

On-Board Diagnostics (OBD) Policy Workgroup

**Mobile Source Technical Review Subcommittee
Clean Air Act Advisory Committee**

**Findings and Recommendations
November, 2002**

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I. Charter for the OBD Policy Workgroup

The Charter for the OBD Policy Workgroup was established in December, 2001 in consultation with the Mobile Source Technical Review Subcommittee. The charter is as follows:

A new workgroup under the Mobile Source Technical Review Subcommittee will provide policy advice to the Environmental Protection Agency (EPA) and the States to help facilitate effective implementation of the use of on-board diagnostics in vehicle inspection and maintenance (I/M) programs.

The key goal of this workgroup is to review EPA's I/M and OBD implementation plans, advise EPA on the adequacy of the plans, and assist the Agency in developing additional strategies, where needed, to be responsive to recommendations from the National Academy of Sciences (NAS) report, "Evaluating Vehicle Emissions Inspection and Maintenance Programs." The workgroup is also asked to advise the Agency on addressing other stakeholder issues regarding the use of OBD in I/M programs for 1996 and newer vehicles. These issues include concerns about the potential conflict of interest for manufacturers checking their own vehicles, OBD durability, and changes in failure rates with the phase-in to the use of OBD for newer vehicles, in I/M programs.

Timeline

The OBD policy workgroup is envisioned to be a short-term effort of six months to a year, with the primary goal of providing the Agency with advice regarding actions the Agency can take to help States to successfully make the transition to the use of OBD. This transition has already begun in some States, and is required by January, 2002, with possible phase-in until 2005.

Workgroup Membership

Brock Nicholson, of North Carolina Department of Environment and Natural Resources, and Lori Stewart, of EPA will co-lead this workgroup. The group will include representatives of States and state associations, environmental groups, I/M consultants, automobile manufacturer representatives, automobile repair, and academia representatives.

II. Status of State Incorporation of OBD in Vehicle I/M Programs

OBD represents a completely new I/M paradigm, and thus requires significant new efforts by the States, including software and hardware changes, public education, technician training and other stakeholder outreach. Thirty-two States plus the District of Columbia are now required to incorporate OBD into their I/M programs. Although EPA rules required use of OBD in I/M programs for 1996 and newer vehicles by January, 2002, significant flexibility is provided for States to delay and/or phase-in their OBD testing. States could delay startup for up to 12 months based on just cause, e.g., the

need for additional training, outreach etc. States could also take one test cycle to phase-in the OBD testing by using OBD as a clean-screen in tandem with a tailpipe test (repair would only be required when tailpipe test also shows failure) . Utilization of both options could mean that States with biennial testing frequencies could postpone full OBD implementation until January, 2005 (or until January, 2004 for annual programs).

State efforts to begin to make the transition to full pass/fail OBD testing for 1996 and newer vehicles are well underway. Seven States started OBD testing before January, 2002 (UT, OR, ME, VT, WI, AK, and IN). Their leadership and positive results helped improve confidence in this new technology. Nine other States have begun OBD testing since January, 2002 (AZ, DE, GA, ID, MD, NC, TX, TN, and WA). Of the 17 remaining areas, about half are already using OBD in some form, e.g., phasing it in as a clean screening tool or using it as an advisory for motorists. Fourteen are expected to begin full incorporation of OBD in 2003 (CA, CT, DC, KT, LA, MA, NV, NM, NJ, NY, OH, PA, RI and VA). Illinois and New Hampshire plan to begin in January, 2004, and Missouri in January, 2005.

III. Results from State OBD Programs and OBD Studies

Since the completion of the NAS report in 2001, substantial data has been generated by State OBD programs, and by studies that were not included in the NAS review. Before moving on to recommendations regarding additional analyses and/or data collection, it is important to highlight the relatively large volume of data currently available on OBD use in I/M programs. This includes:

- Average OBD failure rates are similar to tailpipe testing, at final cutpoints for the same model year vehicles, when all three pollutants (HC, NO_x, and CO) are measured by both tests [Oregon and Wisconsin data, Technical Appendix C, page 4 and K, page 7].
- Oregon and Wisconsin data shows an overall failure rate for the OBD fleet of approximately 2.5%, and 1996 and 1997 model year failure rates are 7% and 3.4% respectively [Technical Appendix C, page 4].
- The most frequent causes of OBD failures include oxygen sensors, misfires, exhaust gas recirculation (EGR), and evaporative codes (65%+ of codes from combined Oregon/Wisconsin OBD failure data). EPA high mileage study data agrees with this data showing 70% of OBD failures for the same systems [Technical Appendix J, pages 6-7].
- OBD I/M scan tool (used by an inspector to query a vehicle's OBD system) communications rates of 99% and higher can be expected in operating programs [Ed Gardetto, US EPA, based on Oregon/Wisconsin data].

- Rejection of vehicles for being “not ready” is low (4.8% in MY 1996 and 1.2% in MY 1997) assuming the program uses the recommended guidance [Technical Appendix C, page 4, and K, page 13].
- Average repair costs are about the same for OBD and tailpipe testing at about \$270 [Oregon study]. Average repair costs at high-mileage, or over 100,000 miles, are statistically the same for OBD and tailpipe testing, averaging around \$370 in the EPA High-Mileage Study [Technical Appendix J, page 16].
- Average emissions reductions are statistically the same between OBD-based repairs and tailpipe testing-based repairs [Technical Appendix J, page 9]. This does not include any future emissions reductions resulting from repairs based on early detection of emission control component failures.
- Cumulative emissions reductions are similar between OBD identified repairs and tailpipe identified repairs [Technical Appendix J, page 10].
- Accurate diagnosis and repair – OBD minimizes trips back for second and third inspections [Technical Appendix C, page 4].
- Short inspection times of five to ten minutes [Technical Appendix K, page 8].
- OBD provides unique evaporative emissions benefits [EPA Evaporative 30-car study, Technical Appendix M, page 5].

IV. Review of NAS Report Issues and Recommendations for Additional Analysis

The OBD Policy Workgroup reviewed the most recent information on three areas of concern raised in the July, 2001 NAS report, “Evaluating Vehicle Emissions Inspection and Maintenance Programs.” These are: OBD failure criteria and potentially high failure rates for aging vehicles equipped with OBDII (1996 and newer vehicles); effectiveness of the “pollution prevention” approach of OBD, and; the apparent lack of overlap in vehicles that fail the traditional tailpipe test and vehicles that fail OBD checks. These issues are summarized in the following sections, along with the Workgroup’s conclusions and/or recommendations. For more information, the NAS report can be read in its entirety (or purchased) at the following website:
http://www.nap.edu/catalog/10133.html?onpi_newsdoc071801.

A. OBD Failure Rates for Aging Vehicles

The NAS report noted the following:

“The current specification is that the malfunction indicator light (MIL) will illuminate if a problem is detected that results in or could potentially result in emissions higher than 1.5 times the vehicles emissions certification standard. Studies have shown that if OBDII were used to decide whether vehicles passed or failed an inspection, most OBDII failing vehicles would have emissions less than 1.5 times the standard. Current I/M programs typically have much higher cutpoints than 1.5 times the vehicle’s certification standard. The OBDII failure point might be too stringent for a cost-effective and publicly acceptable I/M program especially for older OBDII vehicles. An alternative approach, such as tailpipe testing, might be needed for those vehicles.”

Regarding the NAS statements on MIL illumination when emissions are below 1.5 times the standards, the Workgroup believes it is important to emphasize that the OBD system is designed to identify malfunctioning emissions control components before emissions standards are exceeded. Thus the scenario described by the NAS in the above statement is not indicative of a problem, but is a description of the design of OBD systems. Studies have shown that OBD systems identify deteriorated or broken components or systems that lead to higher emissions. OBD systems identify repairs needed to prevent further deterioration of broken emission control components. As discussed below, data to date indicates that repair costs and emissions benefits associated with OBD failures are consistent with those of traditional tailpipe tests. In addition, early repairs that result from OBD failures can prevent more costly repairs in the future.

The Workgroup has reviewed data that has been generated since the NAS study. Highlights of new information presented to the workgroup are provided in the following section.

Relevant Data

State I/M Program Data

- In December, 2001, Ed Gardetto (EPA) presented data from 1999 thru 2001, from about 534,000 OBD, I/M tests in Oregon and Wisconsin. The overall failure rate for OBD equipped vehicles was about 2.5 %. The failure rate for the oldest OBDII equipped vehicles, model year (MY) 1996 vehicles, was about 7% (Technical Appendix C, page 4). These overall failure rates are consistent with failure rates expected with the traditional tailpipe test in those states.
- Ted Kotsakis, I/M program administrator for the State of Oregon, also shared data with the workgroup on OBD failure rates at various mileage intervals (Technical Appendix K).
 - The Oregon I/M lane data for December, 2000 to May, 2001 for about 184,000 vehicles shows an OBD failure rate of about 11% for vehicles with over 100,000 miles, about 7% for 76,000 to 100,000 miles, and about

4% for 51,000 to 75,000 miles.

- The Oregon data on diagnostic trouble codes (DTCs) also showed that the predominant failures are of the primary emission control system components.
- Based on combined I/M lane data from Oregon/Wisconsin, approximately 2% of the MIL illuminations for diagnostic trouble codes (DTCs) would be considered "OBD sensor only." This is based on the evaluation of approximately 5,000 MIL illuminations.

EPA High-Mileage Vehicle Testing Data

- Over the last two years, EPA has been conducting a "high-mileage" study of OBD performance on 1996 through 1999 MY vehicles with over 100,000 miles. This is an ongoing study, with 96 vehicles assessed thus far. Latest findings that are relevant to NAS concerns on failure rates include (Technical Appendix J):
 - About 30% of the OBD failures (including evaporative failures) were for vehicles that required an emissions-related repair, but were not yet exceeding emissions standards by 1.5 times the standard. The NAS report cited earlier data from EPA's initial "200-car" study that had shown that this group of vehicles accounted for about 70% of the OBD failures. Thus, as vehicles age, the OBD failures seem more likely to coincide with existing emissions increases versus the need for preventative repairs to prevent future emissions increases. The higher prevalence of "early detections" in the "200-car" study (when OBD-equipped vehicles were newer) also suggests that a greater proportion of these preventative OBD failures are likely to occur when the vehicle is still under warranty.
 - The cost of OBD repairs for these high mileage vehicles is an average of \$370, with no statistical difference between OBD and tailpipe detected repairs. More data are needed to fully determine statistical significance.
 - There was no statistical difference in the average emissions reductions for OBD repairs and LAB240 (I/M 240 test conducted in the laboratory) repairs. More data are needed to fully determine statistical significance.
 - Of the 66 vehicles with no MIL illumination, only two showed high emissions in the laboratory I/M 240 tailpipe test, indicating that OBD did not miss substantial numbers of emissions problems in this study.

Recommendations

As described earlier, the NAS report noted that an alternative I/M approach, “such as tailpipe testing,” might be needed for older OBDII vehicles if OBD-based failure rates become unacceptable. At this time, the data on overall OBD failure rates and on OBD performance in older vehicles indicates that failure rates are consistent with traditional tailpipe testing failure rates. However, since the oldest model year with OBDII systems is 1996, only six years of data are available. The OBD Policy Workgroup understands that this is an issue that States are concerned about as they plan for the future of their tailpipe testing programs. Although the data do not suggest that OBD failure rates will be problematic, more data is needed to determine whether failure rates will increase substantially as OBDII-equipped vehicles continue to age.

The data to date, when comparing OBD failures to traditional tailpipe failure levels at final cutpoints, do not suggest that OBD failure rates will become unacceptable as vehicles age. However, additional assessment is needed as the OBDII vehicles continue to age. The workgroup recommends that:

- EPA expand the high-mileage study to assess at least 100 vehicles per year (about twice the number of vehicles assessed in 2002). This assessment should continue for at least the next five to ten years. The study should look at both chronologically aging vehicles, and newer vehicles as they reach over 100,000 miles.
- EPA and the OBD Technical Workgroup continue to review additional data from EPA’s ongoing high-mileage vehicle studies and from operating state OBD I/M programs.
- EPA share the results of this ongoing assessment with the States annually.

Simultaneous with this additional assessment of aging OBD vehicles, EPA and the OBD Technical Workgroup should also conduct technical assessments that will aid the States in developing contingency plans in the event that it is determined that OBDII failure rates become excessive at some point in the future. As the NAS report noted, tailpipe testing could be one option for an alternative I/M approach for problematic vehicles. But other options may be available to the States, as well. For example, it may be possible to exempt certain DTCs on older vehicles, and only require repair for the most significant trouble codes. EPA and the OBD Technical Workgroup should consider addressing the following questions (and perhaps others identified by the OBD Technical Workgroup) to give the States the information they need to develop contingency plans, should they be necessary:

- How will the new, very low emission standards such as Tier 2, LEV, ULEV, and SULEV standards impact the effectiveness of various I/M testing technologies?

- Would it be feasible for a state to require repair on older OBDII vehicles (e.g. 200,000 miles and greater, or some other designated mileage level), only for certain OBD diagnostic trouble codes (DTCs)? What codes, if any, could be foregone for the older vehicles? What emissions impacts would result from this action?

Considerations for States

It is the Workgroup's understanding that most States that currently operate I/M programs will need to continue tailpipe testing for 1995 and older vehicles for about seven to ten years, until the fleet turns over, and OBD-equipped vehicles become predominant in the fleet. This timeframe will vary from State to State, depending on State Implementation Plans (SIPs), air quality conditions, fleet turnover rates, etc. The workgroup recommends that States continue to follow closely the results of EPA's ongoing high-mileage vehicle study, and EPA's continued analysis of I/M program lane data to monitor the performance of OBD-equipped vehicles as they age, and consider these results in any decisions about the future of tailpipe testing.

B. OBD Failures for Vehicles in Need of Repair but not yet Exceeding Standards

This issue is clearly related to the above discussion of OBD failure rates. In addition to the NAS statements cited in Section A, the NAS report went on to state the following:

“The OBDII system does not actually measure emissions. Because this system does not measure emissions but rather alerts drivers that there is a problem that might result in excess emissions, evaluating the benefits of such a system is not straightforward.....In addition, the objective of OBD is to prevent vehicles from becoming high emitters. It is difficult to quantify the emissions benefits of preventing vehicles from becoming high emitters.”

Again, the Workgroup emphasizes that the use of OBD in vehicle inspection programs represents a new paradigm. Studies have shown that OBD systems identify deteriorated or broken components or systems that lead to higher emissions. The goal is to identify components in need of repair before emission standards are exceeded, instead of the traditional emphasis on detecting and repairing vehicles with excess emissions after the vehicle is polluting over the standard. Additionally, OBD systems identify repairs needed to prevent further deterioration of broken emission control components. The Workgroup believes it is very important to quantify this benefit, as described in the recommendations that follow.

Relevant Data

- NAS concerns on the “preventative” aspects of OBD were partially driven by the results of EPA’s “200-car” study that showed that about 70% of the OBD failures were “clean but broken” vehicles. As described earlier, more recent results, now that OBDII-equipped vehicles have aged several more years, show about 30% of the OBD failures (including evaporative failures) were attributable to vehicles that required an emissions-related repair, but were not yet exceeding the emissions threshold of 1.5 times the standard. As one might expect, it appears that the OBD failures are more immediately attributable to emissions exceedances as vehicles age.
- In EPA’s high-mileage vehicle data to date, there is no statistical difference in the average emissions reductions for OBD repairs and LAB240 (I/M 240 test conducted in the laboratory) repairs. Additional data, through EPA’s high-mileage study or other similar studies, are needed to fully determine whether there is a statistical difference.
- EPA is currently funding an assessment of “lifecycle OBD benefits,” to attempt to quantify the full range of benefits associated with the early detection of malfunctions by OBD systems. Preliminary results are expected in the Winter, 2002.

Recommendations

- The recommendation in Section A to accelerate EPA high-mileage testing will also help to provide additional data to further determine how the “preventative” nature of OBD failures may change as vehicles age.
- EPA and the OBD Technical Workgroup should build upon the preliminary results from the OBD lifecycle assessment currently underway by EPA, and continue to pursue a comprehensive analysis of all of the benefits associated with the early detection of emissions-related problems by OBD systems. This assessment should also include the evaporative emissions benefits of OBD evaporative monitors.
- EPA’s next update of the emissions modeling tool (the “MOBILE” model) should incorporate the latest available data on the full range of benefits of OBD.

C. Lack of Overlap in OBD and Tailpipe Test Failures

The Workgroup developed a separate statement on this issue, for use by State officials in addressing questions on the lack of overlap in vehicles failing OBD tests versus vehicles failing IM240 tailpipe tests. Please see Attachment A for this

statement. However, the attachment does not include recommendations for additional analysis, as described below.

Relevant Data

- The NAS highlighted data from Wisconsin I/M lanes that showed that of 2,823 On-Board Diagnostics (OBD) and IM240 tailpipe test failures (1,479 and 1,344 respectively), only 173 vehicles failed both tests (Technical Appendix A, page 20). Similar results have also been reported in other studies (including Colorado, Illinois and EPA).
- The EPA high-mileage study, using a laboratory IM240, or “LAB240” tailpipe test, shows much greater overlap between OBD detections and tailpipe test results. If one applied the Wisconsin ratios to the vehicles tested in this study, one would expect 27 vehicles to have IM240 failures with no MIL illumination. Only two vehicles fell into this category, when applying a laboratory IM240 test (Technical Appendix J, page 12).
- The Gordon-Darby vehicle testing contractor randomly tested OBD equipped vehicles in the Arizona I/M system using both the IM147 (second hill of the IM240 run three times) and the OBD I/M test. Because only a small portion of the overall fleet fails the OBD test compared to the number that pass the OBD test the two populations were subject to a different rate of random sampling. The passing OBD vehicles were sampled at a rate of 2.6% while the failing OBD vehicles were sampled at a rate of 26%. This allowed for similar sample sizes to be drawn for each group. The analysis then normalizes this random sample to the entire fleet. The study found the following:
 - 91.9% Pass both (12.9% not fully ready)
 - 1.1% Pass OBD and Fail IM147 (0.1% not fully ready)
 - 6.3% Fail OBD and Pass IM147 (2.1% not fully ready)
 - 0.7% Fail both (0.3% not fully ready)

The overall fail rate for the IM147 was 1.8% while OBD failed 7.0% of the fleet. Some observations made in the analysis are that further analysis of the OBD failures is needed to determine the impact of different systems (e.g. evaporative). Also the impact of the vehicles which were not fully ready needed to be analyzed further to determine any impact of this area of the fleet.

- An additional study is currently underway at the Colorado Department of Public Health and Environment (CDPH&E) (Technical Appendix L). When this study is complete, it should provide additional data to assess the “lack of overlap” between IM240 lane results and OBD results.

The Colorado OBD II study was designed to investigate how well OBD identifies the highest emitting vehicles procured from that State's IM240 program. In the course of their research a number of vehicles have been identified which are above the OBD trigger threshold (1.5 x certification) as measured on the Federal Test Procedure. These vehicles should be identified by the OBD II system as in need of repair. However this has not always been the case in this study. The CDPH&E reports that 40% of the vehicles in the study showed high emissions but were not identified by the OBD II system as malfunctioning. Several points of clarification should be made regarding this preliminary result:

- About half of this group were later identified by the OBDII system at some point during the study.
- Some of what Colorado has seen can be attributed to known OBD design problems and are in fact being addressed with the manufacturers.
- The Colorado sample was not representative of the fleet, but was targetted to high emitters, and thus results differ substantially from studies based on more random test groups.

However, there are instances of high emitting vehicles in the Colorado study which are of concern in that they appear to be missed completely by the OBD system. An additional 20 % of vehicles were not ready for OBD II testing.

Vehicles which are misidentified as high emitters by the IM240 tailpipe test contribute to the lack of overlap in tailpipe testing and OBD testing results. The CDPH&E reports that this could be the case in about 15% of the vehicles in this study to date.

Further review of the CDPH&E study, along with the results of other studies, is needed by the OBD Technical Workgroup to determine how the results of this study should be interpreted and applied to the vehicle fleet as a whole. Recommendations on this issue are discussed further in the following section of this report.

Recommendations

- As described in Attachment A, there are many reasons for the lack of overlap between vehicles that fail OBD tests versus IM 240 tailpipe tests, and the Workgroup believes a significant portion of the “lack of overlap” can be explained. Nonetheless, it would be helpful if the OBD Technical Workgroup could identify, more quantitatively, what portion of this “lack of overlap” should be of concern once all of the explanatory factors are taken into account. For example, as the California Air Resources Board (CARB) adopts additional requirements for OBD systems, such as the NOx catalyst monitor, will we see

more overlap in OBD and tailpipe testing failures (since current OBD systems are HC driven with regard to catalyst detection)?

- Once the CDPH&E study is complete, the OBD Technical Workgroup should review the results of this study as compared to the EPA high-mileage study. The goal should be to determine “lessons learned” and identify key questions that still merit further assessment. Emphasis should be placed on making OBD testing as effective as possible. High-emitting vehicles, as verified through the Federal Test Procedure (FTP), not identified by OBD should be investigated to improve OBD effectiveness. Therefore it is the recommendation of this workgroup that EPA develop an on-going evaluation program designed to focus on the high-emitting vehicles missed by OBD. Although these vehicles could be identified initially through State I/M tailpipe programs, their emissions levels should be verified through FTP testing. The information from any vehicles which are identified as not having adequate OBD system performance should be shared with the manufacturer, States, and CARB so that continuous improvements can be made in this important air pollution strategy.
- A substantial new source of data on OBD performance will be available in the near future. Beginning in 2004, “CAP 2000” institutes an in-use testing program called the In-Use Verification Program (IUVP). The IUVP requires manufacturers to test customer owned and operated vehicles. One year-old and 5 year-old vehicles (minimum 50,000 miles) are tested. EPA will start receiving test data in the 2005 calendar year on 2001 MY high (50,000+) and 2004 low-mileage (10,000+) vehicles. This will be an invaluable data source, in that it will provide about 2000 FTP emissions data points per year, with OBD information that includes:
 - MIL Illumination (on or off)
 - Diagnostic Trouble Codes (DTCs)
 - “Not Ready” codes

EPA will also conduct confirmatory in-use tests on about 150 vehicles per year to verify the results of the manufacturer in-use testing. EPA (and perhaps the OBD Technical Workgroup) should thoroughly review the IUVP data each year to assess the performance of OBD systems on an ongoing basis. This data provides laboratory-quality emissions tests to help to monitor whether OBD MILs are illuminating when emissions are being exceeded. In addition, this data will help to identify problematic vehicles for recall purposes.

V. Review of and Recommendations on Stakeholder Concerns

As described in the Workgroup charter at the beginning of this report, the OBD Policy Workgroup was also charged with addressing two stakeholder issues associated with OBD. One issue raised by States and environmental groups is the potential conflict of interest for dealerships and automobile manufacturers. The second issue is vehicle warranty periods and OBD durability.

A. Conflict of Interest Issue

The perception exists that the use of OBD as an inspection and maintenance tool, where automobile dealerships conduct vehicle inspections, could result in a conflict of interest for both dealerships and automobile manufacturers. This concern was characterized as having three components, as described below. The Workgroup reviewed state and federal measures that are already in place to address these perceived areas of conflict, as well as additional preventative measures that could be employed by EPA and the States, also described in this section.

Dealership Inspection Concerns: A concern has been expressed with dealerships performing I/M inspections in decentralized programs. The concern is that dealerships may have incentive not to properly test and fail their own brand of vehicles to minimize manufacturer's warranty expenses. Another element of the concern is that dealerships may have an easier time than others in performing fraudulent testing known as clean-piping (or "clean-scanning" in terms of OBD).

No evidence was presented to support or refute either element of this concern. However, auto manufacturers and several other workgroup members provided the following reasons why such concerns may be unwarranted; 1) nearly all car dealers are independent businesses not controlled by auto manufacturers, 2) dealers, like independent shops, profit from vehicle repairs, and have an incentive to perform the repair, and 3) collusion between an auto dealership and a manufacturer to manipulate the inspection process could result in enforcement action, including severe financial and possible criminal penalties.

The Workgroup believes that it is important to closely monitor I/M program areas on an ongoing basis to ensure fraudulent activity is not taking place. More specific recommendations are described later in this report.

Potential for Insufficient Warranty/Defect Reporting: Vehicle manufacturers are currently required to report emission defect data to EPA and emission warranty data to CARB, and EPA and CARB can and do take investigative and enforcement action based on this data. A concern has been raised that OBD may more precisely identify the specific component that has malfunctioned which may make it easier for EPA and

CARB to identify specific problems. This could create incentive to under-report or avoid the repairs associated with OBD failures.

On the other hand, warranty data reported to CARB is based on the part numbers of the component(s) replaced under warranty, regardless of whether OBD detected the malfunction or which fault code (if any) the OBD system stored. Some workgroup members maintain that the presence of the OBD system does not provide additional incentive to submit fraudulent warranty data nor does it increase or affect the data reported by the vehicle manufacturers to CARB. It should also be noted that failure to accurately report warranty or defect data to CARB/EPA subjects the manufacturer and its employees to damages (civil and punitive) and a damaged reputation in the marketplace.

OBD System Design and Warranty Periods: Vehicle manufacturers are required to design and build an OBD system that warns vehicle owners when an emission control component malfunctions. However, vehicle manufacturers are also required to have emission control system warranties that will cover the cost of repair for anything detected by the OBD system during the warranty period (minimum of 2 years/24,000 miles Federal or 3 years/50,000 miles California). Thus, a concern has been raised that vehicle manufacturers may have incentive to design the OBD system to not properly detect all required malfunctions to avoid warranty costs.

Conversely, while vehicle manufacturers may have incentive to minimize detection of malfunctions by the OBD system during the warranty period, manufacturers' liability after the warranty period is minimal. After the warranty period, a concern has been raised that vehicle manufacturers may have financial incentive to design systems that are overly sensitive or detect malfunctions even earlier than necessary to maximize the number of replacement parts they sell.

Some workgroup members believe there are adequate safeguards against this type of behavior on the part of manufacturers. To build "over-sensitive" or "under-sensitive" systems, vehicle manufacturers would need to design systems in violation of the OBD II requirements and falsify certification documentation. OBD systems "shall be designed to operate for the actual life of the vehicle...and may not be programmed or otherwise designed to deactivate [turn-off, shutdown, desensitize, or otherwise make inoperable] based on age and/or mileage of the vehicle"(section (d)(1.3) of Title 13, CCR section 1968.2). Further, any manufacturer that designed a system to be overly sensitive after the warranty period risks considerable reduced sales market share due to reduced durability/increased incidence of problems as measured by J.D. Powers, Consumer Reports, Internet sites, etc.

Preventative Measures Currently In Place

Dealership Inspections

- EPA regulations define as tampering, among other things, any action taken to clear the DTC's or MIL illumination without doing the prescribed maintenance (40CFR 86.094-25(b)(6)(iii)). The Clean Air Act established penalties of up to \$25,000/vehicle (plus inflation) for manufacturers or dealerships, and up to \$2,500 /vehicle (plus inflation) for individuals for tampering.
- State franchise and other state and Federal laws help to protect dealerships from undue influence by vehicle manufacturers. Dealerships are also constrained by other potential legal sanctions such as the tampering penalties described above, losing the ability to conduct I/M inspections, and losing the dealership license.
- Individual State/contractor actions vary by location but often include several types of quality assurance and/or inspection fraud safeguards such as:
 - Undercover/sting "audit" vehicles inspected at various inspection facilities including dealerships.
 - Data analysis to compare pass/fail rates at individual inspection facilities to average pass/fail rates.
- CARB is adding a vehicle identification number (VIN) requirement to OBD system as of model year 2005 (all manufacturers currently certify to CARB requirements). This will make vehicle switching for clean-scanning during inspections much more difficult.

Warranty/Defect Reporting

- EPA/CARB use sources beyond defect reports to identify problems, including OBD I/M lane data, technical service bulletins, warranty data, consumer complaints, random in-use testing, internet bulletin boards (e.g., i-ATN), whistleblowers, and technician complaints/alerts.
- Analysis of OBD based I/M data is being used by EPA to identify pattern component failures or discrepancies with defect reporting (OBD I/M records contain specific fault codes identifying specific components and failure modes).
- In 2001, there were about 961 thousand vehicles recalled. 74% of the vehicles recalled were directly related to successful OBD operation in the field. 23% were non-OBD related recalls. 3% were software problems discovered and corrected by the manufacturer.
- Reporting violations are enforced by EPA and penalties to manufacturers can be significant.

- EPA can (and has) audit a manufacturer's warranty records when a defect report indicates a possible emission failure. This can lead to a recall.
- CARB routinely performs unannounced inspections and audits of dealership warranty records and compares the records to the manufacturer's reported warranty rates.

OBD System Design and Warranty Periods

During Warranty Period

- CARB's certification process includes an extensive evaluation of the OBD monitoring system design.
- CARB confirms manufacturer submitted durability demonstration vehicle (DDV) testing results on 3 – 10 vehicles/year and these tests could be conducted on low (during warranty) or high mileage (100,000+ miles) vehicles.
- CARB staff conduct in-use testing for OBD performance on 20-30 random/targeted in-use vehicles/year that are generally less than two years old.
- EPA reviews CARB certification data. EPA/CARB enforcement action against manufacturers has been and can be severe. If a manufacturer is found to have a "misbuild", such as an "under-sensitive" OBD system, then EPA/ARB will take action. Past enforcement cases have been a result of the failure of the OBD system to detect malfunctions at the proper level and have resulted in penalties and remedial actions.
- Newly adopted CARB requirements for the 2004 model year require each manufacturer to perform production vehicle evaluation (PVE) testing on 2-6 vehicles/year. Manufacturers must test every individual diagnostic (about 150 per car) on the vehicle by implanting malfunctions and verifying proper detection within the first 6 months of production.

After Warranty Period

- The CARB certification process also requires OBD DDV compliance testing at 100,000 miles on 1-3 vehicles/year per manufacturer (about 40 total per year) ensuring MIL illumination at 1.5 times the FTP standard for catalyst, misfire, EGR, fuel system, oxygen sensor, and secondary air.
- CARB confirms manufacturer submitted DDV testing results on 3 – 10 vehicles/year and these tests can be conducted on low (during warranty) or high mileage (100,000+ miles) vehicles.

- CARB conducts in-use emission and OBD testing of 40-120 vehicles/year (20-40 models per year with 2-5 vehicles per model tested) to assess the durability of emission control designs.
 - Tests vehicles at 40,000/100,000 miles
 - High emissions or noncompliant OBD systems result in recalls
 - Thus far, 73 manufacturer recalls based on in-use FTP testing since 1983.
- EPA is conducting on-going high mileage vehicle study to continue to monitor OBD performance at 100,000 miles and higher.
- An “over-sensitive” OBD system could be a “misbuild” and can result in EPA enforcement action. EPA’s in-use compliance program is likely to find an “over-sensitive” OBD system. EPA tests about 50 different classes of vehicles and 150 vehicles annually.
- Starting with the 2004 model year, manufacturers are required to conduct in-use testing of approximately 2000 tests per year (see discussion on page 9).
- Defect reports are required by regulation to be provided by manufacturers. Technical Service Bulletins are also provided by manufacturers.
- EPA reviews independent service facilities letters, email, and calls concerning warranty, performance, fuel economy, and emission problems.
- J.D. Powers, Consumer Reports, and other sources track and rate “reliability” and “durability” of vehicles. Manufacturers producing over-sensitive OBD systems would risk substantial loss of market share due to decreased reliability/durability ratings.

Recommendations for Additional Preventative Measures

Decentralized Inspections

As with all I/M programs, individual States should continue to monitor and consider additional safeguards to detect and prevent inspection fraud. While OBD based I/M inspections inherently make it more difficult to conduct a fraudulent inspection (aside from the potential use of tampering devices by the vehicle owner, addressed later in the report), the possibility has not been eliminated.

- EPA should assist states with decentralized programs to ensure that safeguards are in place to detect fraudulent inspections at dealership and non-dealership facilities.

- EPA should cross-check data between centralized and decentralized I/M areas as well as dealership and non-dealership inspections to look for anomalies in pass/fail rates.
- States should consider the many different technologies and approaches available to them to detect inspection fraud including the following:
 - Measures to ensure inspections are being conducted by authorized persons, such as video auditing cameras in each facility to allow the State or contractor to observe and communicate with technicians, or other measures to prevent lane operators from sharing user ID codes.
 - Bar codes to track inspection stickers.
 - Audits of inspection data by the State to detect anomalies.
 - Unannounced inspection of facilities.
 - “Undercover” failing cars can be tested at facilities to verify proper inspection.
 - Third party testing at decentralized inspection stations where repair work is also performed.

Warranty/Defect Reporting

- While warranty reporting/defect reports are required by CARB/EPA, both agencies use several sources of information to find and remedy problems in-use. Further, both agencies appear to have adequate safeguards in place to ensure the automobile manufacturers comply with the reporting requirements.

OBD System Design and Warranty Periods

- EPA should include OBD testing during its approximate 150 confirmatory tests/year.
- Data analysis of OBD I/M results could identify high failure rates of individual components triggering investigation of monitors for over-sensitivity.
- In recognition of the growing reliance of States on OBD I/M over the next decade for maintaining clean air and the amount of money that motorists will spend on OBD-identified repairs, EPA and CARB could increase the number of vehicles that are examined in their in-use compliance testing programs to afford the public an increased measure of confidence in OBD test programs.
- EPA and CARB should set up a database for all state I/M programs with CARB/EPA data on OBD- related information to further data, component and trend analysis, within the constraints of confidentiality requirements. Examples include:

- Defect reports manufacturers must provide EPA whenever an emission related defect affects 25 or more vehicles. The report describes the defect, the vehicles affected, number of vehicles, an evaluation of the emissions impact, any emissions data, and any anticipated follow-up.
 - EPA and CARB in-use testing program data (described earlier).
 - As part of EPA's CAP2000 regulation manufacturers must conduct their own in-use testing program beginning with the 2004 model year. This data which broadly covers the fleet of vehicles, will result in about 2000 FTP emission and OBD tests annually.
- EPA and CARB should continue to require improvements in OBD systems, based on the results of available data.

B. OBD Warranty/Durability Issue

State representatives have expressed concern that the OBD systems could potentially identify excessive amounts of repairs on vehicles after the warranty period, particularly if the systems are not durable as vehicles age. Some suggest that warranty periods should be longer to help provide the incentive to the manufacturers to design OBD systems to be as durable as possible.

Relevant Information

- EPA staff shared information with the Workgroup regarding warranty requirements, and current warranty periods for various manufacturers. The Clean Air Act Amendments (CAAA) of 1990 established warranty requirements for emission control components in Section 207(i).
 - Emission Control and Emission Related Parts are covered for first 2 years or 24,000 miles:
 - An emission control part is any part installed with the primary purpose of controlling emissions. An emission related part is any part that has an effect on emissions.
 - Specified Major Emission Control Components covered for first 8 years or 80,000 miles:
 - Catalytic converters
 - The electronic emissions control unit or computer (ECU)
 - The onboard emissions diagnostic device or computer (OBD)
 - Any other pollution control device or component that, 1) was not in general use on vehicles and engines manufactured prior to the model year 1990, and 2) retail cost (exclusive of installation

costs) exceeds \$200 (in 1989 dollars), adjusted for inflation or deflation.

- Many manufacturers offer longer warranty periods than required by the CAAA. Most offer at least 3 years and 36,000 miles for the parts that are required to have a 2 year/24,000 mile warranty. A list of manufacturer warranty periods is included in the OBD Policy Workgroup presentation (Technical Appendix F).
- OBD systems and emission control components are subject to “useful life” requirements of 100,000 miles for light-duty vehicles and 120,000 miles for light-duty trucks. Manufacturers are subject to enforcement actions if EPA and CARB in-use testing programs find that the systems are not meeting this design requirement. In addition, it is expected that OBD functionality will occur for the “full life” of the vehicle since the OBD logic is contained in the vehicle's computer software and should last as long as the vehicle's computer is operational (i.e., manufacturers are not allowed to shut-off OBD system functions once a vehicle's “useful life” has been reached).
- The data from EPA’s high-mileage study and from state I/M program lane data described earlier in this document did not seem to indicate that failure levels are increasing unreasonably as vehicles age. However, it will be important to continue to monitor the performance of OBD systems as they age.

Recommendations

- The recommendations in Section IV. A., regarding the continued evaluation of aging OBD vehicles through the EPA high-mileage study, and the evaluation of state I/M program lane data will provide useful information on the durability of OBD systems and emission control components. EPA and the OBD Technical Workgroup should assess these data relative to manufacturer warranty information to determine whether warranty periods (or perhaps “useful life” requirements) should be extended. Ultimately, Congressional action would be required to extend the required length of the warranty periods.

VI. Additional Workgroup Discussion: OBD Tampering Devices

Increasing concerns have been raised by automobile manufacturers, environmental groups, states and others about the availability of tampering devices that can be used to bypass the OBD system, and keep the MIL from illuminating. For example, there are numerous websites that offer the “O2 Simulator,” which can eliminate diagnostic trouble codes associated with a malfunctioning catalyst. Although these websites offer the components for “off-road use only,” it is quite possible that these devices are being used on “on-road” vehicles to pass OBD I/M inspections.

It appears that these devices may be difficult to detect using typical OBD testing regimes currently used by state I/M programs.

This issue was not one of the OBD Policy Workgroup's "charter issues," but the workgroup members agreed that the potential proliferation of OBD tampering devices could affect the integration of OBD into state I/M programs. The workgroup recommends a three pronged approach; 1) EPA and CARB should run strong enforcement programs to deter the use of OBD tampering devices, 2) EPA, CARB and the OBD Technical Workgroup should explore technical approaches for identifying tampering devices, and 3) EPA and the states should develop I/M program policies that help deter or remove incentive for the use of OBD defeat devices.

This concludes the summary of OBD Policy Workgroup deliberations. This report, and the Technical Appendix document that includes the presentations provided to the Workgroup, will be posted on EPA's website, at www.epa.gov/otaq/obd.htm.

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Attachment A

Lack of Overlap for Inspection/Maintenance Failures

- Message -

Prepared by the OBD Policy Workgroup

June, 2002

The National Academy of Sciences (NAS), in its report, "Evaluating Vehicle Emissions Inspection and Maintenance Programs," expressed concern about the results of an assessment of Inspection and Maintenance (I/M) program lane data from Wisconsin. The data showed that of 2,823 On-Board Diagnostics (OBD) and IM240 tailpipe test failures (1,479 and 1,344 respectively), only 173 vehicles failed both tests. Similar results have also been reported in other studies (including Colorado, Illinois and EPA).

The 2,823 failures were a subset of a total of 116,667 vehicles tested, meaning that, for the purpose of identifying clean vehicles, the OBD-I/M test and the IM240 tailpipe test agreed more than 97% of the time. However, because the goal of I/M programs is to identify and repair dirty vehicles, EPA and state environmental agencies are committed to ensuring that whatever I/M test method is used is capable of accurately identifying vehicles that need emission-related repairs.

Listed below are several reasons for the lack of overlap between the OBD-I/M tests and IM240 tailpipe tests in fewer than 3% of the tests where failures occurred.

The use of OBD in vehicle inspection programs represents a new paradigm. Studies have shown that OBD systems identify deteriorated or broken components or systems that lead to higher emissions. The goal is to identify components in need of repair before emission standards are exceeded, instead of the traditional emphasis on detecting and repairing vehicles with excess emissions after the vehicle is polluting over the standard. Additionally, OBD systems identify repairs needed to prevent further deterioration of broken emission control components.

Data from EPA and other studies indicate that half or more of the OBD I/M test failures identify vehicles in need of repair before they exceed the emissions standard (explaining half or more of the lack of overlap in OBD and tailpipe failures). The EPA is currently conducting a life cycle analysis to investigate the full range of benefits to both the vehicle owner and the environment of OBD induced repairs on vehicles before catastrophic failure events occur.

- The OBD-I/M inspections also identify evaporative system purge and pressure failures; the IM240 tailpipe inspections do not. Identifying evaporative emissions (HC) will become increasingly important because evaporative emissions are projected to account for 60% of the total HC emissions from the overall fleet of OBD-equipped vehicles in future years.

- OBD systems are designed to identify vehicle emissions-related failures occurring during all types of operating conditions, in real-time. IM240 and other tailpipe test methods are designed to identify vehicle emissions-related failures occurring during a representative set of operating conditions at a one-time inspection every one or two years. For example, a component failure that results in higher NO_x emissions only during highway driving would not necessarily be detected by a tailpipe test.
- Both the OBD and the traditional I/M tailpipe tests have a margin of error, which would account for part of the lack of overlap in I/M lane results.

Overall, the EPA has confidence in both OBD and tailpipe testing as vehicle inspection and maintenance tools. OBD is the most efficient and effective approach to maintaining low emission levels for the future fleet of vehicles (1996 and newer model years). EPA is conducting an ongoing assessment of high-mileage vehicles to continue to monitor the operation of the OBD systems as they age. Traditional tailpipe I/M testing will still play an important role as the means of accurately identifying vehicles that need emission-related repairs for 1995 and older vehicles, and may be needed for OBD-equipped vehicles as they age. Overall, the Agency believes that both OBD and tailpipe testing remain important components of I/M programs.