly important data includes the previous California I/M Review Committee's Fourth Report to the Legislature which showed that the test-and-repair program in California was falling far short of its expected goal, despite the fact that it was aggressively enforced by the State.**

**Reply** The previous I/M Review Committee's Fourth Report to the Legislature ("Fourth Report)" found that California's Smog Check program was achieving reductions of

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<sup>8</sup> The Portland study was performed in the late 1970s. The California study was performed in 1991 and 1992.

19.6 percent for HC, 15.7 percent for CO, and 6.7 percent for NOx.<sup>9</sup> If these results are valid, then comparison with the on-road and ambient data cited above and in the Report indicates that California's I/M program has been phenomenally successful, and far more effective than any other I/M program in the United States.

Researchers at the RAND Corporation (Aroesty, 1994) and the Desert Research Institute (Lawson, 1995), have criticized this study on a number of grounds including the following:

- The sample of cars was non-random and not representative of the on-road fleet.
- The study did not duplicate a real-world Smog Check. ARB staffers brought cars to Smog Check shops for repair. Thus, aspects of real-world motorist-mechanic interactions might not have been included.
- The data were processed through a model (CALIMFAC) that is known to underpredict on-road vehicle emissions, and also does not account for human behavior in Smog Check, or vehicle maintenance. Thus, the primary data were even further removed from the real world because the data were processed through the assumptions of the model.

In addition, investigations by the Los Angeles District Attorney's office have found significant levels of fraud in the Smog Check program. For example, in December 1992, the DA raided 25 Smog Check shops that were found to have issued over 90,000 fraudulent certificates. The 1100 car study did not find overtly fraudulent behavior on the part of mechanics.

Most importantly, on-road data in California contradict the results of the 1100 car study. As we discuss in the Report, on-road data show that the vehicle fleet fails Smog Check at similar rates both before and after inspection. This indicates that I/M is having little or no influence on the emissions of on-road vehicles. Since the on-road data represent the "real-world" (i.e., emissions of vehicles encountered at random on the road) the 1100 car study does not appear to have been a valid measure of the effectiveness of California's I/M program.

**USEPA EPA has conducted about 300 covert audits but also places great emphasis on the more than 10,000 covert audits performed by state agencies. These state-conducted audits also show unacceptably high rates of improper testing in test-and-repair I/M programs. No state agency has put forth valid audit or emission test evidence than its test-and-repair programs is working better than 50%.**

**While tampering and audit data are important indicators, EPA agrees that such studies are of limited usefulness.**

**Reply** The two separate statements above appear to contradict each other. The first suggests that audits alone are a valid way to arrive at the 50-percent discount. The second suggests that they are not.

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<sup>9</sup> This study is generally referred to as the "1100 car study."

USEPA's two I/M assessment documents (USEPA, 1991a; USEPA, 1993a) give no sign that USEPA considered its audits and surveys to be of limited usefulness.

We also note that USEPA still has yet to show the public an explicit methodology whereby it goes from data (audits, surveys, emission tests, or whatever) to its 50-percent discount.

When USEPA claims that test-and-repair programs are working no better than 50 percent, we must ask, "50 percent of what?"

**USEPA Combined with hard data on emission reductions from operating I/M programs, however, these data show clearly that test-and-repair programs are much less effective than test-only programs. As discussed in the previous finding, the report ignored actual emission data presented by EPA and the previous California I/M Review Committee's research both of which show the serious defects in test-and-repair systems.**

**Reply** On-road and ambient data presented in the Report show that both centralized and decentralized I/M programs have had little or no effect on on-road vehicle emissions. In the report we reviewed all of the emission data that USEPA had provided to us at the time. The studies we summarize in the Report used three approaches to determining I/M effectiveness:

1. Measure ambient pollution levels before and after an I/M program is implemented. Researchers who have done this in Arizona and Minnesota have found little or no effect due to I/M.
2. Measure emissions of vehicles on the road. Look at the emissions of cars that were recently inspected and cars that are were approaching their next inspection. If I/M is effective, the recently inspected cars should have lower emissions. Studies that have checked for this in California and Chicago have found no difference in vehicle emissions based on time since the last inspection.
3. Measure emissions of vehicles on the road. Compare the emissions from cars that are in the local I/M program and cars from nearby regions that are not in the I/M program. If I/M is effective, the cars from the I/M region should have lower emissions. A study that did this in Arizona found no difference between I/M and non-I/M cars (Stedman, et al., 1994). One study in Colorado found no difference between the hydrocarbon emissions of I/M and non-I/M cars (Ostop and Ryder, 1989). Another study found the same result for carbon monoxide emissions (Radian, 1992), while the first found the I/M cars to be 13 percent lower in emissions than the non-I/M cars. USEPA modeling predicted a 24 percent reduction in CO due to the I/M program.<sup>10</sup>

An advantage of these measurement techniques is that they reduce or eliminate the impact of other variables that could affect vehicle emissions, such as driving behavior, vehicle maintenance behavior, wealth, weather, attitudes towards environmental

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<sup>10</sup> Personal communication by Donald Wolcott, USEPA, to Donald Stedman, University of Denver.

regulations, etc. By removing these other variables, we can be more certain that any variation in emissions that we measure is an effect of the I/M program alone. A further advantage of the studies we cite is that they are much less likely to include selection biases, because cars are measured at random on the road.

In contrast, USEPA's comparison of cars in different cities includes the effect on vehicle emissions of all of the differences between those cities, and not just the effect of I/M. USEPA's technique includes no reference that allows one to determine to what extent differences in measured emissions are due to differences in I/M programs or are instead due to the numerous other possible factors delineated above. Furthermore, USEPA's approach includes selection bias in that cars are solicited as they arrive for their scheduled I/M test. We showed above that cars are likely to be lower emitting at their I/M test than they are on the road.

As we discussed above, the 1100 Car Study cited by USEPA also did not measure the actual effectiveness of California's I/M program. The data and studies USEPA cites do not ask the central question in assessing I/M effectiveness - are cars on the road lower emitting after I/M than they are before I/M. The studies we cite do ask this question, and they find that the answer is in general no.

**USEPA Review Committee Finding**

**USEPA considers only a subset of the variables that affect I/M effectiveness.**

**EPA Response**

**This is wrong, MOBILE5 has inputs for two of the variables that the report cites: compliance and waivers.**

**Reply** The compliance rate is a number that is an input to MOBILE5. It is not based on knowledge of the rate at which people actually comply with an I/M program, but is simply assumed. We have shown above and in the Report that USEPA did not assess compliance rates in I/M programs. For example, the Arizona Auditor General's report found widespread avoidance of meaningful repairs in Arizona's centralized I/M program, yet USEPA still claims that Arizona is the "best example" of a centralized I/M program. The fact that MOBILE has consistently predicted I/M effectiveness levels far in excess of what we can actually measure on the road is testimony to inability of MOBILE to model what actually happens in the I/M process.

**USEPA EPA rules require states to commit to operating levels of these parameters. EPA rules also require states to take pro-active measures to prevent the kind of problems with waivers and compliance cited by the Committee.**

**Reply** The fact that USEPA rules "require," or that states "commit" has little relation to human behavior in the real world. USEPA's focus on what regulations require or what states commit to accentuates the USEPA's persistent failure to address the human behavior issues that may significantly impact I/M effectiveness.

**USEPA** The other factor speculated upon in the report, that “motorists might look for mechanics who can superficially adjust cars to pass the test without fixing defects that might cause high emissions between tests” has also been carefully addressed by EPA. This is one of the major advantages of the IM240 over steady-state tests. While little hard evidence exists on the actual incidence of superficial adjustment, EPA and state I/M program managers agree that it can be and is done to some extent under current testing regimes. Because the IM240 tests the car at every speed between 0 mph and 57 mph, it makes superficial adjustment to pass the test much more difficult.

**Reply** Evidence exists for superficial adjustment in both centralized and decentralized programs. Rather than speculate, we have already presented evidence that motorists in both Arizona's and Minnesota's centralized I/M programs are passing their I/M tests without performing repairs that result in on-road emission reductions (Arizona Auditor General, 1988; personal communication with Huel Scherrer, March 16, 1995).

USEPA's assertion that IM240 can't be beaten is not based on evidence, but on faith. The reason that we have only the anecdotal experiences of mechanics and not systematic studies, is that USEPA did not perform any.

**USEPA** The Committee document cites only the oral (and unverified) opinions of two BAR technicians (neither of whom actually repairs cars for a living) to support its speculation that the IM240 can and will be defeated.

**Reply** The six mechanics in the El Monte study are BAR employees, or employees of referee facilities. They all have years of experience repairing cars, and they performed all the repairs in the study. We asked them in a public, on-the-record, meeting if they thought they could beat the ASM and/or IM240 tests. They stated that they believed they could, and suggested ways to do it. In addition, Joe Beebe, in a talk at the 1994 Mobile Sources Clean Air Conference in Colorado (Beebe, 1994), stated that he had found ways to beat the IM240 test for both NOx and CO failures.

USEPA may be correct that IM240 can't be beaten. However, circumstantial evidence suggests that it might be possible to defeat IM240. The only way to know for sure is to give mechanics the chance to do so in a controlled study. Even if we accept USEPA's paradigm for I/M, if cars can be made to pass the IM240 without meaningful repairs, then the extra expense of using IM240 equipment will have been wasted.

**USEPA Review Committee Finding**

**On-road and ambient measurements of vehicle emissions indicate that both centralized and decentralized I/M programs have performed poorly.**

**EPA Response**

**These studies cannot credibly be used to compare results among programs or program types. All that can be said is that most such studies are not statistically conclusive of any positive or negative statement about I/M.**

**Reply** As demonstrated above and in our Report, this statement more correctly applies to the USEPA's assessments of I/M effectiveness.

Blanket charges such as "not statistically conclusive" are vague. USEPA must back up its assertions with specific analysis.

**USEPA There is no scientific basis for the report's assertion that remote sensing measurements can be used to accurately measure average in-use emission rates.**

**Reply** This is a significant misrepresentation of the conclusions reached in a large body of scientific literature on remote sensing (much of it, unlike USEPA's I/M studies, published in peer-reviewed journals) .

USEPA itself published a study that directly contradicts USEPA's statement above (Glover and Clemmens, 1991).<sup>11</sup> The study states, "a comparison of the overall RSD mass estimates at the bottom of Table 6 with the IM240 mass CO emissions shows reasonably good agreement." Note, furthermore, that this study looked at estimates of absolute mass emissions. The studies we cite that used RSD to compare emissions of cars before and after I/M, and to compare cars in I/M and non-I/M regions looked only at relative differences in emissions (and all measurements were made at the same sites). This is much easier than determining absolute emissions because all of the factors that affect both instrument performance and the cars' performance cancel out in a relative comparison, whereas these factors must all be accounted for in an absolute measurement. Also note that the Glover and Clemmens data were collected in 1990 when remote sensing was still in its infancy. Today remote sensing is more accurate and reliable than it was when Glover and Clemmens performed their study.

**USEPA RSD is unlikely to accurately assess fleet wide in-use emissions because most modes of operation are precluded by RSD siting criteria.**

**Reply** The goal of using on-road RSD is not to acquire RSD measurements of each car at every mode in the IM240 test cycle.

One goal of using on-road RSD is to find cars whose emissions can be reduced by repair. Another goal is to assess whether cars are becoming lower emitting due to I/M. Numerous studies have shown that on-road RSD is effective in both of these tasks.

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<sup>11</sup> Mr. Glover and Mr. Clemmens were USEPA employees at the time the study was performed.

For example, Figure 4 shows the results of a study comparing RSD with IM240 in Michigan. The data set contains 119 post-1980 vehicles that were measured by RSD and also tested on I/M240 at the roadside.<sup>12</sup> As the Figure shows, for HC emissions, using an IM240 cutpoint of 0.8 grams per mile, and "failing" the highest emitting 15 percent on the RSD, RSD captures 65 percent of the excess emissions (i.e., emissions above the IM240 cutpoint) with an error of commission rate of 0.8 percent (1 false failure in 119 vehicles). In addition, if the lowest emitting 25 percent of these vehicles were to be excused from a scheduled inspection based on the RSD readings, only 2.9 of the total excess emissions would be forgone.

Figures C1 and C2 in the Report show that average RSD measurements correlate very well with both average IM240 and average FTP measurements. As we noted above, USEPA itself has noted that RSD "shows reasonably good agreement" with IM240 measurements (Glover and Clemmens, 1991).

Because RSD measures emissions of cars as they drive by at random on the road, RSD samples actual on-road driving behavior. Is USEPA suggesting that laboratory driving cycles are more "real" than the driving modes encountered on the road?

**USEPA** **The graph presented to support the existence of a de facto correlation are unpersuasive because it treats FTP emissions as the known variable rather than the variable to be predicted. While in principle statistical tests can be made of whether differences exist in emissions during RSD-observable modes, the report does not present any formal statistical analysis of this sort.**

**Reply** This comment misrepresents our remote sensing analysis, and also demonstrates a misunderstanding of basic statistical analysis.

We did not treat FTP emissions as the known variable. We performed our regression using RSD emissions to predict FTP emissions (although we did put the RSD result on the vertical axis, which might have created some confusion).

The correlation between FTP and RSD measurements (or any correlation) is not affected by which of two variables is chosen as known or predicted. Consultation of any statistical analysis text will confirm this.<sup>13</sup>

We doubt that professional statisticians would agree with USEPA's contention that regression and correlation analyses (both of which we present in Appendix D of our Report) do not constitute a "formal statistical analysis."

We found a correlation coefficient ( $r$ ) of 0.9997 for the relationship between quintiles of averaged FTP and RSD measurements. This indicates that the average RSD measurements were highly predictive of the average FTP measurements in this experiment. USEPA's contention that we did not present a statistical analysis is contradicted by the fact that we do present a statistical analysis in Appendix D of the

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<sup>12</sup> One-third of the cars were measured once by RSD, one-third were measured twice, 15 percent were measured 3 times, and the remaining 20 percent were measured between 3 and 10 times.

<sup>13</sup> For example, see Kachigan, S. K., Statistical Analysis, Radius Press, New York, 1986.

Report. In Table 5, below, we add the 95 percent confidence intervals and t-statistics for the regression. The large t-statistics, and tight confidence intervals confirm that on average, RSD measurements are highly predictive of FTP measurements.

**Table 5**  
**Regression Statistics for RSD/FTP Quintiles**

Equation:  $FTP = \text{slope} * RSD + \text{intercept}$

	Coefficients	Standard Error	t Statistic	Significance	Lower 95%	Upper 95%
<b>Intercept</b>	-2.57	0.12	-21.56	2.74E-05	-2.95	-2.19
<b>Slope</b>	67.15	1.30	51.67	8.40E-07	63.01	71.29

**USEPA While in principle statistical tests can be made of whether differences exist in emissions during RSD-observable modes...**

**Reply** Because RSD measures vehicles on the road, it can be cited to observe any potential mode of vehicle operation, including modes that are not part of IM240, or FTP.

For example, RSD can measure cars in cold start modes, unlike I/M tests, which measure only warmed up cars. If cars have higher emissions because of problems with the cold start portion of the emission control system, I/M tests won't detect the problem, but RSD might be able to.

**USEPA The report cites a Minnesota study on the impact of I/M on air quality. At the same time, the report ignores another study that does show substantial benefit from test-only I/M.**

**Reply** On March 9, we asked USEPA to inform us as to what study it is referring to. USEPA has not replied as of the date of this writing.

**USEPA Ambient air quality trends are dependent on many variables other than I/M. The report cites studies by others that made no attempt to isolate these variables.**

**Reply** We first note that in this comment USEPA affirms the existence and importance of many variables besides I/M that affect air pollution levels. Nevertheless, when comparing IM240 emissions from cars in Arizona and California USEPA ascribes all differences to whether an I/M program is centralized or decentralized, and ascribes none of the differences to other variables.

The study we cited (Manhard, 1994) looked at trends in ambient ozone and carbon monoxide levels between 1983 and 1992 for regions with centralized and decentralized I/M programs. The results are displayed in Table 6.

**Table 6**

**Average Reduction in Ambient Ozone and Ambient CO between 1983 and 1992 for Non-Attainment Regions Aggregated by Type of I/M Program**

<b>Type of I/M Program</b>	<b>Ambient Ozone Reductions</b>	<b>Ambient CO Reductions</b>
<b>Centralized</b>	-24%	-36%
<b>Decentralized</b>	-23%	-35%

Source: USEPA, 1993c; Manhard, 1994

The data indicate that average reductions in ambient ozone and CO levels from 1983 to 1992 were independent of whether a region had a centralized or decentralized I/M program. We correctly noted in the report that there could be systematic differences between regions with centralized and decentralized I/M programs in terms of socio-economics, climate, culture, etc.

However, USEPA claims that centralized I/M programs have achieved CO reductions on the order of 20 to 30 percent. Eighty to ninety percent of CO emissions come from on-road gasoline powered vehicles. If decentralized I/M programs were half as effective as centralized I/M programs, one would expect ambient CO reductions in regions with decentralized I/M programs to be substantially less than ambient CO reductions in regions with centralized I/M programs. If we:

1. Assume USEPA is correct about its 50-percent discount, and
2. We observe no difference between emission reductions between centralized and decentralized I/M programs,

Then, there must be countervailing systematic differences between regions with centralized I/M programs and regions with decentralized I/M programs that would mask the differential effect of the different network types. However, given that we do not observe individual I/M programs to be effective, it is more logical and parsimonious to conclude that USEPA is wrong about its 50-percent discount, and that whether an I/M program is centralized or decentralized has not made a difference in program effectiveness.

**USEPA** The report chose to dismiss, with no factual basis, a study showing that a difference exists between I/M and non-I/M areas in Colorado.

**Reply** We cite two remote sensing studies in Colorado. Both found that HC emissions of cars in I/M and non-I/M regions are the same. One found the same result for CO. The other found that I/M cars had lower CO emissions. We did not dismiss either of these studies.

USEPA appears to contradict itself. In a comment above, USEPA claimed that remote sensing measurements are invalid. Here USEPA suggests that remote sensing measurements are valid.

Colorado has a decentralized I/M program. Among the on-road and ambient studies summarized in the Report, Colorado is the only IM program studied for which there is evidence that I/M might be causing reductions in the on-road CO emissions of some vehicles.

## References

- ARB, 1994, "On-Road Remote Sensing of CO and HC Emissions in California," Contract No. A032-093, Report prepared by D. H. Stedman et al., University of Denver, February, 1994.
- Arizona Auditor General, 1988, "Performance Audit: Department of Environmental Quality, Vehicle Emissions Inspection and Maintenance Program," Report to the Arizona Legislature, #88-11, December, 1988.
- Aroesty, J., 1994, "Restructuring Smog Check: A Policy Synthesis," RAND Corp. report # DRR-885-CSTC, October, 1994.
- Beebe, J., 1994, Paper presented at the Mobile Sources/Clean Air Conference, Estes Park Colorado, NCVECS, October, 1994.
- CA I/M Review Committee, 1993, "Evaluation of the California Smog Check Program and Recommendations for Program Improvements - Fourth Report to the Legislature," February 16, 1993.
- California I/M Review Committee, 1995, Interview of El Monte Pilot Study repair mechanics, January 4, 1995.
- GA1989, "1988 Georgia Audit Findings," June, 1989
- Glover, E. and W. Clemmens, "Identifying Excess Emitters with a Remote Sensing Device: A Preliminary Analysis," SAE paper 911672, August 5, 1991.
- KY1989, "1989 Northern Kentucky Anti-Tampering Program Audit Report," USEPA Region IV, 1989.
- Lawson, D. R., 1990, "Emissions from In-Use Motor Vehicles in Los Angeles: A Pilot Study of Remote Sensing and the Inspection and Maintenance Program," *J. Air Waste Manage. Assoc.*, 40, 1096-1104, 1990.
- Lawson, D. R., 1993, " 'Passing the Test' - Human Behavior and California's Smog Check Program," *J. Air Waste Manage. Assoc.*, 43, 1567, 1993.
- Lawson, D. R., 1995a, "The Costs of "M" in I/M -- Reflections on Inspection and Maintenance Programs," *J. Air Waste Manage. Assoc.*, in press.
- Manhard, R., 1994, Untitled analysis of USEPA emission trend data. Can be obtained from Mr. Manhard at (303)773-2079.
- MD1991a, "Maryland Covert Audit Results," Memo from Mr. David Sosnowski to Mr. Gene Tierney and Mr. Kelly Bunker, July 5, 1991.
- MD1991b, "Maryland Covert Audit Results," Memo from Mr. Kelly Bunker to Mr. David Sosnowski, July 26, 1991.
- MD1991c, "State of Maryland, Motor Vehicle Emissions Inspection and Maintenance, Draft Audit Report," USEPA Region III, January, 1991.
- MO1993, "1993 Audit Report of the St. Louis, Missouri Inspection/Maintenance Program," USEPA Region VII, 1993.

- NY1990, "National Air Audit System, New York Inspection and Maintenance Program, Final Report," February, 1990.
- Ostop, R. L. and L. T. Ryder, 1989, "Ute Pass Carbon Monoxide Emissions Study," City of Colorado Springs, Department of Utilities, Environmental Services Division, March, 1989.
- Radian, 1992, "Colorado Automobile Inspection and Readjustment Program Performance Audit, Final Report," Prepared for the Colorado State Auditor, June, 1992.
- Scherrer, H. C., and D. B. Kittelson, 1994, "I/M Effectiveness as Directly Measured by Ambient CO Data," SAE Paper #940302. March, 1994.
- Stedman, D. H., G. A. Bishop, J. E. Peterson, P. L. Guenther, I. F. McVey, and S. P. Beaton, 1991, "On-Road Carbon Monoxide and Hydrocarbon Remote Sensing in the Chicago Area," ILENR/RE-AQ-91/14, Report Prepared for the Illinois Department of Energy and Natural Resources, Office of Research and Planning. October, 1991.
- Sunoco, 1994, "Sunoco Emissions Systems Repair Program," Prepared for Paul Durkin, Sun Co., Inc., Philadelphia, PA, 1994.
- USEPA, 1988, "Motor Vehicle Tampering Survey - 1988," Office of Mobile Sources, August, 1988.
- USEPA, 1990b, "Motor Vehicle Tampering Survey - 1989," Office of Mobile Sources, May, 1990.
- USEPA, 1991a, "I/M Network Type: Effects on Emission Reductions, Cost, and Convenience," USEPA-AA-TSS-I/M-89-2, by Mr. Gene Tierney, Office of Air and Radiation, January, 1991.
- USEPA, 1992a, "Inspection/Maintenance Program Requirements; Final Rule," Federal Register, 40 CFR Part 51, November 5, 1992.
- USEPA, 1993a, "Quantitative Assessments of Test-Only and Test-and-Repair I/M Programs," EPA-AA-EPDS-I/M-93-1 Office of Air and Radiation, November, 1993.
- USEPA, 1993b, "Motor Vehicle Tampering Survey - 1990," EPA 420-R-93-001 Office of Air and Radiation, February, 1993.
- USEPA, 1993c, "1992 National Air Quality and Emissions Trends Report," EPA 454/R-93-031.
- Walsh, P. A., D. R. Lawson, and P. Switzer, 1991, "An Analysis of U. S. Roadside Survey Data," Paper presented at the Fourth CRC On-Road Vehicle Emissions Workshop, March 17, 1994.
- Zhang, Y., D. H. Stedman, G. A. Bishop, P. L. Guenther, S. P. Beaton, and J. E. Peterson, 1993, "On-Road Hydrocarbon Remote Sensing in the Denver Area," *Environ. Sci. Technol.*, 27(9), 1885-1891, 1993.
- Zhang, Y., S. P. Beaton, G. A. Bishop, D. H. Stedman, 1994, "Final Report: Tucson Intersection Study of Automobile Emissions," University of Denver, Department of Chemistry, September, 1994.