

OBD Policy Workgroup Report Technical Appendix

Compilation of presentations and materials
provided to the OBD Policy Workgroup

December, 2001 - October, 2002

OBD Policy Workgroup Report - Technical Appendix Index

<u>Apdx.</u>	<u>Title</u>
A	<i>Evaluating Vehicle Inspection and Maintenance Programs</i> , K. John Holmes, National Research Council.
B	<i>The Use of On-Board Diagnostics in Inspection and Maintenance Programs</i> , Lori Stewart, U.S. EPA
C	<i>OBD Technical Workgroup Status</i> , Ed Gardetto, U.S. EPA.
D	<i>Assuring Compliance with Emission Standards</i> , Mike McCarthy, California Air Resources Board

OBD Policy Workgroup Report - Technical Appendix Index

Apdx.

Title

- E ***OBD and Vehicle Emission Compliance Programs***,
Dan Harrison, U.S. EPA
- F ***OBD Warranty Information***, Arvon Mitcham,
U.S.EPA
- G ***OBD and I/M Failures***, Edward Gardetto, U.S. EPA
- H ***OBD Hardware/Software Issues***, Charlie Gorman,
ETI and Arvon Mitcham, U.S. EPA

OBD Policy Workgroup Report - Technical Appendix Index

<u>Apdx.</u>	<u>Title</u>
I	<i>OBD Communication and Outreach</i> , Sally Newstead, U.S. EPA
J	<i>EPA High-Mileage OBD FTP Study</i> , Edward Gardetto, U.S. EPA
K	<i>Oregon Vehicle Inspection Program, Decisions and Statistics</i> , Ted Kotsakis, Oregon DEQ
L	<i>Colorado's OBD II Study Update</i> , Rick Barrett, CO Department of Public Health and Environment

OBD Policy Workgroup Report - Technical Appendix Index

Apdx.

Title

M *Summary of Studies Regarding On-Board
Diagnostics use in Inspection/Maintenance
Programs, U.S. EPA*

N *Analysis of IM 147 and OBDII Inspection Data,*
Rob Klausmeier -- dKC

OBD Policy Workgroup Report

Technical Appendix A

THE NATIONAL ACADEMIES

*Evaluating Vehicle Inspection and
Maintenance Programs*

by

**National Research Council's Committee on
Vehicle Emission Inspection and
Maintenance Programs**

December 11th, 2001

K. John Holmes, NRC Senior Staff Officer

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Origin of Study

- **1995 Hearing before House Subcommittee on Oversight and Investigation**
 - **Effectiveness of I/M programs, including enhanced I/M**
 - **Accuracy of MOBILE model**
- **FY1998 budget for EPA called for “the NAS to conduct a study of the effectiveness of EPA’s inspection and maintenance programs”**

Related Studies

- **NRC Committee to Review EPA's Mobile Source Emissions Factor Model**

Modeling Mobile Source Emissions

(National Academy Press 2000)

- **A second phase to this study was planned but not funded**

Statement of Task

This study (Phase I) will assess the effectiveness of I/M programs for reducing mobile source emissions

- **Assess emissions from vehicles exceeding certification levels**
- **Compare vehicle emissions in areas with and without I/M**
- **Identify criteria to evaluate I/M programs**
- **Develop methodologies to evaluate I/M programs**
- **Make recommendations to improve I/M programs**
- **Identify research needs**

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Committee Members

Ralph J. Cicerone (chair)	University of California, Irvine
David T. Allen (vice-chair)	University of Texas, Austin
Matthew J. Barth	University of California, Riverside
Hugh Ellis	The Johns Hopkins University
Gerald Gallagher	J Gallagher and Associates, Inc.
Deborah Gordon	Transportation consultant
Robert Harley	University of California, Berkeley
Harold Haskew	Harold Haskew and Associates, Inc.
Douglas R. Lawson	National Renewable Energy Laboratory
Virginia McConnell	Resources for the Future
Alison K. Pollack	ENVIRON International Corporation
Robert Slott	Consultant

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Report Reviewers

Thomas Austin	Sierra Research, Inc.
Robert Frosch	Harvard University
Richard Goody	Harvard University
Jay Gordon	Gordon-Darby, Inc.
Thomas Graedel	Yale University
Thomas Hubbard	University of Chicago
Roland Hwang	Natural Resources Defense Council
Roberta J. Nichols	Ford Motor Company (retired)
Robert Sawyer	University of California, Berkeley
Joel Schwartz	Reason Public Policy Institute
Donald H. Stedman	University of Denver

Overall Findings and Recommendations

- **Evaluations have found much smaller estimated emissions reductions due to I/M than those predicted by models**
- **There is a continuing need for programs that identify and repair, or remove from the fleet malfunctioning vehicles that contribute a disproportionate share of total emissions**
- **States must expect less emissions reduction benefits from I/M**
- **Crediting of the emissions benefits of I/M should be more closely tied to actual emissions reductions demonstrated in I/M evaluations, not to model predictions**

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“Inspection and maintenance programs should focus on repairing the worst polluting vehicles and verifying repairs, but in ways that are both cost-effective for states and not overly burdensome for owners. We also need better methods of evaluating the impact of these programs. But having said that, it's important to emphasize that these programs are absolutely necessary to reduce harmful auto emissions and achieve better air quality.”

Ralph J. Cicerone, Committee Chair

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Evaluating I/M Emissions Reductions

Finding

- **Most biennial evaluations of enhanced I/M programs required by CAAA90 have not been completed**

Recommendations

- **Comprehensive evaluations - some programs should undergo comprehensive, long-term evaluations**
- **Shortened evaluations - not all jurisdictions will be able to devote the resources needed to perform comprehensive evaluations**
- **Performance metrics**

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Research Issues in Evaluating I/M Emissions Reductions

Finding

- **Many critical factors that have large effects on the emissions reduction benefits from I/M programs are still unknown**

Recommendations

- **Comprehensive evaluations should be used to research aspects thought to have major impacts on the emissions-reduction benefits from I/M programs, such as**
 - **durability of emissions-related repairs**
 - **extent of pre-inspection repairs**
 - **the fate of vehicles that fail and never pass**
 - **non-tailpipe emissions reductions**

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Importance of Cost-Effectiveness and Public Response to I/M

Findings

- **Costs are inextricably linked to emissions reductions, making cost-effectiveness a critical evaluation criterion**
- **Another important consideration is public concern about new technologies, such as OBDII or remote sensing**
- **Confusion about new technologies could reduce public and political support for their introduction into I/M programs and/or reduce their effectiveness**

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Importance of Cost-Effectiveness and Public Response to I/M

Recommendations

- **I/M programs can be improved by identifying ways to make them more cost-effective, more readily understood and by easing the testing burden for vehicle owners**
- **Some of the issues that deserve further research include the following:**
 - **durability of emissions-control systems**
 - **understanding owners' responses to I/M regulations**
 - **cost and emissions consequences of enforcement efforts**
 - **more effective means of public outreach and education**

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Use of the MOBILE Model

Finding

- **Predictions from MOBILE have greatly overestimated the emissions benefits from I/M programs**

Recommendations

- **The methodology used in MOBILE for estimating I/M benefits should be reevaluated**
- **Models will continue to be needed to estimate I/M program benefits in future years, but evaluations of current I/M performance should be based on empirical data (e.g., on-road vehicle-emissions measurements) rather than on models**

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Emerging Testing Technologies

- **Emissions Profiling**
- **Remote-sensing**
- **On-Board Diagnostic Systems on 1996 and Newer Model Year Vehicles (OBDII)**

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Report's Discussion of OBDII

- **Human Response to OBDII**
- **Readiness Codes**
- **Pollutants of Concern**
- **Failure Criteria**
- **Technical Analyses of OBD I/M**

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Readiness Codes

OBD I/M check

1996-2000 model year vehicles can have 2 unset readiness codes

2001 model year vehicles can have 1 unset readiness code

Concerns about readiness codes include:

- **excessive number of vehicles rejected for testing**
- **post-repairs resetting of codes**
- **system performance in extreme weather**

Pollutants of Concern

- **Many state I/M programs are designed to address a particular air-quality program (CO non-attainment area, NO_x or HC limited ozone non-attainment area)**
- **OBD I/M will fail a vehicle if HC, CO, or NO_x emissions exceed the failure criteria**

Failure Criteria

- **Malfunction indicator light (MIL), also known as the “check engine” light, is illuminated if a problem is detected that *could* cause emissions to exceed 1.5 times the emissions standards**
- **Most I/M programs fail vehicles for excess emissions that are much higher than vehicles certification standards**

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Technical Analyses of OBD I/M *Issue 1 - Fraction of Vehicles with MILs Illuminated and Low Emissions*

- **EPA (Gardetto et al. 2000; Gardetto and Trimble 2000) reported 70% of OBD I/M failures had emissions below certification standards**
- **EPA also reported 17% of OBD I/M failures had a malfunction that could not be reproduced**
- **Durbin et al. (2001) found 63% of OBD I/M failures had emissions below certification standards**

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Technical Analyses of OBD I/M

Issue 2 - Lack of Overlap of Vehicles Failing OBD I/M and IM240

- **EPA (Trimble 2000) Wisconsin Lane Data results - 1,479 OBD failures, 1,344 IM240 failures, and 173 vehicles that failed both (out of 116,667 vehicles tested)**
- **Colorado Department of Public Health and Environment (Barrett 2001) results - 2,835 OBD failures, 393 IM240 failures, and 66 vehicles that failed both)**
- **EPA (Gardetto and Trimble 2000) results - 21 vehicles with emissions 2 times greater than certification standards, 19 identified by OBD and 13 identified by IM240**

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Technical Analyses of OBD I/M

Issue 3 - Smaller Per Vehicle Emissions Reductions for OBD Repairs

- **EPA (Gardetto and Trimble 2000) results for LDVs**
 - Ave. reductions of CO for IM240 failures = 2.4 g/mi**
 - Ave. reductions of CO for OBDII failures = 15.4 g/mi**
- **Barrett 2001 results**
 - Ave. emissions change for CO for IM240 failure**
47.1 g/mi to 5.7 g/mi
 - Ave. emissions change for CO for MIL failures**
4.7 g/mi to 3.3 g/mi

Onboard Diagnostics

Findings

- **The current data set for evaluating the effectiveness of OBDII for I/M testing is inadequate**
- **Given its current specifications for MIL warnings, it is not clear whether OBDII can fulfill both objectives of alerting vehicle owners to potential vehicle malfunctions and serving as a testing device in I/M programs**
- **The OBDII system could operate as designed by automobile manufacturers and still indicate OBD I/M test failures on vehicles with low emissions**

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Onboard Diagnostics

Recommendations

- **An independent evaluation should be established using researchers outside the agencies to review the effectiveness and cost-effectiveness of OBDII testing programs before moving forward with full implementation of OBD into I/M programs**
- **The recommended evaluation should study issues such as:**
 - **the value of repairing vehicles with low emissions to prevent an increase of emissions in the future**
 - **fraction of vehicles with MILs illuminated that do not fail the exhaust test or any evaporative test**
 - **fraction of vehicles without MILs illuminated that fail a traditional I/M test**

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Final Thoughts

The NRC Committee thought I/M should focus on the small fraction of high emitters (50% of emissions)

- **Is OBD I/M the way to get at the other 50% of emissions?**
- **Are there more efficient strategies for ensuring that a vehicle's emissions control equipment is operating properly through the vehicle's lifetime?**

The NRC Committee was concerned that the problem of high emitters is as much a socio-economic problem as a technical one

- **Will OBD I/M “cure” the problem of the high emitter?**
- **What will OBDII vehicles look like in terms of their maintenance requirements when they get to be 15-20 years old?**

OBD Policy Workgroup Report

Technical Appendix B

The Use of On-Board Diagnostics in Inspection and Maintenance Programs *Issues and EPA's Plan*



OBD Policy Workgroup

Lori Stewart, US EPA

December 11, 2001

Overview



- Outline Major I/M/OBD Issues and EPA's Implementation Plan
- Identify Key Areas for Workgroup Advice to Successfully Implement OBD

OBD and Inspection & Maintenance Programs



- OBD II, on 1996 and newer vehicles, monitors emission control systems. Potential benefits are:
 - Prevention (not just detection) of emission exceedances
 - Improved evaporative emission detection
 - Improved diagnosis and repair
 - More reproducible I/M results for the technician and consumer
 - Incentive for more durable emission control design
 - Shorter inspection time for the public
 - Simpler Testing Tools (Scan tool)

Current Status of I/M, OBD



- 33 States and DC Operate Programs in 54 Areas
- OBD currently required, by CAA, in I/M Areas by January 2003
 - Six States Started: OR, WI, AK, UT, ME, VT
 - Twenty States (34 areas) plan to start in 2002
- NAS Identified Several Key I/M and OBD Issues
- Other Issues Identified by Stakeholders

NAS: Program Evaluation



- **Issue:** States have not evaluated programs as required under CAA.
- **Current Status:**
 - Six states have submitted evaluations (CA, TX, GA, CO, MD, DE)
 - Fourteen states are overdue

NAS: Program Evaluation (cont)

■ Actions:

- Finish two guidance documents on methods of evaluation
 - | Complete by Winter, 2002
- Provide seed money to one to four states to evaluate programs
 - | Complete by September, 2002
- Partner with Coordinated Research Council (CRC) on remote sensing study
 - | Complete in 2003

NAS: Target High Emitters



- **Issue:** I/M programs should focus efforts on the highest emitters in the fleet.
- **Current Status:**
 - EPA allows exemption of new model years
 - small SIP credit loss
 - EPA allows use of Remote Sensing to target high emitters and for clean screening
 - EPA allows use of high emitter profiling

NAS: Target High Emitters



■ Actions:

- EPA agrees with NAS that targeting high emitters is important, but balance of fleet also substantial portion of emissions.
- EPA will continue to offer states flexibility in designing their I/M programs.
- Remote sensing is most useful for program evaluation v. implementation.

NAS: Modeled v. Real World Benefits



- **Issue:** Predictions from current version of MOBILE model (MOBILE5) have overestimated benefits.
- **Current Status:** EPA is about to release the new MOBILE6 model, with benefits estimates aligned to “real-world” benefits.

NAS: Lack of Data to Evaluate OBD



- **Issue:** 200 car study not enough data/no data on naturally-aged vehicles - independent effectiveness study prior to full OBD implementation.
- **Current Status:**
 - EPA has continued to gather OBD/FTP data
 - | Cumulative emissions reductions higher for OBD
 - | Average repair costs are same for OBD and IM240
 - EPA has examined 534,000 OBD tests from WI and OR. Data from two states is consistent.
 - OBD Rule allows gradual phase-in, up to 2005

NAS: Lack of Data to Evaluate OBD



■ Actions:

- Continue High Mileage Vehicle Study to increase our confidence in OBD as the fleet ages (25 to 66 vehicles)
- Work with CDH on their FTP/OBD study which looks for OBD misses (44 vehicles)
 - Complete Summer 2002
- Analysis of OBD Field Data (800k vehicles)
 - Continuous

NAS: Higher Failure Rates with OBD



- **Issue:** OBD failure rates on future fleet (aging fleet and Tier 2) will be too high.
 - Current rule and existing production at 1.5 x standard
- **Current Status:**
 - Current data from Wisconsin and Oregon show failure levels of 2.5%
 - Model Year '96 failure rate is about 7%
 - Projections of "future" failure rates by Oregon show OBD failure rate to be lower at 10 year point compared to BAR31 tailpipe test

NAS: Higher Failure Rates with OBD



- **Action:** Evaluate failure rates on LEV & Tier 2 fleets
 - Data from current programs and high mileage study
 - Impact of OBD trigger points on LEV & Tier 2 vehicles
 - Complete by Spring 2002

NAS: OBD's Pollution Prevention Approach

- **Issue:** OBD fails clean, but broken vehicles as well as dirty vehicles. This *may* cause public concern.
- **Current Status:**
 - Six states now operating OBD programs not reporting public concern
 - Less “ping-pong” events with OBD repairs than with tailpipe


NAS: OBD's Pollution Prevention Approach



■ Action:

- Conduct life-cycle analysis of OBD in I/M early repair benefits
 - Complete spring/summer 2002
- Evaluate data from OBD I/M programs and continued high-mileage test data
- Key focus of public outreach efforts

Stakeholder Concern: OBD Warranty



- **Issue:** Will OBD system significantly deteriorate beyond the warranty period?
- **Current Status:** High mileage study
- **Action:** Protect consumers by ensuring that deterioration curve is normal
 - Data from high mileage Study
 - Data from OBD I/M field studies

Stakeholder Concern: Conflict of Interest



- **Issue:** Will dealerships fail OEM products? Will OEM's write software to fail vehicles with no tailpipe oversight?
- **Current Status:**
 - | Coordination with CARB
 - | OBD evaluations added to in-use investigations
- **Action:** Strengthen existing EPA compliance presence
 - | simulated I/M check in certification process
 - | special testing programs in enforcement

OBD: State Start-up and Repair Community Support, and Public Education



- **Issue:** Need for national coordination & collaboration to address public perception and understanding regarding the OBD system.
- **Current Status:**
 - OBD Outreach and Communication Plan
 - OBD Implementation Guidance
 - Service Information Rule (66 FR 30830)
 - OBD Stakeholder Workgroup & Repair Community Subgroup
 - National OBD Clearinghouse (Weber State)
 - OBD@EPA.gov: for public to post OBD questions to EPA

OBD: State Start-up and Repair Community Support, and Public Education



■ Actions:

■ State start-up support

- | provide specialized assistance - next major areas: GA, NC, TX
- | continue sponsorship of state and local workgroup

■ Response to Repair Industry

- | continue sponsorship of repair sub-group
- | leverage participation in repair community education and outreach activities

■ Public Education

- | utilize contractor findings & recommendations (currently funded 2nd phase) to create a national outreach campaign
- | develop educational materials and tools easily adapted for communities (and repair facilities)

OBD Policy Workgroup



Overall Goal: Successful Implementation of OBD for 1996 and Newer Vehicles

- What are the highest priority OBD data needs?
- What issues are most critical to successful use of OBD in I/M programs?
- What issues can the Workgroup impact most? How can this be accomplished?

OBD Policy Workgroup Report
Technical Appendix C

OBD Technical Workgroup Status

Ed Gardetto

December 11, 2001

Overview

- Data from operating I/M programs
- Investigation of scan tool concerns
- Recommendations on implementation protocols
- Importation of vehicles
- Review of studies

Data From OBD Programs

- Centralized
 - Oregon, Wisconsin
- Decentralized
 - Vermont, Utah, Maine

Overview of data

- All the data looks similar
 - overall success ~98%
 - overall fail rate ~2.5%
 - overall “not ready” ~1.0%
 - OBD test takes less time ~5 minutes
 - MY ‘96 fail rate of ~7%
 - Less “ping-ponging” on repairs

Scan Tool Concerns

- Need for standardization of nomenclature
- Development of a “gold” standard
 - EPA addition of “generic” scan during cert.
- Communication with multiple computers on a vehicle
- Review of CARB additional parameters

Implementation Recommendations

- Dealing with Readiness in I/M
- Dealing with Readiness in repair
 - Catalyst DTC and repair
- Need for continued data gathering
- Data Link Connector concerns

Dealing with Canadian Vehicles

- '96 - '98 Canadian vehicles may not have fully functional OBDII systems
- Vehicles have shown up in operating programs
- Group is reviewing extent of problem and impact
- Recommendation will follow

Review of OBD Data

- Group has advised and reviewed EPA studies
 - 200 vehicle study
 - High-mileage study
 - Original Wisconsin data
 - EPA OBD 30 vehicle EVAP study
- Group has reviewed CE-CERT OBD study
- Group is reviewing CDH data as it comes in
- Group continues to review state operating data which becomes available

Review of OBD Data

- General Observations
 - OBD can be effectively performed in I/M
 - OBD does miss some “dirty vehicles”
 - OBD does identify “clean vehicles” which are broken
 - OBD can identify evaporative problems
 - OBD identified repairs are easier to repair than I/M tailpipe only identified repairs

OBD Policy Workgroup Report

Technical Appendix D

Assuring Compliance With Emission Standards

Mike McCarthy
Mobile Source Controls Division
Air Resources Board
FACA Workgroup 2/12/02

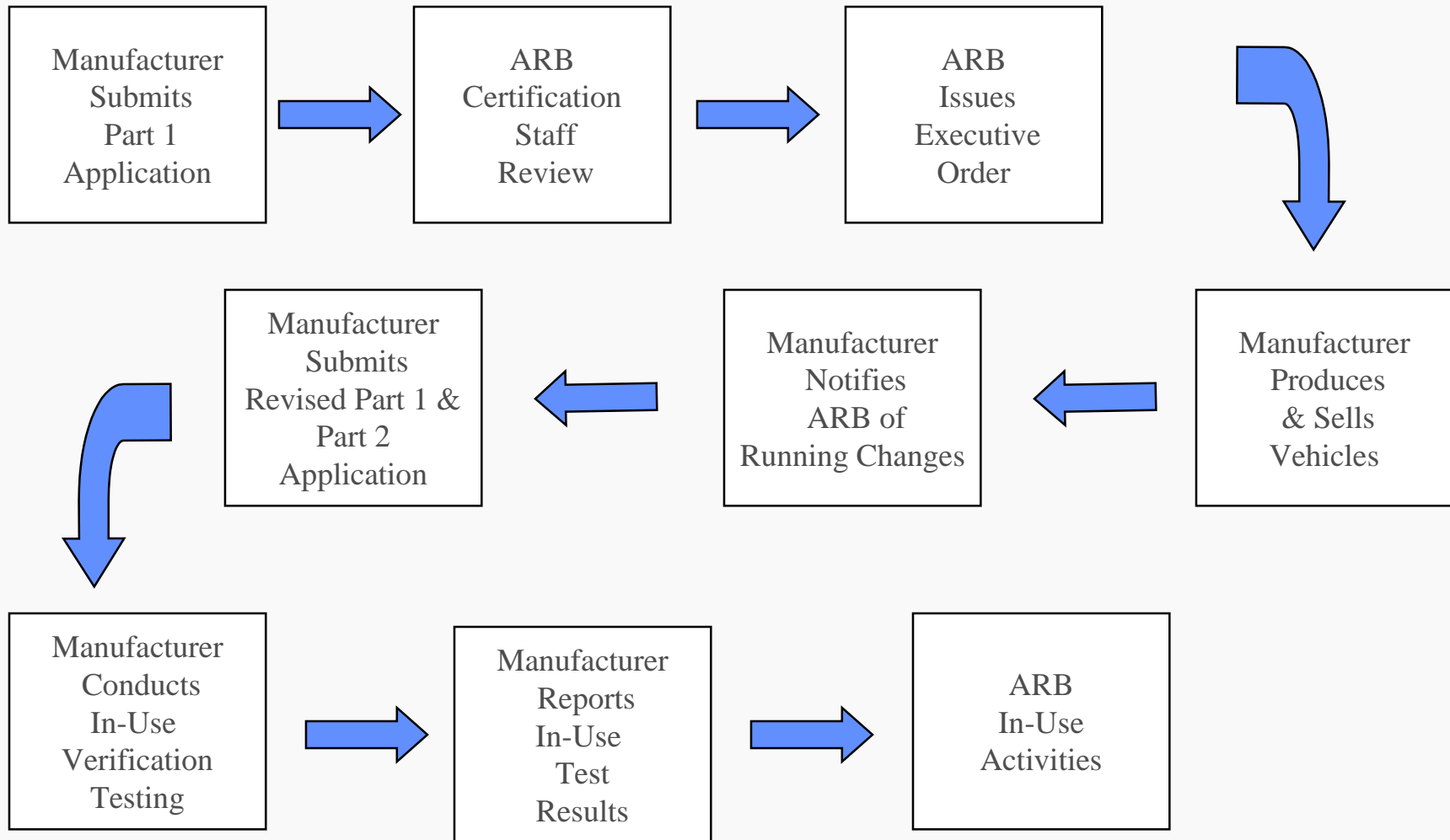
California Environmental Protection Agency

 **Air Resources Board**

Overview

- Certification
- In-use Testing
- Warranty Reporting
- Compliance Testing

CERTIFICATION PROCESS



Certification Application

- Description of test group and emission control system
- Description of test vehicles
- Test Results (FTP, SFTP, Evap, 50°F data)
- Identification of Models to be Certified
- Statement of Compliance
- On Board Diagnostic System (OBD 2) Description

CERTIFICATION “Duties”

- Evaluate manufacturers’ test programs and data
- Evaluate durability and aging procedures for emission controls and evaporative emission controls.
- Evaluate for defeat devices
- Evaluate OBD II compliance
- Evaluate labels
- Evaluate warranties
- Evaluate fuel tank fill pipe and opening specifications
- Evaluate phase-in compliance plans

OBD II Review Process

- Details of Monitoring System Design are reviewed by ARB engineering staff
- All information necessary to test in-use performance of vehicles must be submitted (including calibration values)
 - Fault Codes
 - Malfunction Criteria
 - Monitoring Conditions

Engine Family xxxxx.xxxxxxx		Certification Standard (Tier 1, TLEV, etc..)	Enhanced Evap (yes/no)					
Component/ System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Required	MIL Illum.
Catalyst	P042x	oxygen storage	rear oxygen sensor vs front oxygen sensor	> xxx	Engine speed Injector pulse width vehicle speed	xxxx - xxxx rpm xxx - xxx ms xxxx - xxxx mph	xxx secs once per trip	two trips
		Malfunction criteria: (1.5 x standard, 50% efficiency, 2 x standard + 4k, etc...)						
Misfire	P0301 to P030x P0300	Crankshaft speed fluctuation Multiple misfire	FTP Emissions Threshold I/M Emissions Threshold	> xxx % > xxx % Disable conditions:	Engine speed Load change Speed change Time from engine start-up rough road	xxxx - xxxx rpm < xxx ms/s < xxx mph/s	1000 revs continuous	two trips
			Catalyst Damage	see load/rpm map			200 revs	immediately
Evaporative Purge System	P0440	functional check	Lambda shift	> xxx	Coolant temperature Fuel system status normal purge	> xxx deg C closed loop on	xxx secs	two trips

Emission Durability Testing

- DDV testing well ahead of production
- Purpose:
 - prove durability of emission control systems
 - demonstrate emission compliance at useful life
 - determine deterioration factors (DFs)
- Extended mileage
 - mileage accumulation of 100,000/120,000 miles
 - emission testing at periodic intervals and at final mileage
 - bench aging of evaporative components (canister, purge valve, fuel injectors, carburetor, gas cap) to equivalent of 100,000 / 120,000 / 150,000 miles

OBD Durability Testing

- OBD DDV testing prior to certification
- Purpose:
 - Demonstrate OBD II system compliance at 100k
 - Demonstrate MIL on before 1.5 x FTP standards
 - Required for catalyst, misfire, EGR, fuel system (lean and rich), oxygen sensor, and secondary air
- Required testing on 1-3 models per year
- ARB “confirms” test data on 3-10 vehicles a year by duplicating manufacturer’s testing at ARB.

“Title 13” Emission Testing

- ARB “seizes” 5-10 identical model cars at point of entry (e.g., shipyard, rail-yard, etc.)
- Tested for FTP emission performance
 - To “confirm” new vehicles meet the standards
- Vehicles targeted based on certification durability data, new models, etc.

OBD In-Use Testing

- Engineering staff test 20-30 vehicles a year
 - 1-2 year old vehicles obtained through rental fleets, etc.
- Tested for OBD II performance:
 - Faults implanted by staff
 - Testing mostly done on-road
 - Various scan tools used during testing to identify standardization problems
- Vehicles targeted based on certification issues, new models, breadth of coverage
- Most OBD II recalls initiated by this testing

In-Use Compliance Testing Objectives and Process

OBJECTIVES

- Durable Emission Control Designs
- Catch and Fix Problems in the Field

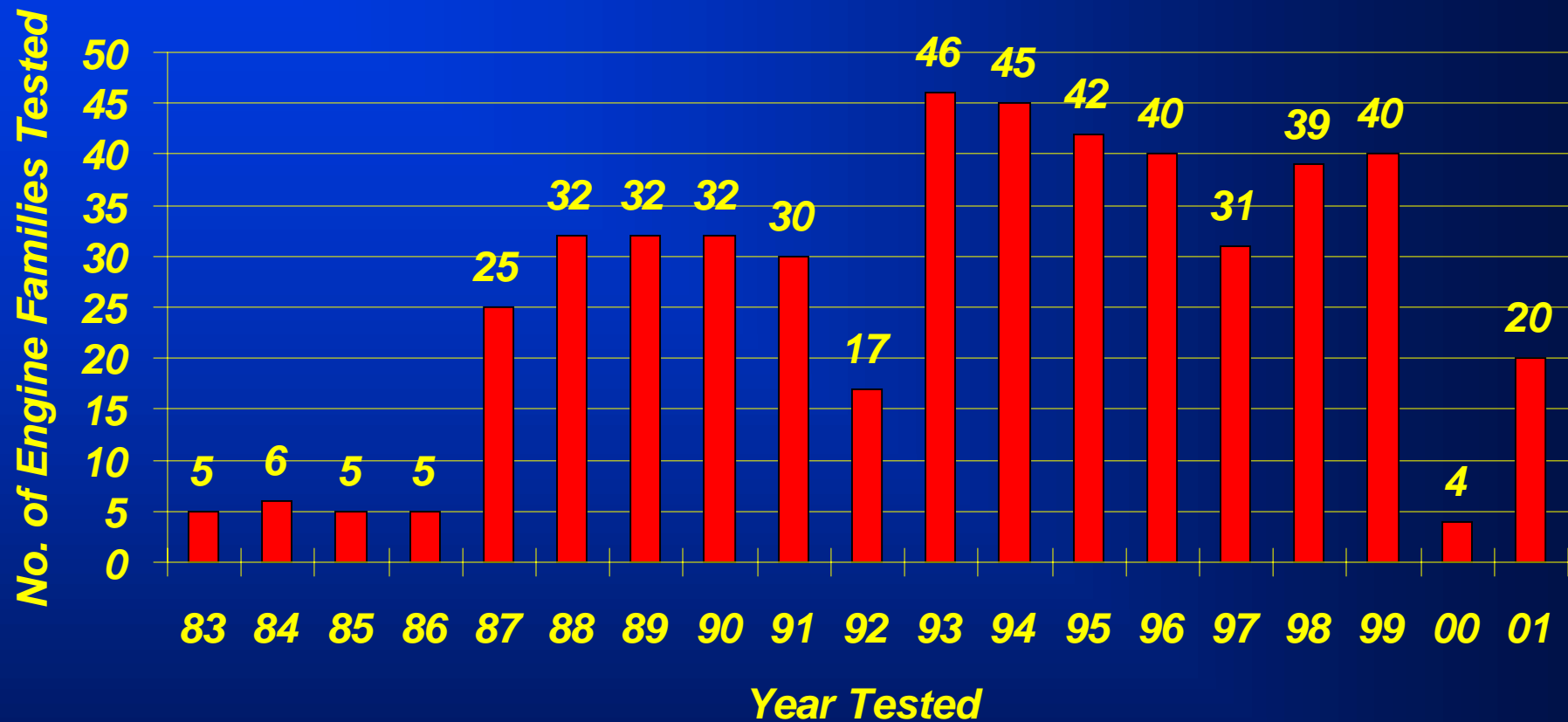
PROCESS

- Identify Models Likely to Fail
- Recruit/Test Vehicles at 40K/75K Miles
- If Emissions Over Standard, Recall
- If OBD II system noncompliant, Recall
- Recall Repairs Enforced Through Registration

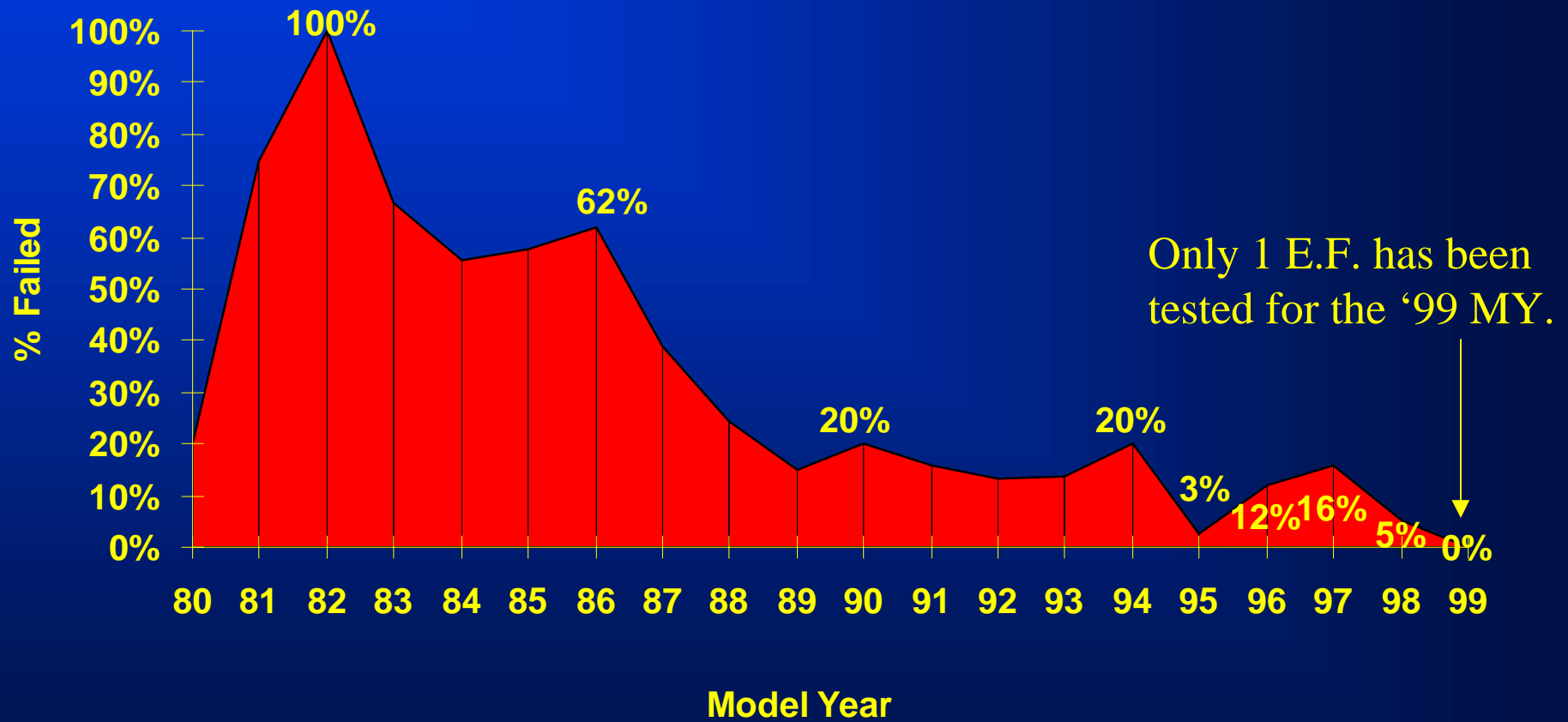
History

- PROGRAM BEGAN IN 1983
5 Engine Families Tested
- BASED ON HIGH FAILURE RATE
Program Was Expanded in 1987
- AVERAGE OF 43 ENGINE FAMILIES
Tested Annually Since 1993
- ARB/US EPA COORDINATE TO
Avoid Duplicating Efforts

In-Use Testing 1983 - 2001



In-Use Failure Rates



In-Use Compliance General Statistics Since 1983

- 473 engine families tested
- 5,000 vehicles tested (representing 10 million vehicles)
- 73 recalls based on in-use testing (affecting 1.5 million vehicles)

Emission Warranty Reporting Program

- Use warranty data to identify defective emission controls
- Program began with 1990 MY
- Manufacturers must report when warranty claims for any one part exceed 1%
- Additional reporting and assessment required when claims reach 4 %
- Corrective action required when true failure rate exceeds 4%
- Field audits of dealership warranty records done by ARB staff to ensure accuracy of submitted data
- OBD II usually the indicator for a warranty claim

Emission Warranty Reporting Program Status (since August 1990)

- 61 recalls implemented to correct problems (375,000 vehicles)
- 16 service campaigns implemented to correct other problems (150,000 vehicles)
- 5 extended warranties implemented to address special problems

OBD Policy Workgroup Report
Technical Appendix E

OBD Policy Workgroup



OBD and Vehicle Emission Compliance Programs

EPA

Office of Air and Radiation

Office of Transportation and Air Quality

February 12, 2002

Compliance Program Goals



- Ensure Compliance
- Deter non-compliance
- Vehicles are designed and built which meet emission standards throughout their useful life
- Problems are found and fixed early

Legal Authority



- Clean Air Act
 - Sec. 202 Emission Standards & OBD Requirements
 - Sec. 207 Remedy for non-conformity
 - Sec. 208 Manufacturer Testing

- 40 CFR 85 Subpart S
 - Recall Regulations

- 40 CFR 85 Subpart T
 - Emission Defect Reporting Requirements

- 40 CFR 86 Subpart S
 - General Compliance Provisions
 - In-Use Verification Program

Certification



- Manufacturers cannot introduce vehicles into commerce without an EPA certificate of conformity
- Manufacturers perform emissions tests and EPA will confirmatory test at the NVFEL
- EPA employees make the decisions on certification and confirmatory testing
- EPA plans to conduct OBD readiness checks when confirmatory testing



Certification

- OBD system must be described in application and approved by EPA and ARB prior to EPA issuing a certificate
- A vehicle that differs from the certification application is a misbuild and in violation of the CAA
- ARB conducts Durability Demonstration Vehicle testing at OBD threshold levels
 - Results reported to EPA in application

In-use Compliance Program



- Review Information
- Investigate
- Select classes
- Procure vehicles from public
- Test Emissions and OBD
- Evaluate
- Remedy problems in-use

Review Information



- Defect reports
 - OBD found many problems
- Voluntary emission recall reports
- OBD - I/M data
- Technical service bulletins
- Warranty information (MIL, components)
- Quarterly reports
- NHTSA
- CARB
- Consumers

Class Selection



- Demonstrated problems (defect reports, OBD problems, service bulletins, etc.)
- Other data indicating problems (past history, reality check or CAP 2000 data, certification, CARB information, end of line data, I/M information, etc.)
- New standards and/or technology that increase the risk of non-compliance
- Random selections
- Fleet coverage

Emission Testing

- FTP
- HWFEE
- Evaporative



- Investigate emission failures for potential OBD failures

OBD Testing



- EPA tests OBD on each in-use class
 - OBD readiness
 - EVAP (lg & sm leaks)
 - Misfire

- Additional In-use OBD Testing by EPA
 - Catalyst failure detection
 - Oxygen sensor detection
 - Can test any OBD function



Recalls

- EPA can order or influence a recall
- Manufacturers can conduct voluntary recalls
- 2 million recalls in CY-2000
- 340,000 recalls result of OBD working



Recent Example

VW Recall announced - Jan 2002

- 324,000 vehicles
- Emissions failure found at EPA - NVFEL
- Failed Oxygen Sensor - OBD MIL- 6 codes
- MY 1999, 2000 & 2001
- Found by EPA in-use program
- Also identified by Oregon I/M-OBD program

Future



■ OBD Evaluations

- Functional testing of OBD systems using known failing parts to determine if the OBD systems can identify the failure
- Procure vehicles for OBD testing from certification, production, or in-use vehicles or special procurements
- Use OBD information from I/M lanes (beginning in 2002)



Summary

- Compliance programs are successful
- No certificate if failure to meet standards
- Recall if non-compliance
- Program ensures reliable OBD systems
- OBD system problems are being found and fixed
- OBD uncovers problems in-use
 - warranty claims
 - defect reports
 - I/M

OBD Policy Workgroup Report
Technical Appendix F

OBD Warranties/Durability

OBD Policy Workgroup Meeting

Arvon L. Mitcham, U.S. EPA

February 11, 2002

Clean Air Act Requirements

CAAA 207(i) "Warranty Period":

- Emission Control and Emission Related Parts 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

2) retail cost (exclusive of installation costs) exceeds \$200 (in 1989 dollars), adjusted for inflation or deflation

Attachments/References

Appendix A: Clean Air Act Amendments (CAAA) Language

Appendix B: 2002 Manufacturer Warranties from "Motor" Magazine

For more details on components covered under applicable warranty periods, see EPA Warranty Guidance Letter (EPA420-F-96-020, March 1996) available at:

www.epa.gov/otaq/consumer/warr95fs.txt

Appendix A: Clean Air Act Amendments Language

CAAA 207(i) "Warranty Period"

(1) In general.-For purposes of subsection (a)(1) and subsection (b), the warranty period, effective with respect to new light-duty trucks and new light-duty vehicles and engines, manufactured in the model year 1995 and thereafter, shall be the first 2 years or 24,000 miles of use (whichever first occurs), except as provided in paragraph (2). For purposes of subsection (a)(1) and subsection (b), for other vehicles and engines the warranty period shall be the period established by the Administrator by regulation (promulgated prior to the enactment of the Clean Air Act Amendments of 1990) for such purposes unless the Administrator subsequently modifies such regulation.

(2) Specified major emission control components.-In the case of a specified major emission control component, the warranty period for new light-duty trucks and new light-duty vehicles and engines manufactured in the model year 1995 and thereafter for purposes of subsection (a)(1) and subsection (b) shall be 8 years or 80,000 miles of use (whichever first occurs). As used in this paragraph, the term `specified major emission control component' means only a catalytic converter, an electronic emissions control unit, and an onboard emissions diagnostic device, except that the Administrator may designate any other pollution control device or component as a specified major emission control component if-

"(A) the device or component was not in general use on vehicles and engines manufactured prior to the model year 1990; and

"(B) the Administrator determines that the retail cost (exclusive of installation costs) of such device or component exceeds \$200 (in 1989 dollars), adjusted for inflation or deflation as calculated by the Administrator at the time of such determination.

For purposes of this paragraph, the term `onboard emissions diagnostic device' means any device installed for the purpose of storing or processing emissions related diagnostic information, but not including any parts or other systems which it monitors except specified major emissions control components. Nothing in this Act shall be construed to provide that any part (other than a part referred to in the preceding sentence) shall be required to be warranted under this Act for the period of 8 years or 80,000 miles referred to in this paragraph.

Appendix B: 2002 Manufacturer Warranty Periods from “Motor” Magazine

Manufacturer	Basic Warranty	Powertrain Warranty
Buick	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Cadillac	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Chevrolet/GMC	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Daimler-Chrysler	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Ford	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Lincoln	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Mercury	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Oldsmobile	5 yrs./60,000 mi.	5 yrs./60,000 mi.
Pontiac	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Saturn	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Acura	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Audi	4 yrs./50,000 mi.	4 yrs./50,000 mi.
BMW	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Daewoo	3 yrs./36,000 mi.	5 yrs./60,000 mi.
Honda	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Hyundai	5 yrs./60,000 mi.	10 yrs./100,000 mi.
Infiniti	4 yrs./60,000 mi.	6 yrs./70,000 mi.
Isuzu	3 yrs./50,000 mi.	10 yrs./120,000 mi.
Jaguar	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Kia	5 yrs./60,000 mi.	10 yrs./100,000 mi.
Land Rover	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Lexus	4 yrs./50,000 mi.	6 yrs./70,000 mi.
Mazda	3 yrs./50,000 mi.	3 yrs./50,000 mi.
Mercedes-Benz	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Mitsubishi	3 yrs./36,000 mi.	5 yrs./60,000 mi.
Nissan	3 yrs./36,000 mi.	5 yrs./60,000 mi.
Porsche	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Saab	4 yrs./50,000 mi.	4 yrs./50,000 mi.
Subaru	3 yrs./36,000 mi.	5 yrs./60,000 mi.
Suzuki	3 yrs./36,000 mi.	3 yrs./36,000 mi.
Toyota	3 yrs./36,000 mi.	5 yrs./60,000 mi.
Volkswagen	4 yrs./50,000 mi.	5 yrs./60,000 mi.
Volvo	4 yrs./50,000 mi.	4 yrs./50,000 mi.

CAA Requirements	
Emission Components	2 yrs./24,000 mi.
PCM, ECU, & Catalyst	8 yrs./80,000 mi.

OBD Policy Workgroup Report

Technical Appendix G

OBD and I/M Failures

OBD Policy Workgroup

Ed Gardetto

2/12/02

Data Sources for OBD and I/M Tailpipe comparisons

- EPA OBD/FTP study
- EPA Wisconsin study
- Barrett (9/00 to 7/01) Study
- Colorado OBD/FTP study (in progress)
- Illinois study
- Oregon study

OBD vs. Tailpipe concern

- Concern has been raised regarding the lack of overlap of OBD failures and tailpipe failures
- Implication is that tailpipe is finding “dirty” vehicles which OBD is missing
 - therefore, OBD I/M is not accurate

Points to Consider

- Tailpipe and OBD I/M are not the same
 - tailpipe test mainly targeting gross emitters
 - OBD targeted at system maintenance
- OBD tests for evaporative failures while tailpipe programs, at best, do only gas cap
- In order to determine which test is correct an independent standard must be used

EPA OBD/FTP Study

- As part of the EPA 200 car study EPA procured 17 vehicles with high lane tailpipe emissions and no MIL illumination
 - IM240 lane test with not all preconditioning improvements in-place
 - Final EPA cut points used
- 15 of 17 vehicles did not reproduce lane failure in lab (FTP not run on all)

EPA Wisconsin Study

(USA Today citation)

- EPA analyzed 116,669 paired OBD and IM240 tests from Wisconsin
 - EPA found little overlap between IM240 failures and OBD failures
 - This data does not contain a valid standard to allow for selecting one test over the other (this was not the purpose of this study)

Barrett (9/00 to 7/01) Study

- I/M lane study comparing visual OBD failures to IM240 failures
- Study looked at 140,118 vehicles
 - 97.6% passed
 - 241 failed for tailpipe emissions
 - 1,441 failed for gas cap, opacity,
 - 2,096 failed for visual MIL
 - Overlap of 42 vehicles (between tailpipe and OBD)
- Results consistent with EPA studies

Colorado OBD/FTP Study

- Recruiting vehicles which fail the IM240 test (back-to-back twice)
 - recruiting based on Colorado IM240 cut points which are looser than final IM240 cut points
- Study is in progress at this time and has not been written up formally
- Results to date consistent with EPA studies

Illinois Study

- Evaluated OBD (MY 96 - 98) and full IM240 tests (n=11,580)
 - IL only fails for HC, CO, and gas cap
- 736 OBD failures
 - 194 with evap or EGR codes
- Remaining 542 vehicles emitted 2.7 times and 2.9 times HC and CO on the IM240

Oregon Study

- Oregon tested 5,173 vehicles with OBD and BAR31 test (at phase in cut points)
 - 259 pass BAR31 and fail OBD
 - 29 fail BAR31 and pass OBD
 - Overlap of 12
- Results consistent with EPA studies

OBD Policy Workgroup Report
Technical Appendix H

OBD Hardware/Software Issues

Charlie Gorman, ETI

Arvon L. Mitcham, U.S. EPA

OBD Policy Workgroup

February 12, 2002

OBD Hardware/Software Issues

Focus:

- OBD I/M Test Equipment:
Vehicle Communication Design
- OBD I/M Vehicles and Equipment
Compatibility

OBD I/M Test Equipment: Vehicle Communication Design

Two areas of concern:

- OBD-I/M Equipment Robustness
- Future OBD Communication Protocol Implementation

OBD-I/M Equipment Robustness

Issue:

- OBD-I/M Software Integration into I/M Tailpipe Testing Hardware
 - I/M integrators lack of experience with OBD communication protocols implementation
 - OBD-I/M equipment handling multiple ECU responses
 - Timing issues: request for info and vehicle response
 - Flexibility in ISO protocols: ISO 9141-2 and ISO14230-4 (Keyword Protocol or KWP 2000)

OBD-I/M Equipment Robustness

Solutions:

- OBD-I/M flow chart/specification developed to explain OBD communication process (Fig. 1)
- List of “work arounds” from OBD hand-held scan tool manufacturers being developed (Fig. 2)
 - initial compilation from CARB, ETI will perform further compilation

OBD-I/M Equipment Robustness

Solutions:

- ETI Membership developed a practice or specification regarding handling multiple ECU responses (Fig. 3)
- Pending EPA request for information from OEM's on ISO protocol implementation

Future OBD Communication Protocol Implementation

Issues:

- Proliferation of OBD communication protocols
- Current equipment capability w/ new protocols such as Control Area Network Protocol (CAN, ISO 15765-4)
 - Urgency: specifications for contracts

Future OBD Communication Protocol Implementation

Solution:

- CAN Protocol expected to last 10+ years
 - CARB/EPA limited CAN protocol to a single speed rather (500 kbps) before specification development
 - CARB Proposal: only allow CAN protocol in MY 2008
 - OBD-I/M equipment: still needs to work w/ existing protocols
- Pending discussions between States and OEMs on CAN protocol specifications and implementation timeframes

OBD I/M Vehicles and Equipment Compatibility

Issues:

- OEM Protocol Compliance and Implementation
- Verifying compatibility

OBD I/M Vehicles and Equipment Compatibility

Solutions:

- EPA developed simulated I/M checks for pre-certification vehicles (Fig. 4)
 - uses generic/aftermarket scan tools
 - pending internal review and implementation
- CARB Proposal: require OEMs to verify compatibility on early production vehicles (Fig. 5)
 - Supply information in certification application

OBD I/M Vehicles and Equipment Compatibility

Solutions:

- Developed vehicle scanning audit for OBD equipment manufacturers and states (Fig. 6)
- Development of protocol verification tool
 - SAE J1699 committee developing specification
 - Tool will generate protocols to specification and outside of specification (mainly software driven)
 - Can be used by agencies, OEMs, OBD equipment manufacturers, states, service technicians, etc.

OBD Policy Workgroup Report
Technical Appendix I



OBD Communication and Outreach
February 12, 2002
Sally Newstead
US EPA

OBD Gains Momentum



- Nine programs have started OBD pass/fail checks: Oregon, Wisconsin, Alaska, Utah, Maine, Vermont, Indiana, Arizona and D.C.
 - Fourteen more states plan to start in 2002
 - Several expected to request delay, start in 2003
 - Connecticut, Missouri will delay, phasing in OBD for 2005 start
 - NJ is proposing delay and partial phase-in

Expected Startup Schedule



February	DC, Delaware, Nevada,
March	Illinois
April	Louisiana, Tennessee
May	California, Georgia, N.Carolina, Texas
June	Massachusetts
July	Kentucky, Washington, Maryland
September	Virginia
January 2003	New Hampshire, New Mexico, New York, Ohio, Rhode Island

Outreach-Communication Strategy



- Continue to lead the OBD State and Local Stakeholder Workgroup
 - Provides a formalized network for states and others to share information
 - on a regular basis, states share case studies, best practices, communication tools and lessons learned

Hold Workgroup meetings via conference call in February, Late March, July and September. On-site meeting will be held during Weber State OBD conference in May

- Lead OBD Repair Community Sub-group
 - prioritize issues for service writers and technicians.

Outreach & Communication Strategy



- Weber State OBD2K2 Conference
 - Co-sponsor Conference
 - Participate on steering committee for agenda development and conference planning
 - Convene OBD State and Local Stakeholder Workgroup meeting in conjunction with conference

Conference Dates - May 22-24, 2002

Outreach & Communication Strategy



- Update and enhance OTAQ's existing OBD website
 - Provide most current information and links for consumers, repair community and state and local program administrators

Expected Completion Date - Winter, 2002

Coordinate with Oregon and Wisconsin to co-author an annual report on OBD programs

- Will help other areas implement and market OBD programs

Expected Completion Date - Spring, 2002

Outreach-Communication Strategy

- OBD Leadership Meeting held January 28, 2002

- Goal of the meeting was to discuss EPA's strategy and solicit input, feedback and a commitment from meeting participants for supporting activities.

- Participants included representatives from:

U.S. EPA	Georgia	AAA
Illinois	STAPPA/ALAPCO	AAIA
Wisconsin	ASE	Ford
Oregon	ASA	GM
Maryland	NADA	Honda

Outreach & Communication: Next Steps for EPA

- Develop Media Tool Kit
 - Press release
 - Fact sheets
 - OBD Expert Contact List
 - Facts & Figures
 - Oregon - Wisconsin report on real-world success
- Consider development of two brochures targeting:
 - General Public, Service Writers and Repair Technicians

*Expected Completion Date - April/May, 2002. Present at
Weber State OBD2K2 Conference*

Outreach & Communication: Opportunities for State and Local Programs



- State and Local Program Administrators
 - Provide local support to national press outreach (local politics influence degree of participation).
 - Assist in distribution of national materials.
 - Create state specific materials.
 - Promote OBD to the driving public by including information in vehicle registration notices, state websites.
 - Generate positive media coverage on the success of OBD implementation statewide.
- STAPPA/ALAPCO Public Education Committee
 - Continue work with EPA, Regions and states to create and distribute OBD education information.

Outreach & Communication:

Opportunities for other OBD Leaders:

■ Auto Industry

- Work with internal communications staff to provide possible opportunities/activities to support OBD, coordinate with *Road & Track* magazine for an updated article on OBD.

■ AAA

- Provide articles on OBD to its 80 auto clubs for placement in AAA magazines, share results of recent AAA survey.

■ NADA

- Reach automotive dealerships with OBD information, assist in identifying and coordinating opportunities to highlight OBD technology at national and state auto shows.

Outreach & Communication:

Opportunities identified for other OBD Leaders



- ASA
 - Tailor OBD messages for independent repair shops and distribute materials to service writers.
- ASE
 - Publish OBD article (Feb. 2002), include OBD information at website, assist in production and distribute of OBD information to technicians.
- AAIA
 - Include OBD in planned consumer awareness campaign.

Outreach-Communication Strategy



We will continue to collaborate with state and local I/M-OBD program administrators, repair community national representatives, and others on:

- Effective messages
- Reaching dealerships, service writers and repair technicians
- Reaching consumers
- Further assisting state and local areas
 - The need for communication and outreach efforts doesn't stop at program implementation. OBD has the best chance of continued success if targeted outreach continues through a full test-cycle.

OBD Policy Workgroup Report
Technical Appendix J

EPA High-Mileage OBD FTP Study



August, 2002

Ed Gardetto

Overview

- **Overall goal: to evaluate effectiveness of OBD on very high-mileage vehicles**
- **Overall findings: OBD appears very effective at finding emissions problems on very high mileage vehicles**
 - **addition of tailpipe test adds little**

Selection of Vehicles

- **MY '96/97/98/99**
- **Must have over 100,000 miles**
- **Manufacturer weighted by sales**
 - **LDV/LDT within mfr weighted by sales**
- **MIL illumination is not a criteria**
- **Selection is not entirely random due to:**
 - **incentives, location of selection**

Testing Protocol

- **LA-4 cycle**
- **IM240 test**
- **Drain in-use fuel; refuel with indolene**
- **LA-4 cycle**
- **FTP test**
- **IM240 test**
- **Repair**

Manufacturer Distribution

- **96 Total in sample**
 - 46 LDTs
- **GM 27 (11)**
- **Ford 25 (15)**
- **Daimler/Chrysler 12 (7)**
- **Toyota 11 (6)**
- **Honda 7 (1)**
- **Nissan 7 (5)**
- **Suzuki 3 (1)**
- **VW 1**
- **Kia 1**
- **BMW 1**
- **Subaru 1**
- **# in parenthesis is total # of LDTs for that mfr**

MILs and DTCs

- **30 vehicles with MIL illuminated**
- **48 DTCs**
 - **14 Oxygen sensor**
 - **7 Misfire; 7 Evap; 6 EGR**
 - **3 intake air temp**
 - **3 lean condition**
 - **3 catalytic converter**
 - **1 coolant temp; 1 variable valve; 1 knock sensor; 1 intake runner valve**

MILs vs DTCs from Operating OBD I/M data

- **Analysis of I/M lane data of 5,272 OBD failures:**
- **Over 65% of MILs for O2, Evap, EGR, or Misfire [21.8%, 20.4%; 12.8%, 11.7%]**
- **fuel control 9.1%; catalyst 6.4%; engine sensors 3.7%; inlet air sensors 3.6%**

Statistical Investigation

- **Looked at repair costs and emission reductions due to repairs**
- **Main areas of concern are:**
 - **OBD identified repairs**
 - **LAB240 identified repairs**
 - **FTP identified**

Statistical Results

- **More data needed to determine if statistical difference is present**
- **No statistical difference between OBD repair costs and LAB240 repair costs**
- **No statistical difference between the average emissions reductions for OBD repairs and LAB240 reductions**
 - **NAS cited 41.4 g/m reductions for IM240 CO vs 1.4 g/m reductions for OBD**

Cumulative Emissions Reductions

- **Cumulative reductions (gpm) identified by OBD n=30:**
 - **11.5/191.7/13.4 (THC/CO/Nox)**
- **Cumulative reductions (gpm) identified by LAB240 n= 12 (all but two vehicles overlap with above):**
 - **10.1/177.3/9.7 (THC/CO/Nox)**
 - **ATL219 assigned repaired emissions levels equal to 1/2 TLEV cert. levels due to lack of repair data**

Statistical Results

- **OBD identifies an additional 12% THC, 8% CO, 28% NOx tailpipe benefits with the addition of 48% in OBD failures (including preventative detections) over LAB240 failures.**
- **Adding the LAB240 to OBD adds little significant cumulative benefit (3% THC; 1% CO; 6% Nox).**

Lack of Overlap between 240 and OBD?

- **Original study on Wisconsin data has been cited as showing little overlap between OBD and LaneIM240**
- **This high-mileage testing is close to random and you would expect 27 vehicles with no MIL and failing 240 results (based on WI ratio)**
- **There are two!**

Poster Child for MIL Repair

- **'96 Ford Windstar with 110k miles**
- **MIL has been on for one year prior to procurement**
- **passed LAB240; failed FTP**
 - **NMHC 0.49/ CO 4.53/NOx 1.4/MPG 18.8**
- **Vehicle had DTCs for intake manifold runner control and misfire cylinder #1**
- **Inspection revealed a disconnected IMRC and a disconnected PCV system**

Poster Child for MIL Repair

- **Disconnected PCV system had caused oil contamination of entire aircleaner and MAF**
- **Repairs cost \$217 (P&L)**
- **Misfire returned after repair**
- **Intake removed/found EGR system compromised from oil and #1 fuel injector low flow**
- **Repairs cost \$459**
- **Oxygen sensor codes then set for two dead O2 sensors (possible oil contamination)**

Poster Child for MIL Repair

- **Repairs for O2 \$263**
- **MIL finally out**
- **FTP retest results**
 - **NMHC 0.16/ CO 1.86/NOx 0.38/MPG 18.3**
- **Total cost to repair: \$1009 (addition of 1 hr diagnostic)**
 - **catalyst expected lifetime?**
- **Estimate original repair would have been under \$100**

Conclusion

- **Findings appear to follow field data on DTCs**
- **Data does not support large numbers of OBD errors of omission that I/M tailpipe test would find**
- **Adding a tailpipe test to an OBD test does not offer any real emissions benefits**
- **OBD failures which are “FTP clean” down to 43% (30% if Evap MIL not counted)**
 - **was 70% in earlier EPA study**
- **OBD repairs will average between \$238 and \$497 for high mileage vehicles (no statistical difference between OBD and tailpipe costs)**

OBD Policy Workgroup Report
Technical Appendix K

Oregon Vehicle Inspection Program

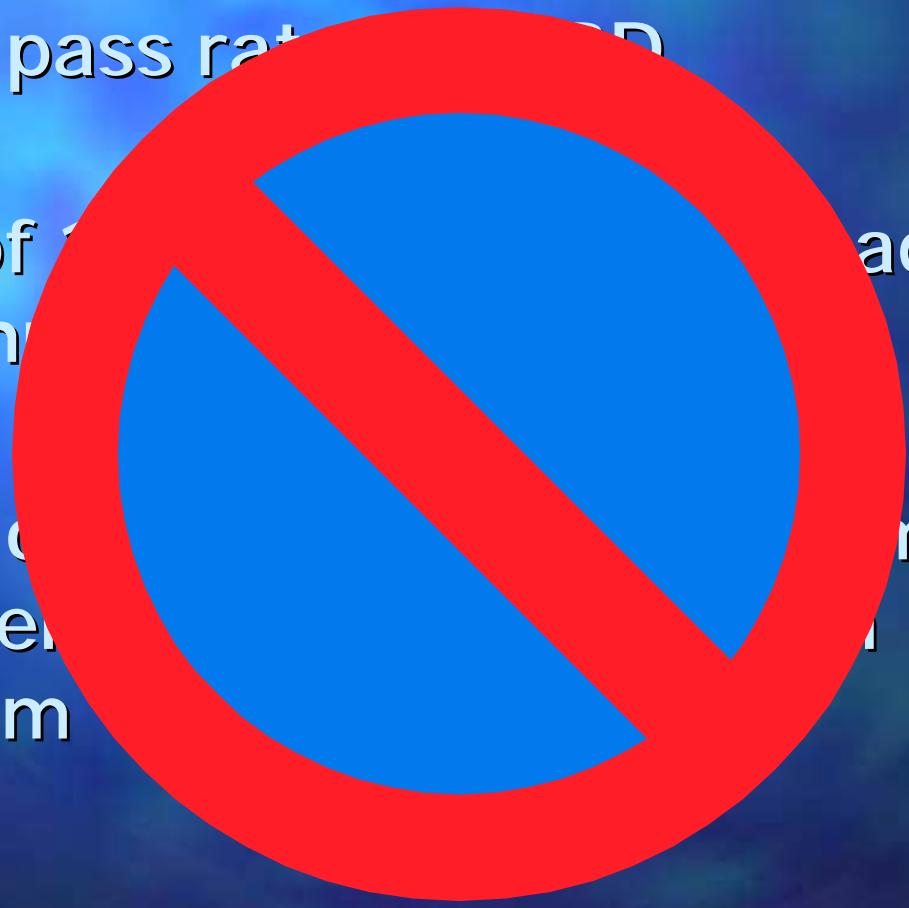
Decisions & Statistics

Ted Kotsakis - Presenter



TRUE STATISTICS FOR OREGON

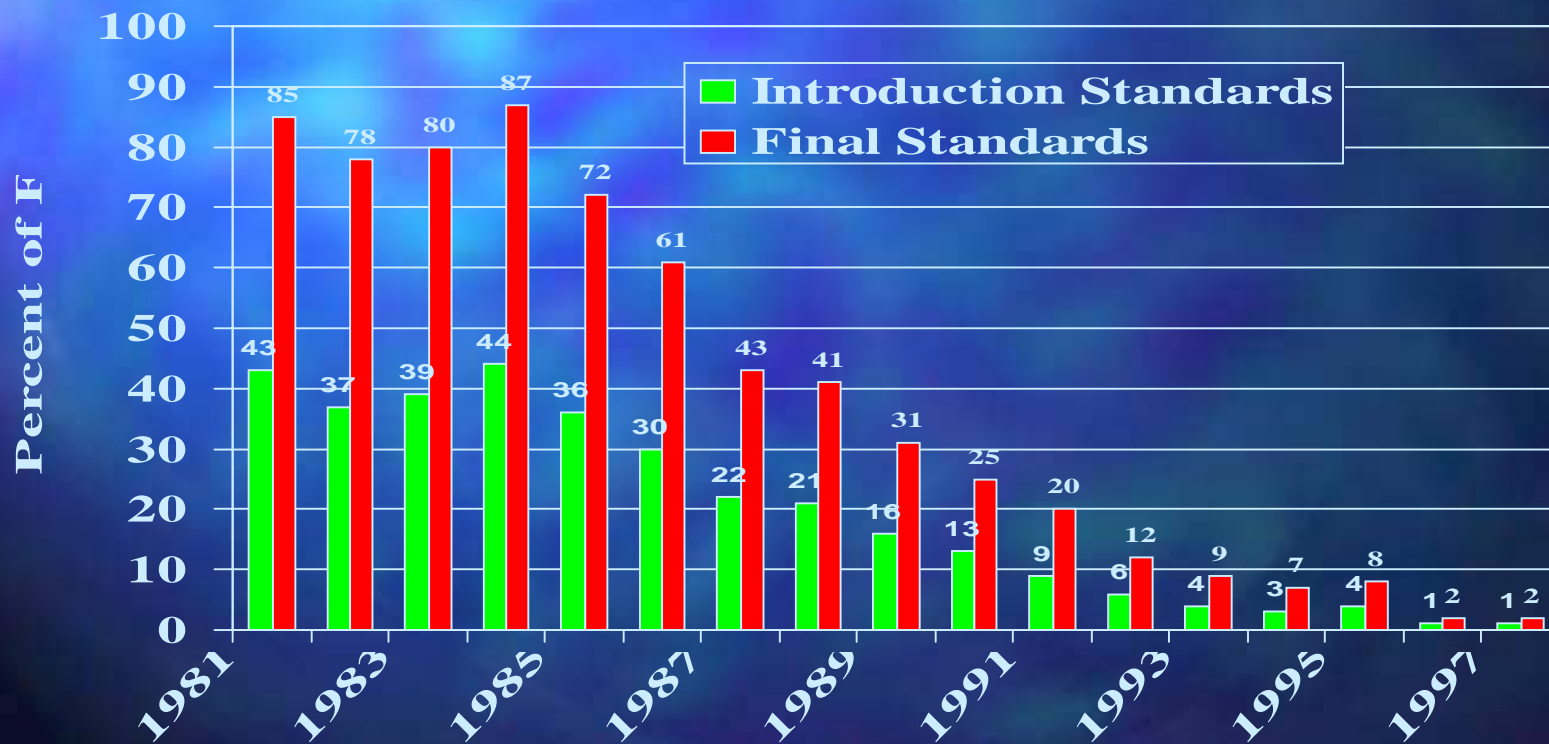
- 100% pass rate on the exam
- 98% of students are "ready" first time through the program
- 100% of graduates are able to maintain their vehicle I/M program



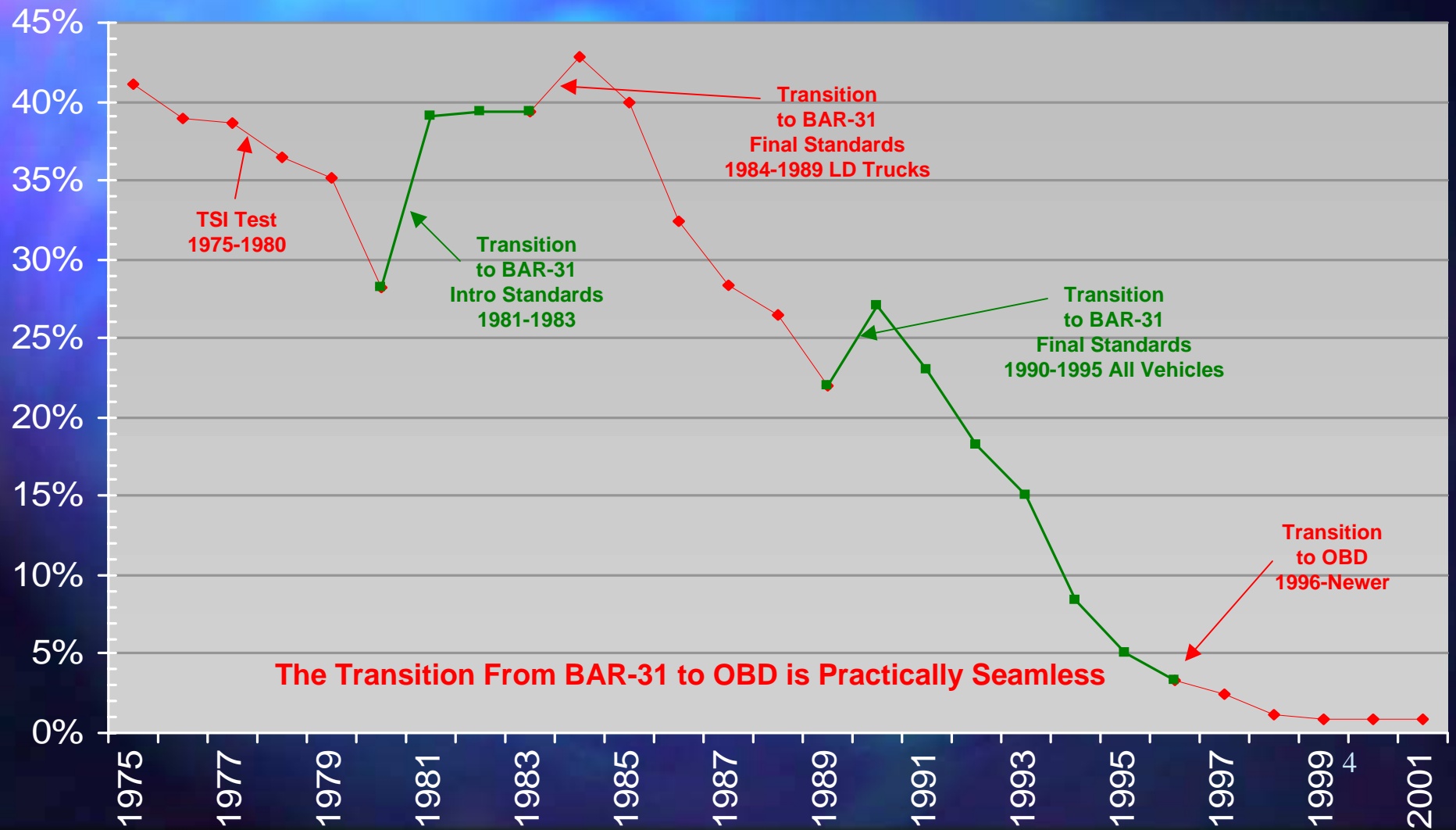
FAILURE RATE BY MODEL YEAR

INTRODUCTION STANDARDS/FINAL STANDARDS

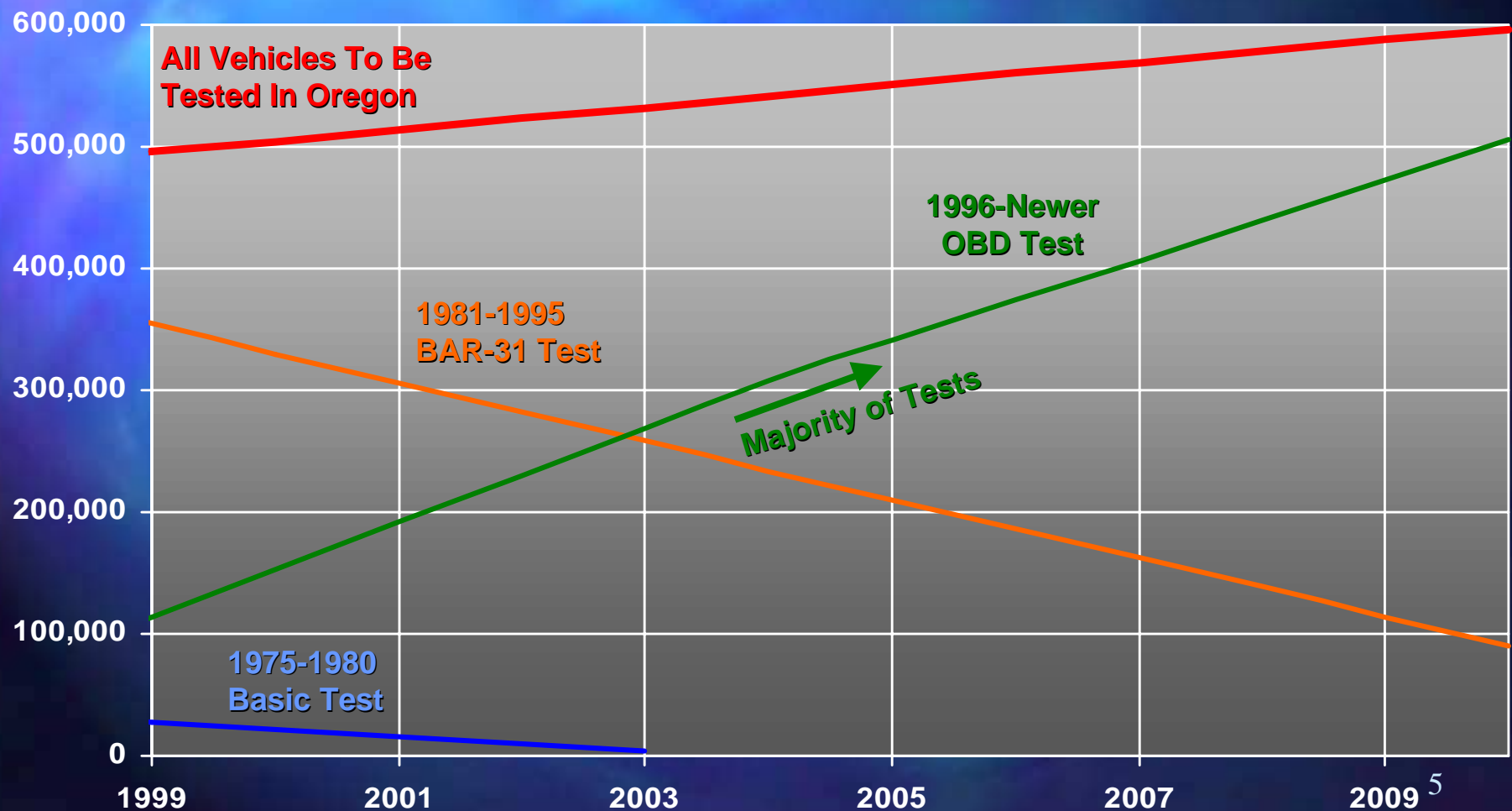
Failure By Model Year



What is Oregon's Failure Rate vs Model Year and Test Type?



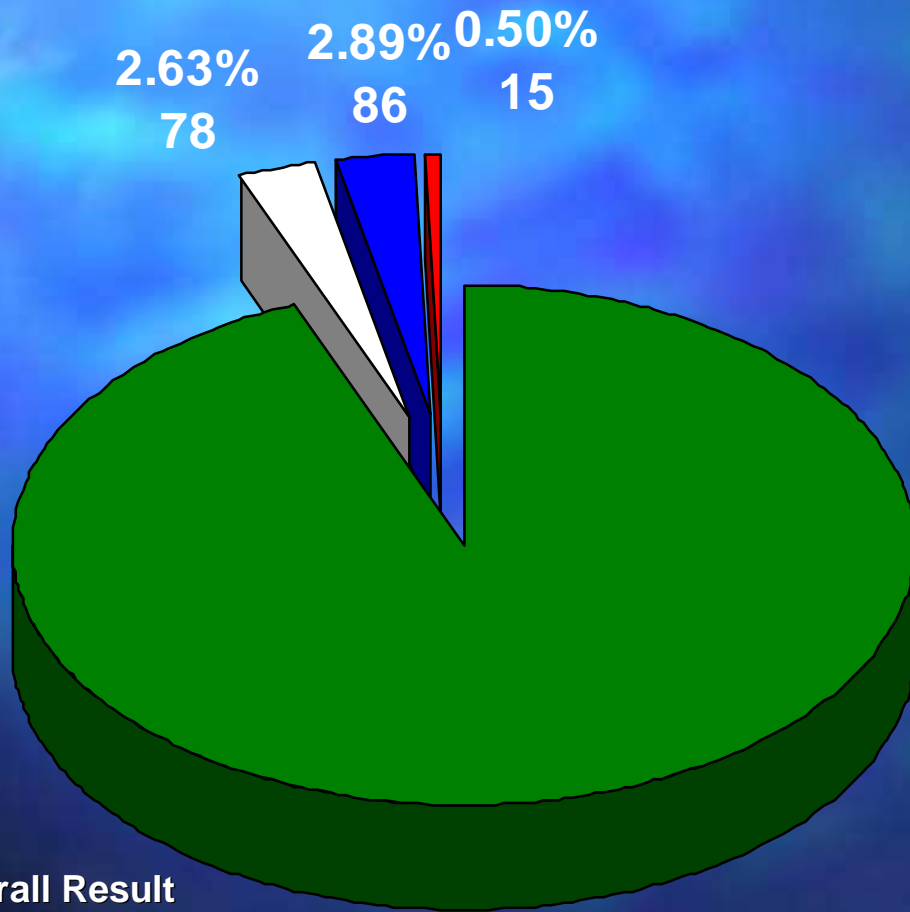
What Is Oregon's Vehicle Model Year Population Trend?



How Does Oregon's OBD Test Compare to its BAR-31 Test?

(Jan 14 - Jan 19) 2002

2,972 Vehicles Tested
Four Phase BAR-31 Test



■	Pass	BAR-31	Pass	OBD
■	Fail	BAR-31	Pass	OBD
■	Pass	BAR-31	Fail	OBD
■	Fail	BAR-31	Fail	OBD

Model Years

1996 = 587
 1997 = 353
 1998 = 710
 1999 = 331
 2000 = 813
 2001 = 167
 2002 = 11

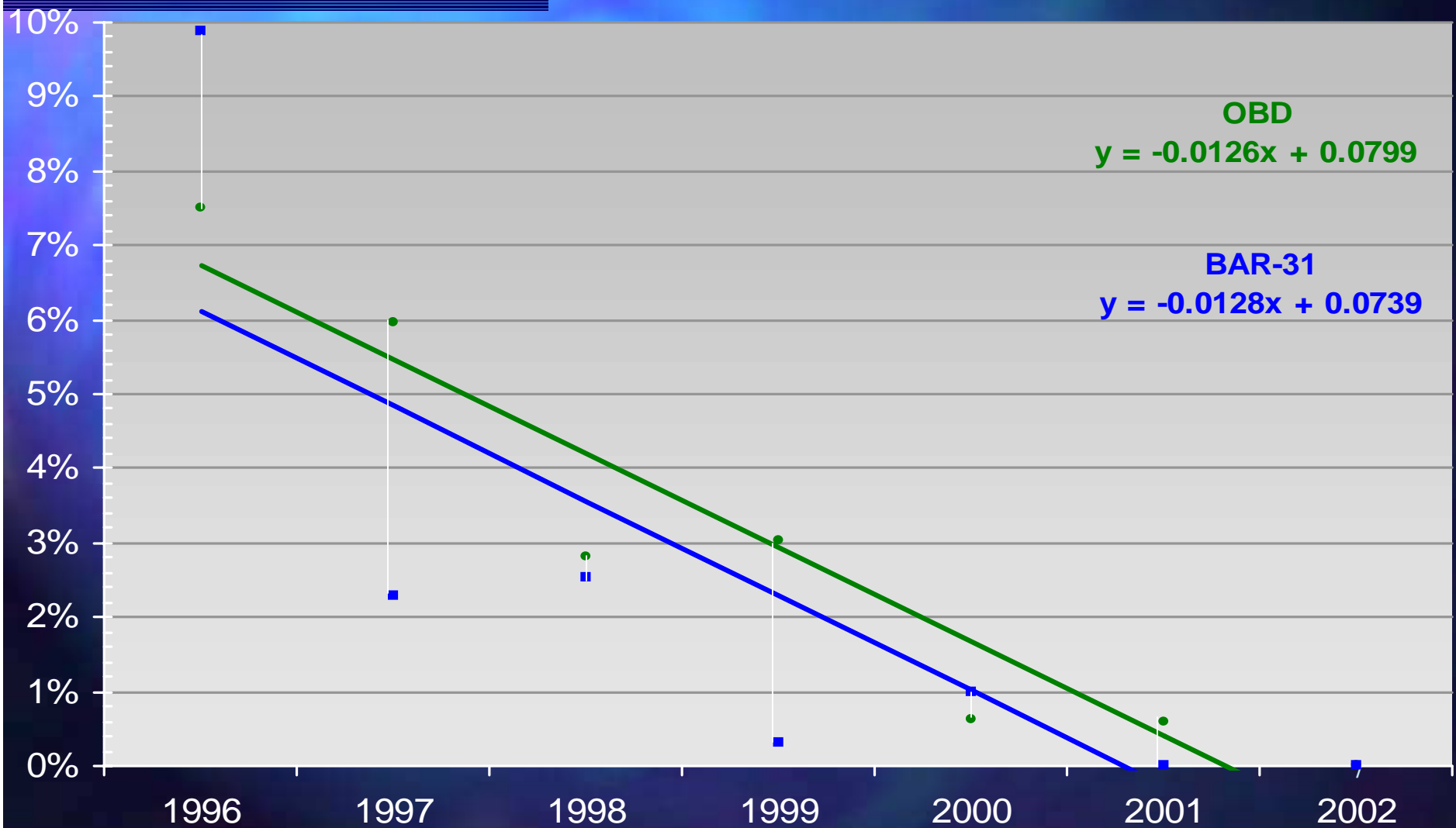
Overall Result

Fail BAR-31 = 93 or 3.13%

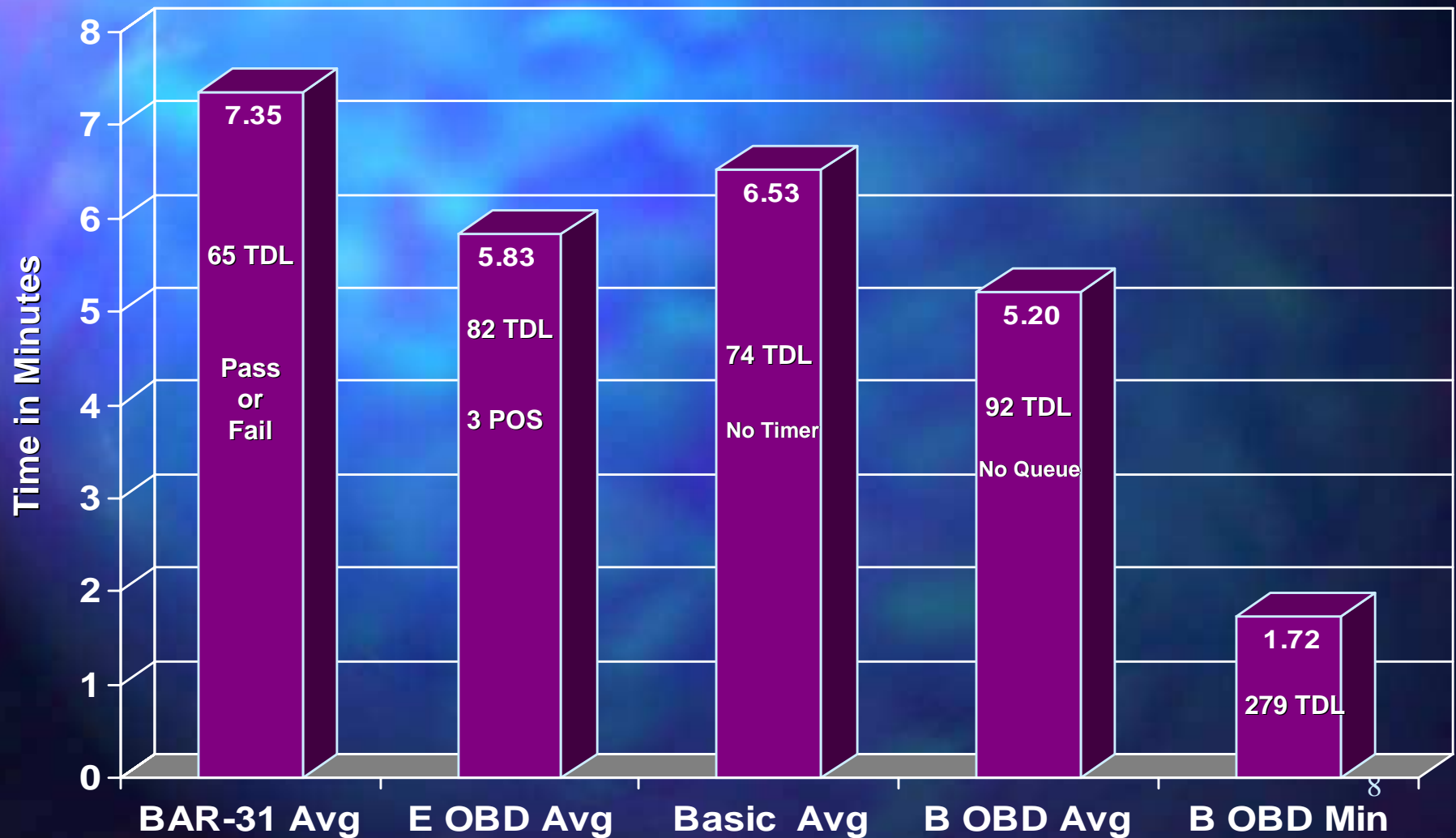
Fail OBD = 101 or 3.40%

93.98%
2,793

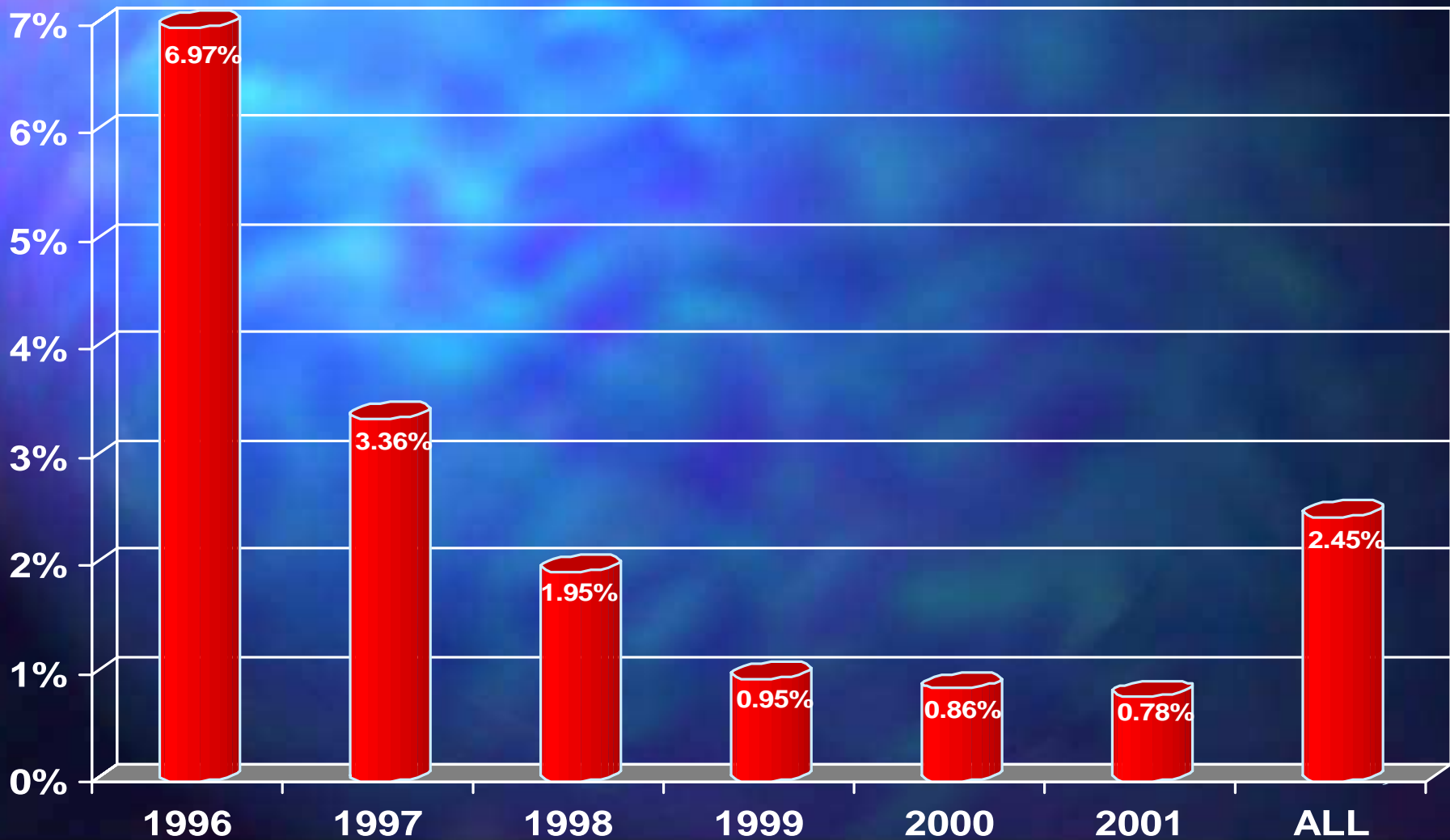
How Does the OBD Failure Trend Compare to the BAR-31 Failure Trend?



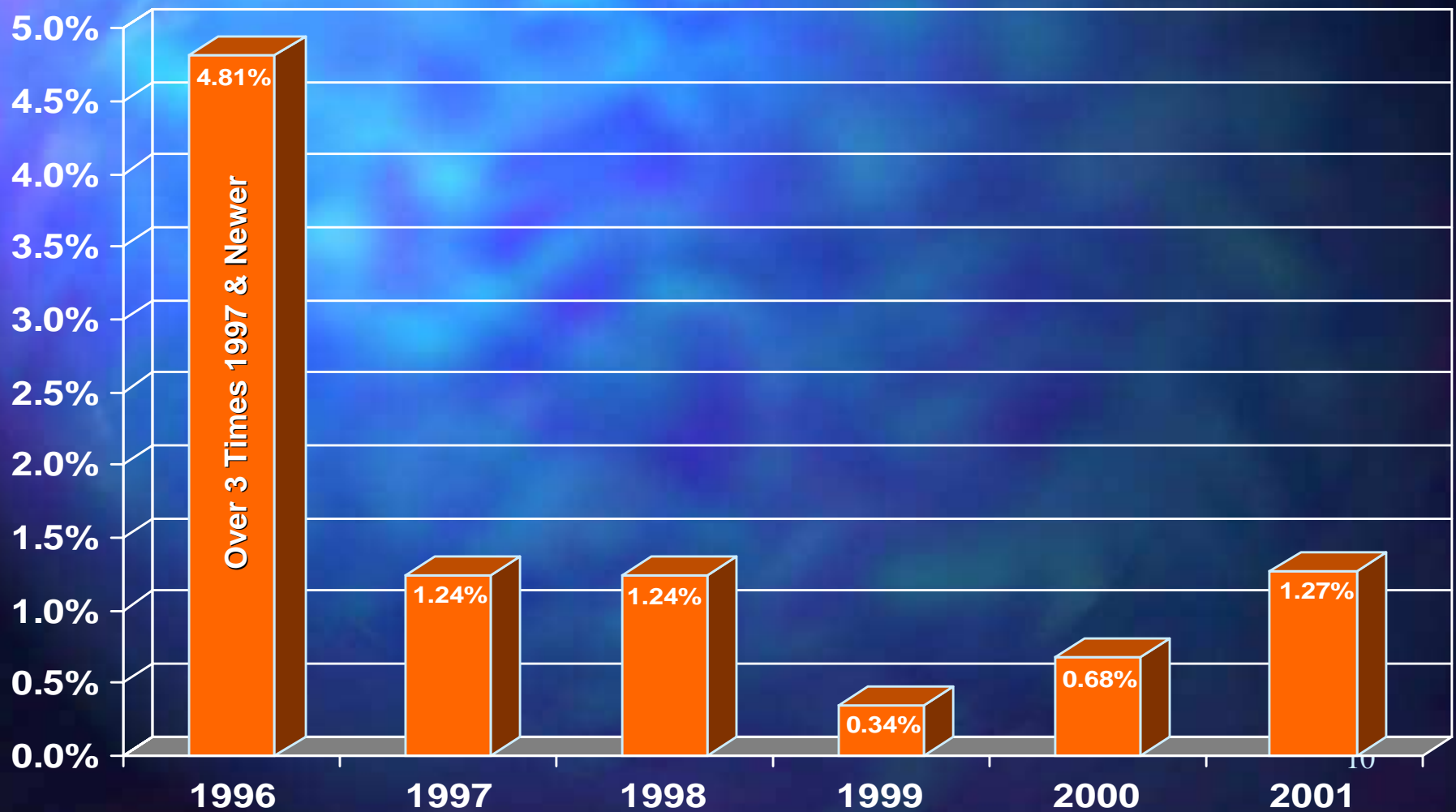
How do Oregon's OBD Test Times Compare to Emission Test Times?



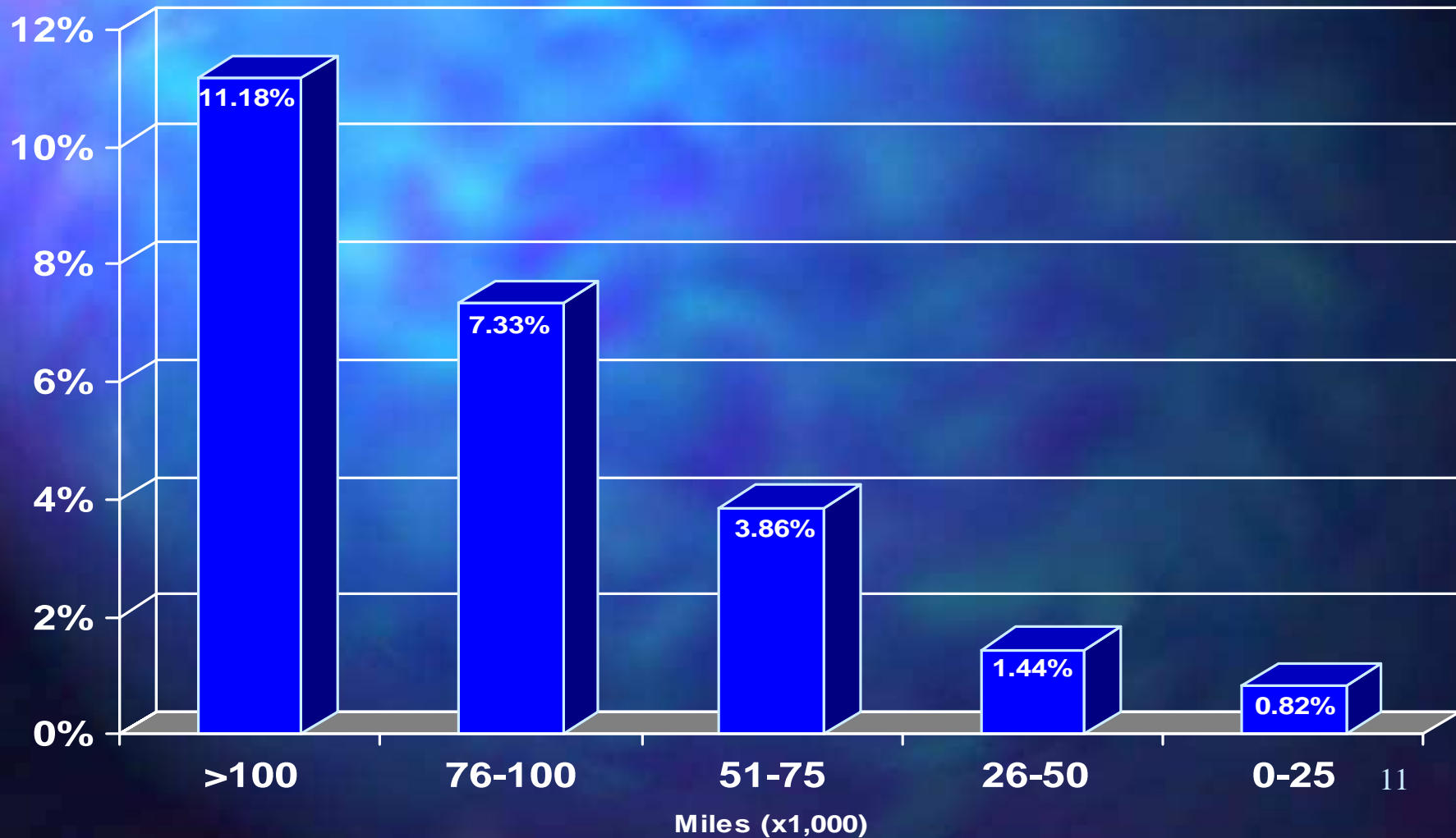
What is Oregon's OBD Fail Rate by Model Year?



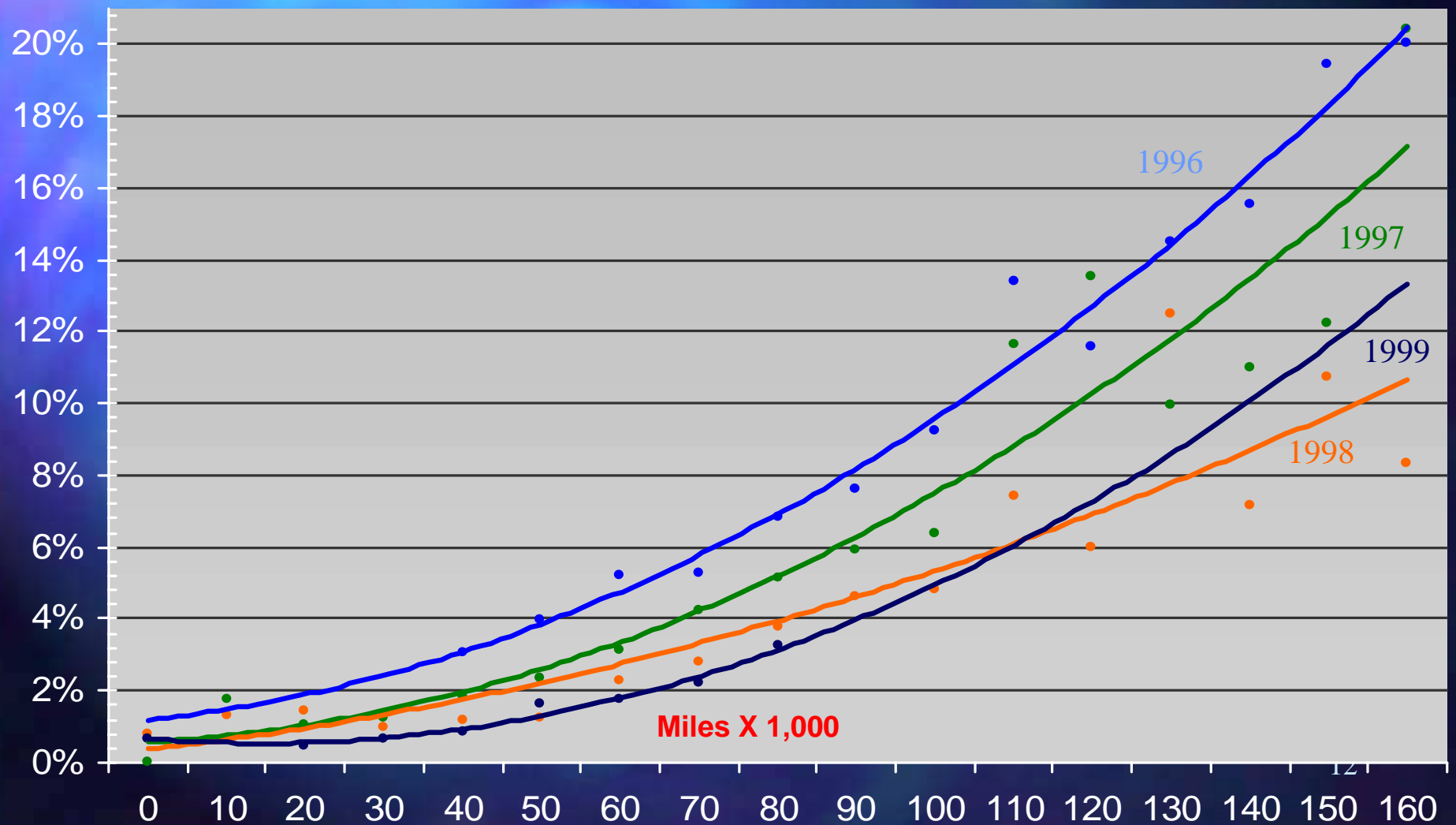
What is Oregon's OBD Not-Ready Rate by Model Year?



What is Oregon's OBD MIL Rate by Vehicle Mileage?

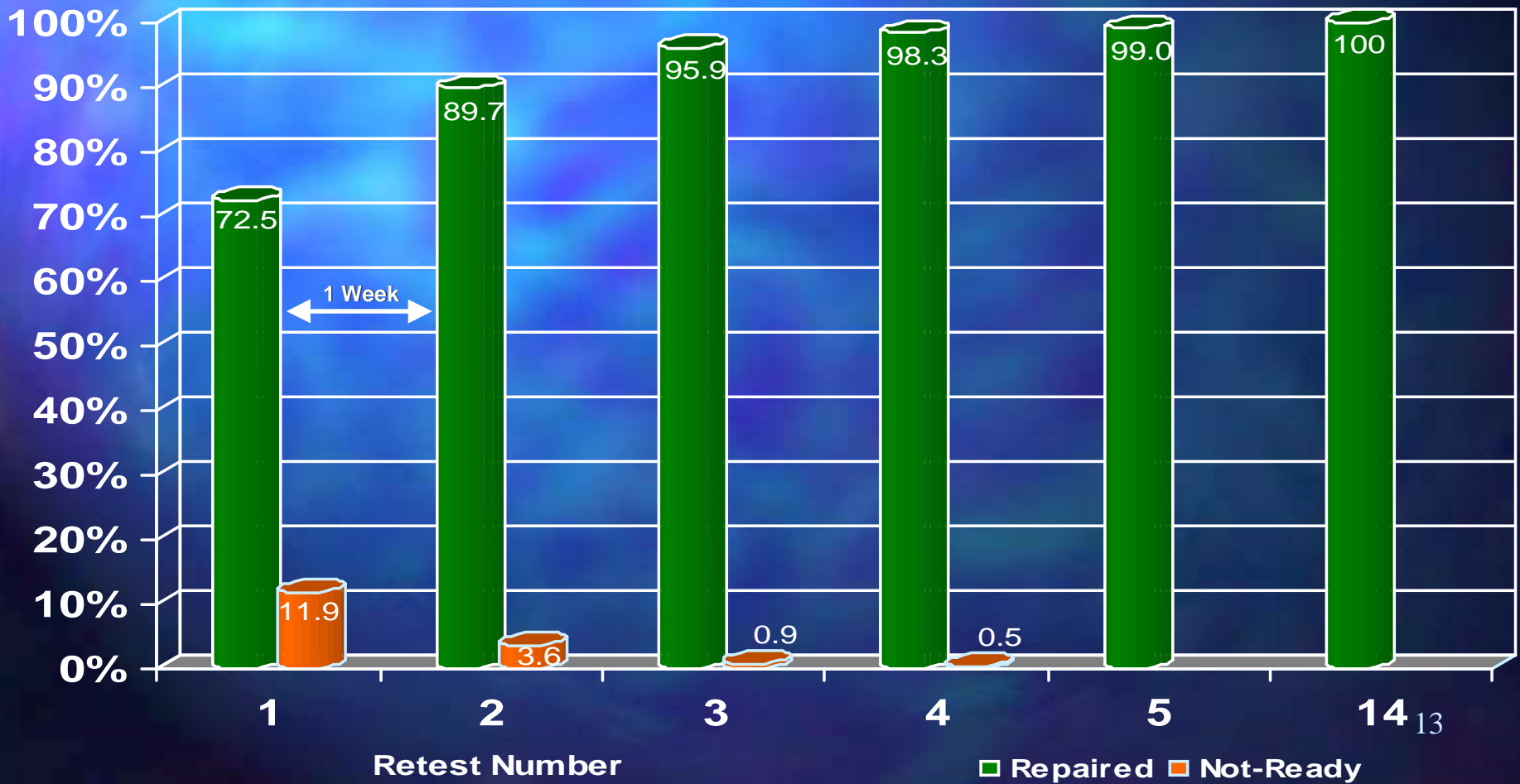


What is Oregon's OBD MIL Rate vs Mileage and Model Year?

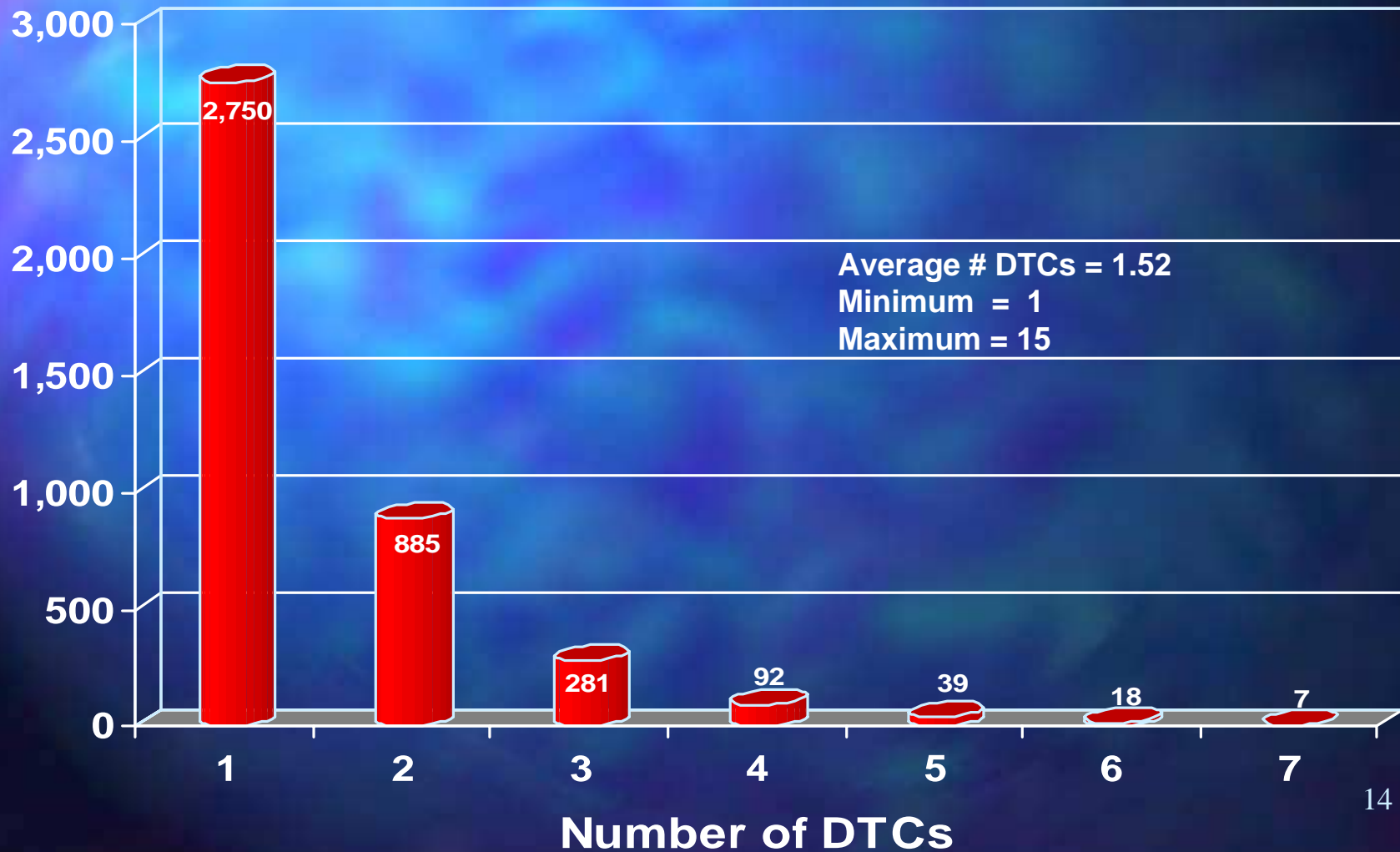


What is Oregon's MIL Repair Effectiveness & Not-Ready Rate?

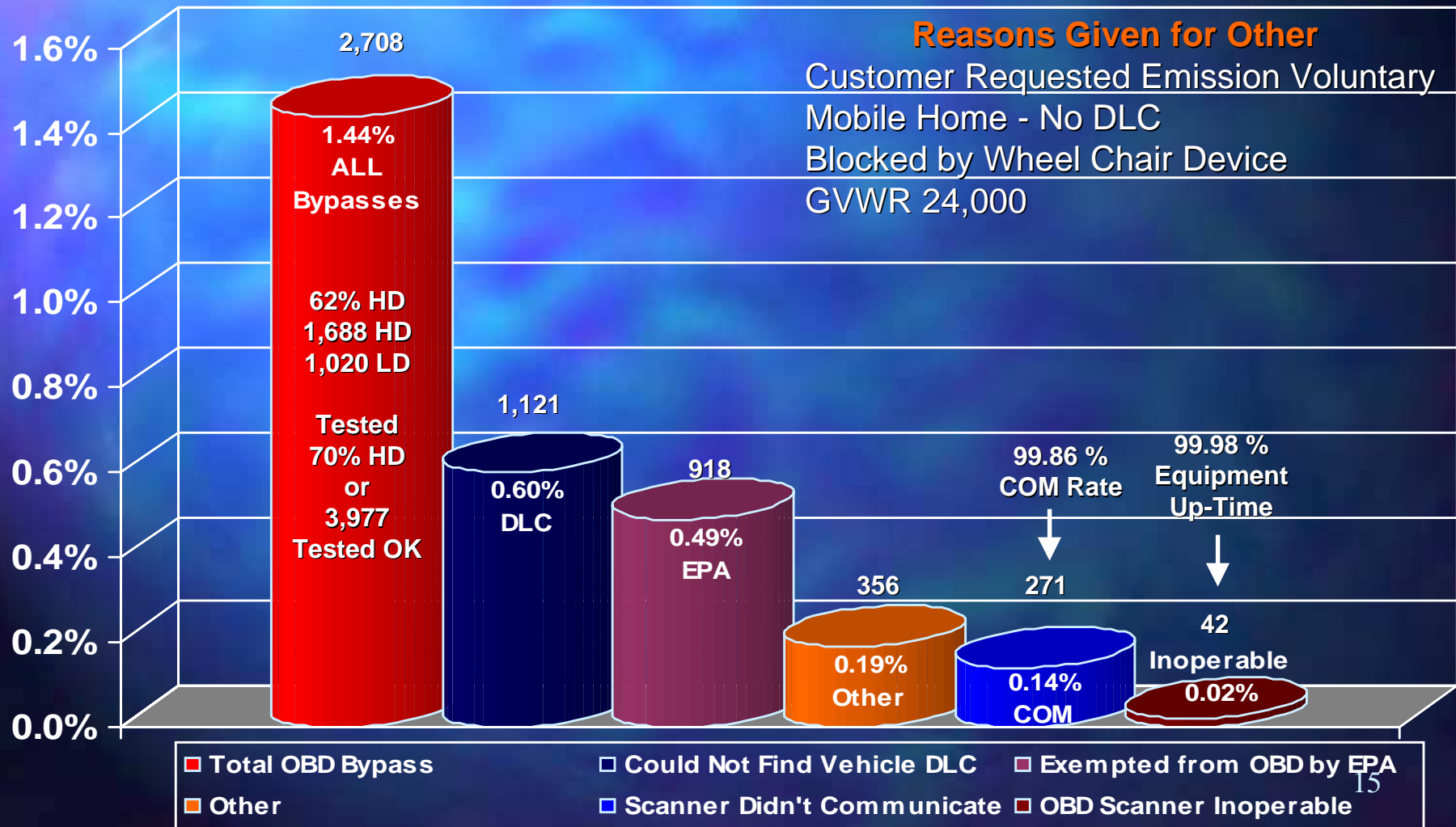
804 Vehicles Tested Between Dec 2000 - Apr 2001



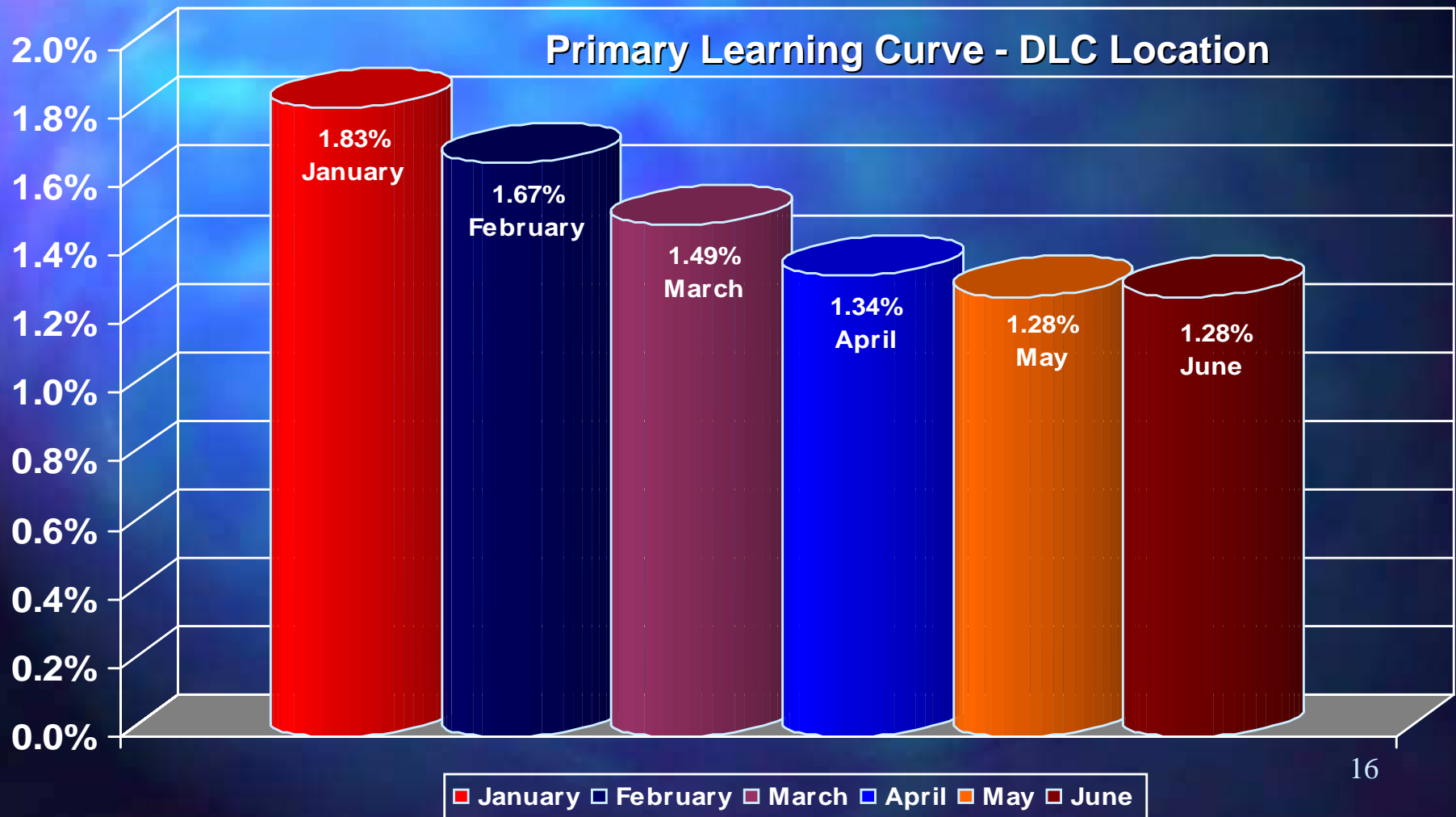
How Many DTCs Do Failing Vehicles Have?



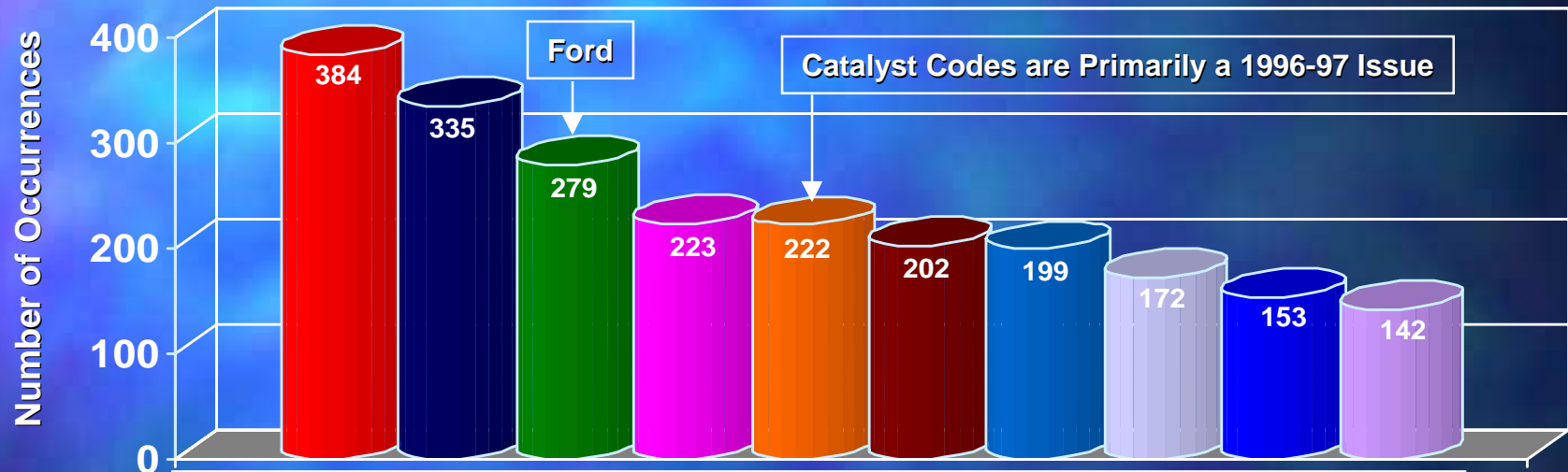
How Does Oregon's OBD Bypass Data Break Down?



Is Oregon's OBD Bypass Rate Improving With Time?



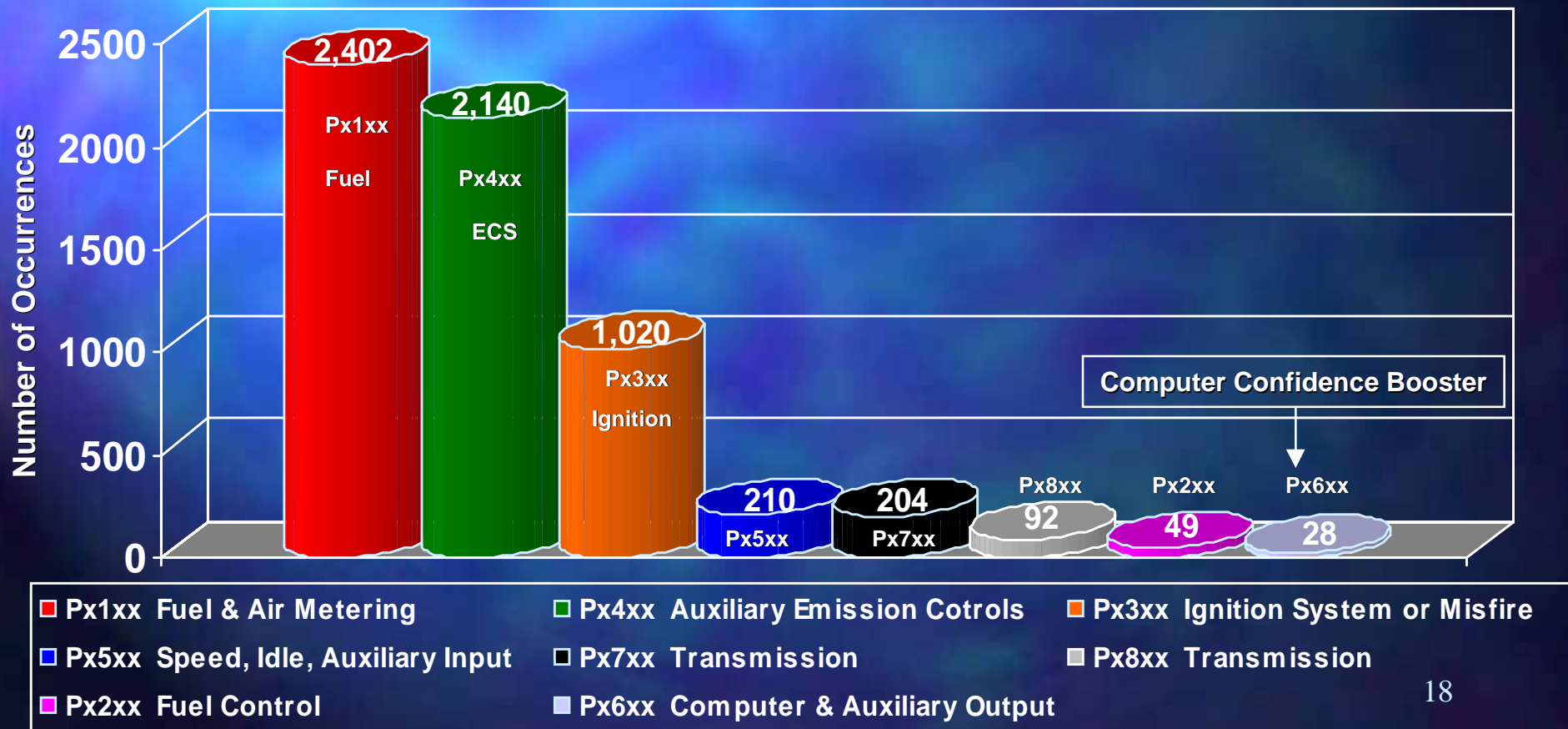
What Are Oregon's Top Ten Diagnostic Trouble Codes?



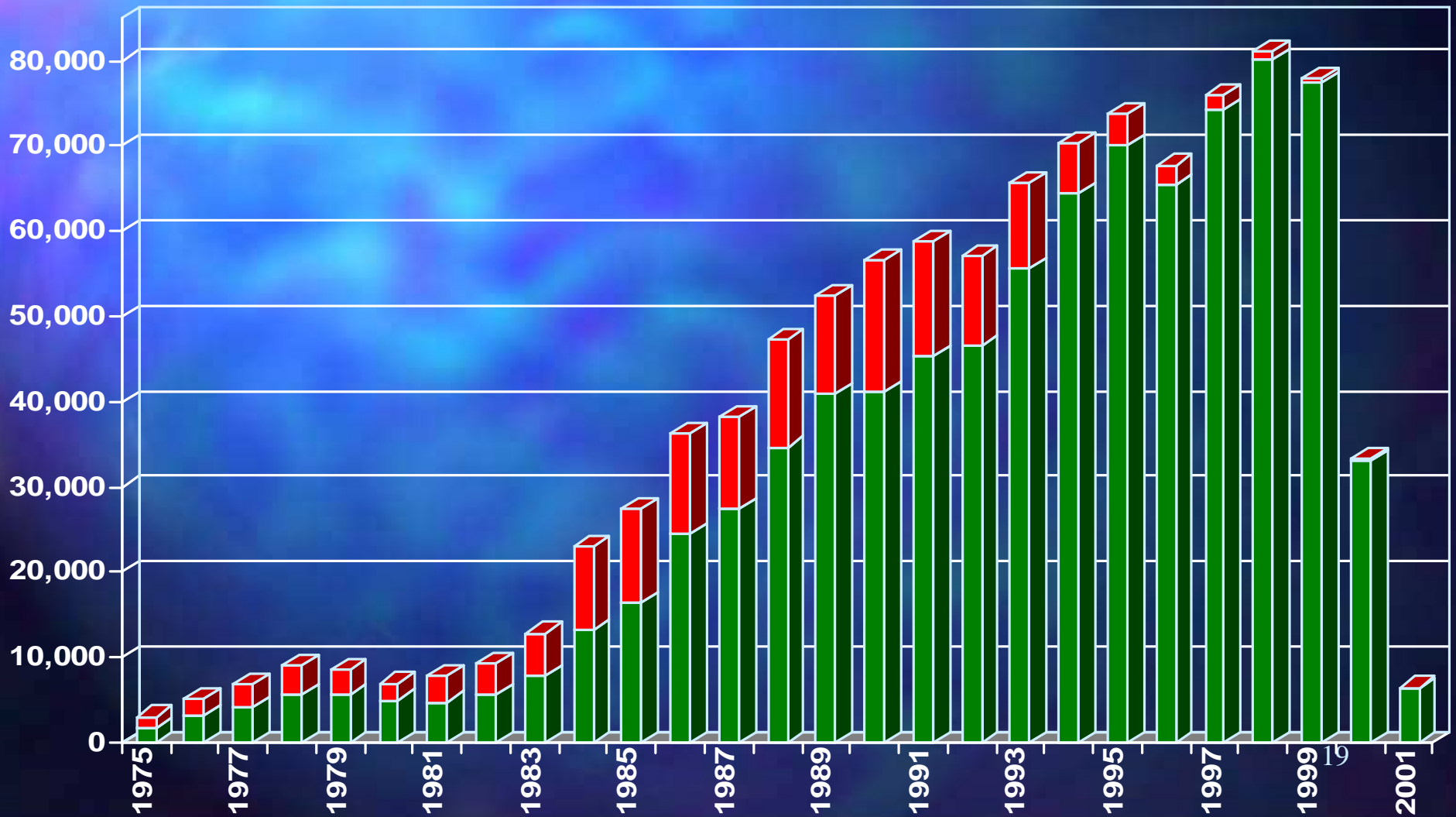
- (384) P0171 System too Lean (Bank 1)
- (335) P0401 Exhaust Gas Recirculation Flow Insufficient Detected
- (279) P1443 (Ford/Lincoln/Mercury) Evaporative Emission Control System Control Valve
- (223) P0174 System too Lean (Bank 2)
- (222) P0420 Catalyst System Efficiency Below Threshold (Bank 1)
- (202) P0141 O2 Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)
- (199) P0133 O2 Sensor Circuit Slow Response (Bank 1 Sensor 1)
- (172) P0300 Random/Multiple Cylinder Misfire Detected
- (153) P0455 Evaporative Emission Control System Leak Detected (gross leak)
- (142) P0135 O2 Sensor Heater Circuit Malfunction (Bank 1 Sensor 1)

What Are Oregon's Top Vehicle OBD System Failures?

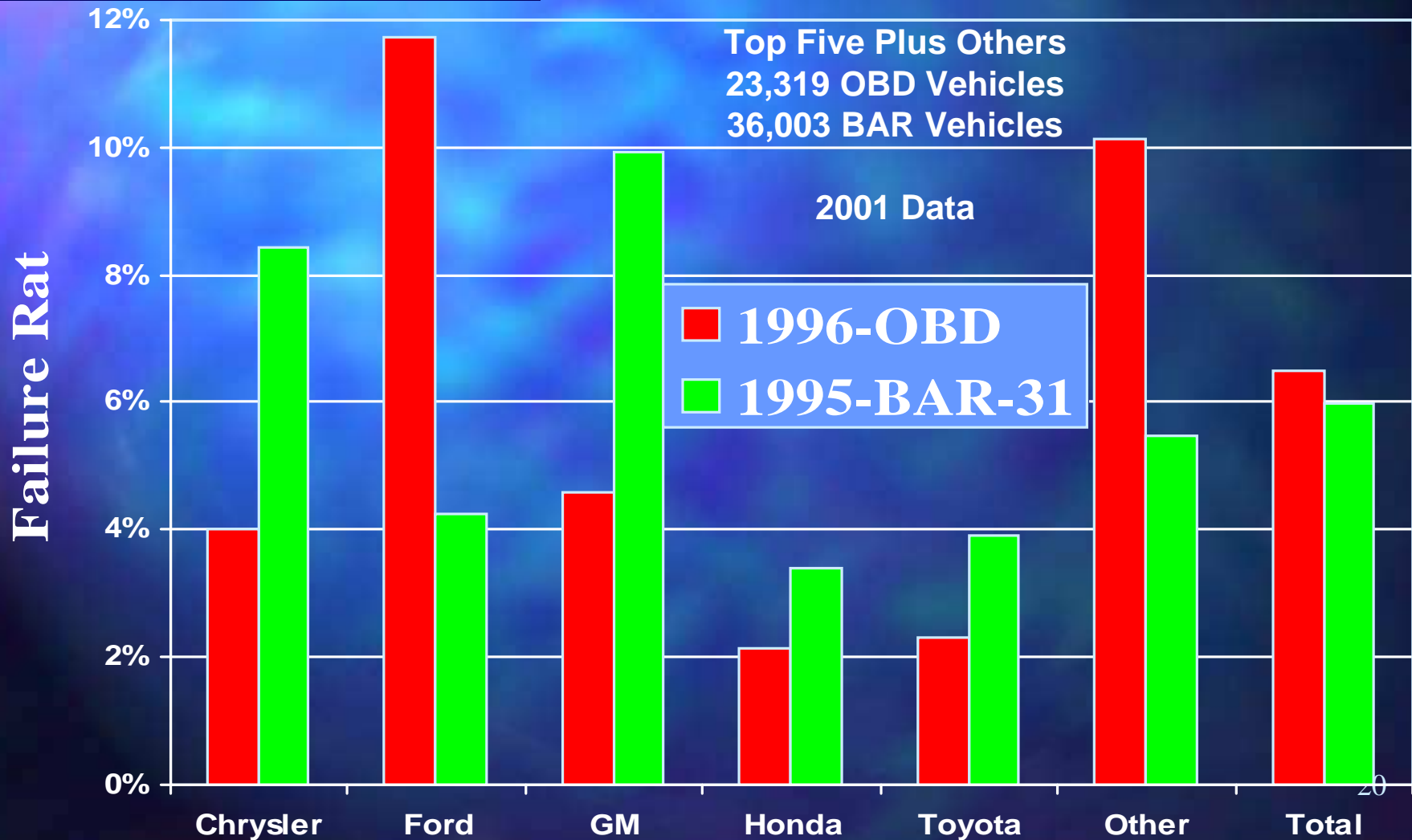
Based upon ALL DTC's Grouped by System



What is Oregon's Vehicle Model Year Volume vs Failure Rate?



How do Manufacturers Compare 1996 OBD Versus 1995 BAR-31?



OBD Policy Workgroup Report
Technical Appendix L

Colorado's OBD II Study Update



Rick Barrett

**Colorado Department of Public Health and
Environment**

COLORADO'S CURRENT I/M PROGRAM

- Current program focused on CO
- Hybrid Program
 - Enhanced Area (Denver Area since 1995)
 - I/M240 1982 and Newer LDV
 - Pass/Fail on visual MIL since 1988
 - OBDII vehicle interrogation since 1998
 - Colorado final stds. > EPA final stds.
 - Two Speed Idle for all others vehicles
 - Basic Area
 - Two Speed Idle

Why Colorado's OBD study?

- EPA's 196 vehicle study focused on OBD failures (some procurement and testing performed by CDPH&E)
- Wisconsin's I/M data indicated very little overlap between I/M240 and OBDII failures
- Colorado's I/M program data also showed Wisconsin's trends
- CDPH&E was concerned that OBD may not be identifying all high emitting vehicles

OBDII STUDY DESIGN

- 100 - 1996 and newer high emitter vehicles procured from Colorado's inspection lanes (failing back-to-back I/M 240s)
- Vehicles evaluated in state emissions laboratory using both the I/M240 and FTP
- Cooperative effort
 - CDPHE
 - ESP
 - Colorado State University
- Start date of August 2000

STUDY GOALS

- Determine at what rate OBD II identifies high emitters
- Investigate the cause of vehicles failing back-to-back I/M 240s without MIL illumination
 - I/M 240 false failures
 - Preconditioning
 - Dynamometer settings
 - Driver variability
 - Uncontrollable environment variables (i.e. temperature, humidity, etc.)
 - OBD II false passes
 - System operation
 - Interrogation software/hardware
 - Combination of both

STUDY GOALS

- Determine if back-to-back I/M 240s provide an accurate assessment of vehicle emissions
- Evaluate inspection equipment accuracy/reliability
- Determine the effectiveness of repairs based on failures of both the I/M240 and/or OBD II
- Determine the cost effectiveness of repairs based on both the I/M240 and OBD II
- Determine how OBD behaves in an I/M environment
 - System readiness codes
 - Vehicle communications

VEHICLE RECRUITMENT

- Procure vehicles at time of failure during the inspection process
- Focus on vehicles which fail two back-to-back I/M 240s
 - Exhaust failure only
 - Exhaust failure and other test components
- Maximum 50% 1996 model year
- Representative of Denver's fleet (cars and trucks)

TEST PROTOCOL

- Confirm lane I/M240 failures in the CDPH&E lab by conducting lane/lab grade I/M240s and FTPs
- Multiple evaluations of OBD system (hand held scanners and lane equipment)
- Analyze pump fuel RVP
- Perform FTP
- Perform OBD II system evaluation at the laboratory

TEST PROTOCOL (cont.)

- Have the vehicle repaired if applicable (dealership/independent)
- Conduct post repair I/M240s utilizing lane and lab grade equipment
- Perform post repair FTP
- Provide a certificate of emissions compliance to vehicle owner
- Return the vehicle back to the owner

Note: Additional evaluation protocols have been identified to address questionable fail vehicles.

OBDII STUDY PROGRESS



- 76 vehicles total to date (with 4 in progress)
- Vehicle failures represent all three pollutants
- 45 cars - 31 trucks
- 12 different manufacturers

OBD Study Progress

- Study vehicles fall into two categories:
 - **Consistent Failures** – All observed I/M240 emissions values (between 8 and 10 inspections) are consistently above federal final I/M240 standards for one or more pollutants.
 - **Inconsistent Failures** – All observed I/M240 emissions values (between 8 and 10 inspections) are not above federal final I/M240 standards, i.e. at least one I/M240 showed emissions below federal final standards for all pollutants.

OBD Study Progress

(Consistent Failures)

- 59% (n=45) of study vehicles to date, have shown consistent I/M240 failures
 - Out of these 45 vehicles:
 - 51% (n=23) had their MIL on, or commanded on at the time of their initial inspection
 - 49% (n=22) had their MIL off at the time of their initial inspection
 - Three of the 22 vehicles had the MIL illuminate during the study in the lab
 - All vehicles had emissions > FTP standards

OBD Study Progress

(Inconsistent Failures)

- 41% (n=31) of study vehicles to date were not consistent I/M240 failures (based on EPA's final I/M240 stds.)
 - Out of these 31 vehicles:
 - 23% (n=7) had their MIL on, or commanded on at the time of their initial inspection.
 - An additional 19% (n=6) had their MIL illuminate while being evaluated at the CDPHE lab.
 - 58% (n=18)
 - 14 vehicles received an FTP (3 vehicles procured before protocol change, 1 AWD)
 - 8 of the 14 had emissions > FTP standards (5 had emissions values >1.5x certification values)
 - 6 vehicles had emissions < FTP standards

POTENTIAL PROBLEM TRENDS IDENTIFIED

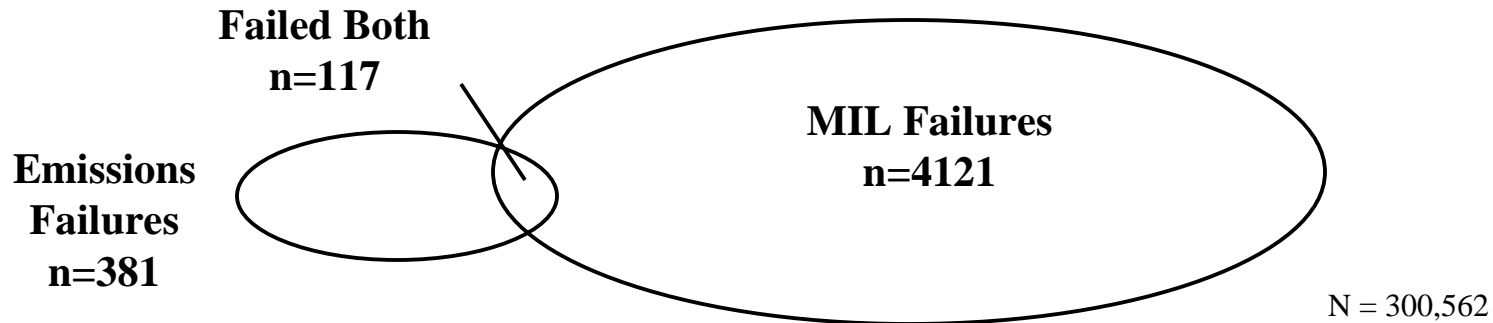
- Dodge LDGT
 - Inoperative catalyts (empty) without MIL illumination
- Chevrolet Camaro
 - Evaporative system leaks (hose disconnected)
- Ford LDGT
 - O2 sensor malfunctions
- Hyundai Elantra
 - O2 sensor malfunctions
 - Inoperative catalyts
- Volkswagen
 - O2 sensor malfunctions

Program Failures vs Study Procurement

TOP 20 TAILPIPE ONLY FAILURES (Inspection year 2001)

- ***1996 DODGE RAM 1500 (57,3)***
- 1997 FORD F-150 (21)
- ***1997 FORD EXPLORER (16,1)***
- ***1996 FORD MUSTANG (15,1)***
- 1996 CHEV CAVALIER (14)
- 1996 FORD EXPEDITION (14)
- 1997 HONDA CIVIC (13)
- ***1996 CHEV CAMARO (13,4)***
- ***1997 DODGE RAM 1500 (12,1)***
- ***1996 CHEV CORSICA (12,2)***
- ***1996 FORD CONTOUR (11,1)***
- ***1997 KIA SEPHIA (11,1)***
- ***1996 FORD BRONCO (11,4)***
- ***1997 GEO METRO (11,2)***
- ***1998 FORD CONTOUR (11,2)***
- ***1996 FORD TAURUS (10,2)***
- 1997 CHEV CAVALIER (10)
- 1997 CHEV CAMARO (10)
- 1997 PONT FIREBIRD (8)
- ***1997 DODGE NEON (8,2)***

Colorado's I/M Program Results



Vehicle Model Year	Failed Emissions	Failed Both Emissions & MIL	Failed MIL
1996	146 (.26%)	50 (.09%)	1636 (2.87%)
1997	146 (.17%)	46 (.05%)	1502 (1.72%)
1998	44 (.08%)	8 (.01%)	534 (.94%)
1999	25 (.06%)	6 (.01%)	201 (.49%)
2000	13 (.04%)	6 (.02%)	164 (.46%)
2001	7 (.03%)	1 (.00%)	83 (.38%)
2002	0	0	1 (.09%)
TOTALS:	381 (.13%)	117 (.04%)	4121 (1.37%)

Vehicle Procurement Changes

- Colorado's I/M 240 standards changed Jan. 1 2002
 - Only for LDGV
 - Only for HC and NOx
 - HC – 2.0 gpm to 1.2 gpm
 - NOx – 4 gpm to 3.0 gpm
- Starting May 2002 switched procurement standards from Colorado's I/M 240 standards to EPA's final standards

	Colorado's I/M240 Standards			EPA Final Standards		
	HC	CO	NOX	HC	CO	NOX
LDGV	1.2	20	3.0	.6	10	1.5
LDGT1	4	20	9	.6	10	1.5
LDGT2	4	20	9	.8	13	1.8
LDGT3	4	20	9	.8	13	1.8
LDGT4	4	20	9	.8	15	2.0

Vehicle Procurement Changes

- Readdressing our initial vehicle procurement goals
 - Problematic vehicles have dominated individual procurement classes
 - Dodge Trucks
 - Chevrolet Camaro
 - Hyundai Elantra
 - Volkswagens
 - Excepting additional vehicles in these classes other than the vehicles above

OBD Study Progress

(Vehicles procured from EPA stds.)

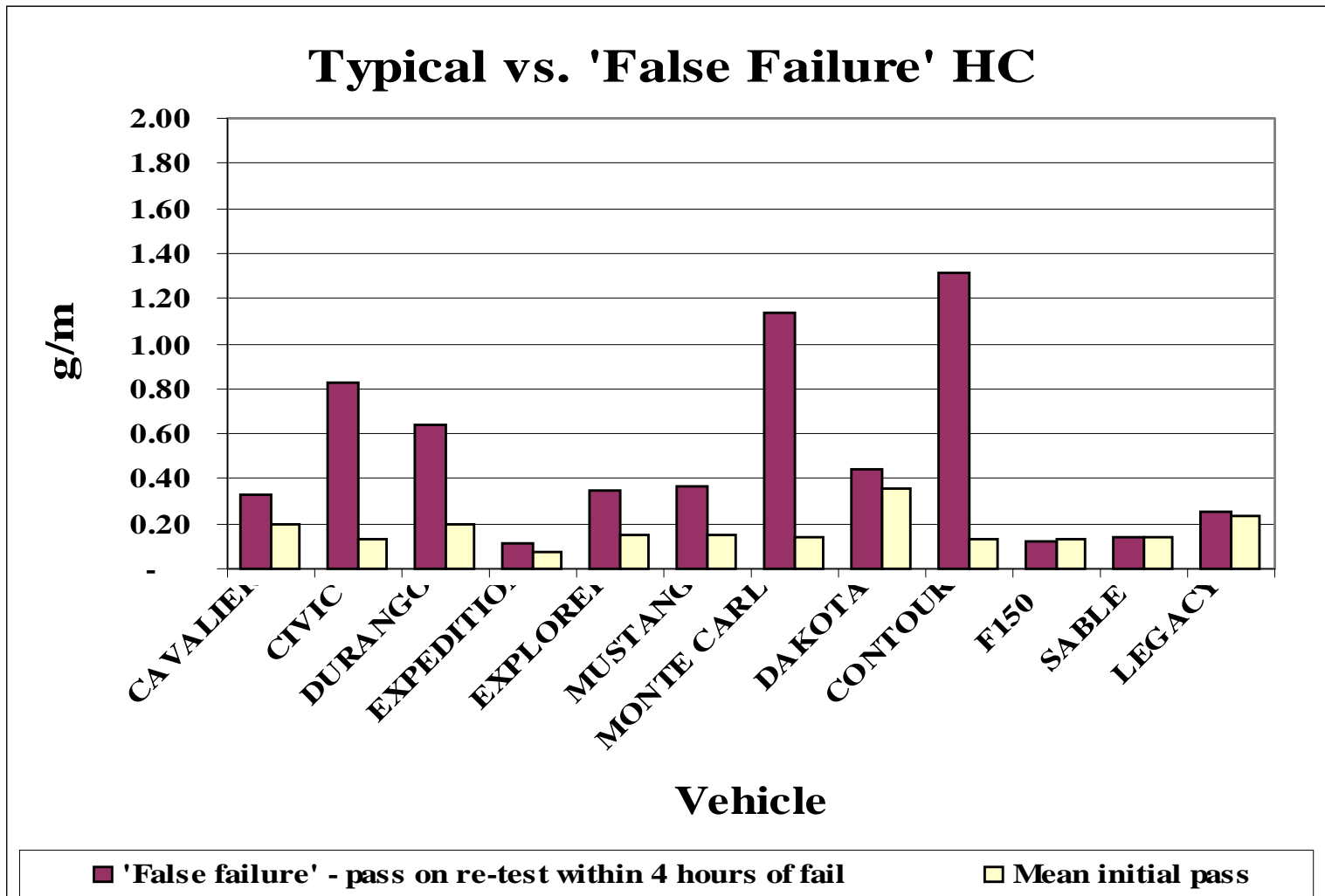
- Six vehicles passed Colorado's stds. with emissions > EPA's final stds.
 - Five vehicles classified as inconsistent
 - All five vehicles failed the FTP by 1.6 to 7.2 times certification levels for the failing pollutant.
 - Four of the five did not have the MIL illuminated at the time of their initial inspection
 - Three of the four had their MIL illuminate while being evaluated at the CDPHE lab
 - One vehicle consistently failed the I/M240s in the lab
 - The MIL remained off throughout the study
 - All six vehicles have or are currently being repaired

Preconditioning Analysis

- 499 vehicles were eligible for 2 back-to-back I/M240 inspections
- 27% (n=134) received a second set of back-to-back I/M240 inspections
 - 52% (n=70) passed the second set of I/M240 inspections

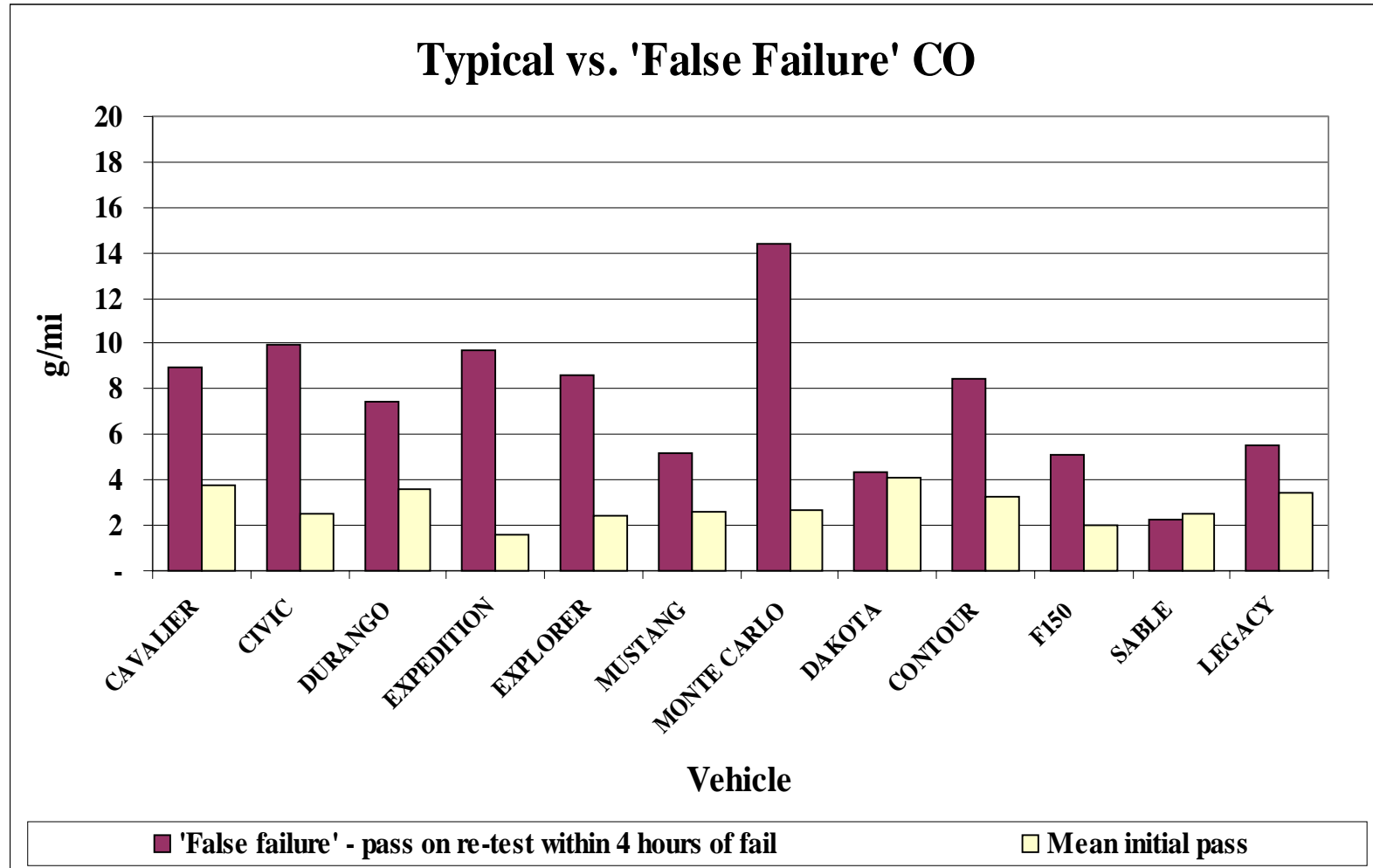
Preconditioning Analysis

Note: Vehicles with two or more data points



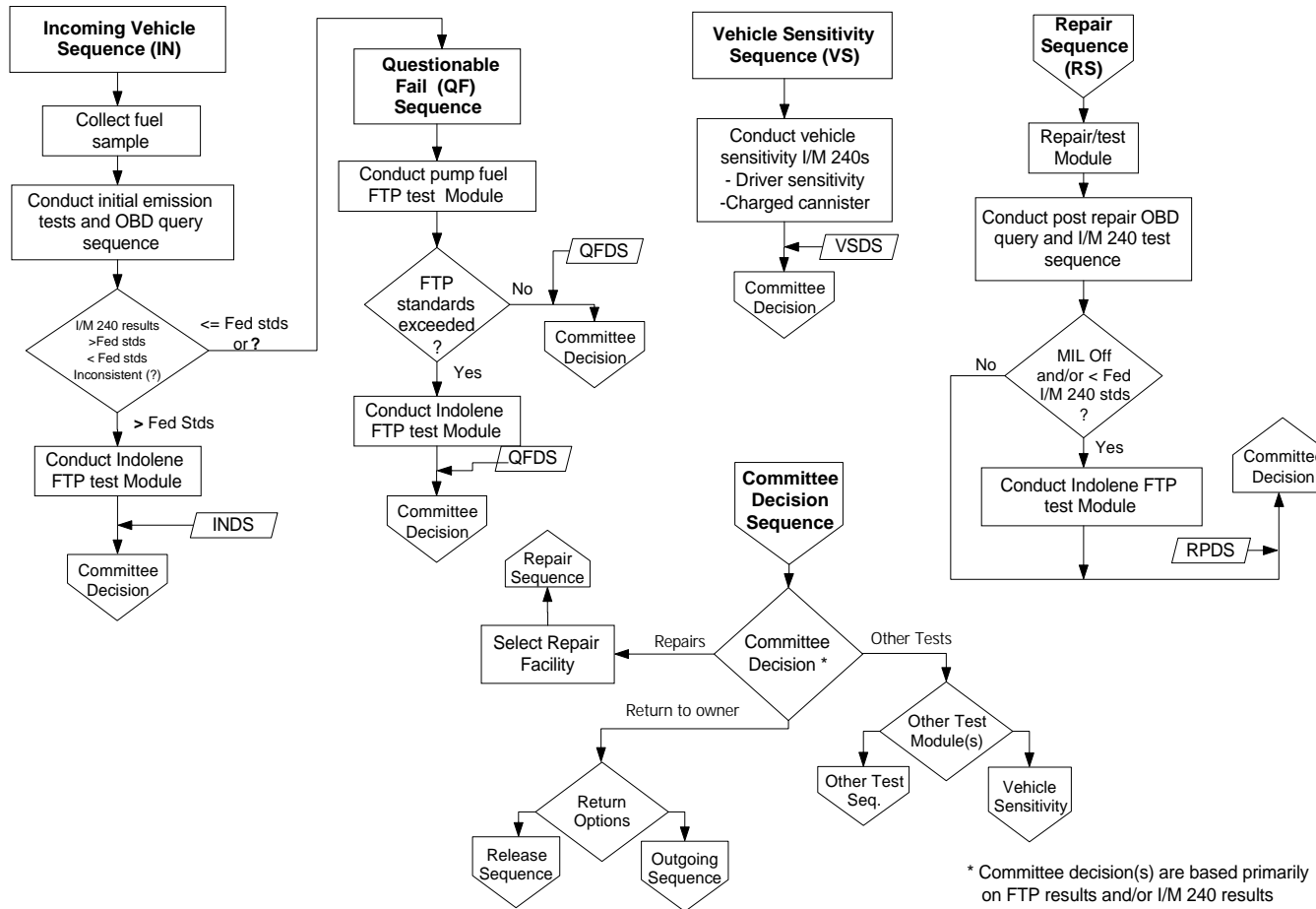
Preconditioning Analysis

Note: Vehicles with two or more data points



Study Protocol Overview

CDPHE/ESP (OBDII) STUDY TEST PROTOCOL OVERVIEW



OBD Policy Workgroup Report
Technical Appendix M

**Summary of Studies Regarding On Board Diagnostics
use in Inspection/Maintenance Programs
July 2002**

Current and ongoing OBD studies/data collection efforts

1. EPA High Mileage Study

Authors: Edward Gardetto and Ted Trimble
On-Going

– Purpose and Methods

This study is still in progress and has not been fully analyzed at this time. This test program has been reviewed and continually briefed before the FACA OBD Technical Review workgroup. The purpose of this test program is to identify model year 1996 and newer vehicles with over 100,000 miles for evaluation using the FTP tailpipe test. The vehicles are also tested using the OBD system and a lab grade IM240 test. The sampling is biased to the model years '96 through '98 and also weighted to reflect the fleet in manufacturer sales. Vehicles qualify only by mileage and not by MIL status (unlike the "200 Car OBD Study").

– Conclusions

At this time EPA has tested 96 total vehicles and believes that the data shows the following trends:

- Less presence of the MIL "on," but clean FTP emissions than seen in the "200 Car OBD Study" (43% versus 70%)
- No cases of vehicles having "maintenance not required" (MNR) have been found with the MIL illuminated vehicles in this test program

This test program is ongoing and will continue through this fiscal year. Testing is planned to continue next fiscal year contingent on funding.

Ed Gardetto provided an update of the analysis of this program to the OBD Policy Work Group and the OBD Technical Review Work Group at the June, 2002 meetings.

2. CAP2000 Certification data (continuous in-use testing data)

CAP 2000 institutes an in-use testing program called the In-Use Verification Program (IUVP). The IUVP program requires manufacturers to test customer owned and operated vehicles, as follows:

- One year-old and 4 year-old vehicles (min 50K miles) are tested

- Testing is on randomly selected vehicles and run “as received”
- Testing includes FTP, SFTP on all vehicles
- Some vehicles (1 vehicle per evaporative family or test group) tested for evaporative emissions and at high altitude

2000 vehicles expected to be tested each year. Every test group over 5000 sales is tested annually. EPA will start receiving test data in the 2005 calendar year on 2001 MY high-(50k+) and 2004 low-mileage (10k+) vehicles.

OBD information includes:

- MIL Illumination (on or off)
- Up to 5 Diagnostic Trouble Codes (DTCs)
- Up to 5 “not ready” codes

3. CRC RSD no OBD I/M study (3 year study)

This study will gather remote sensing data from a no I/M area which will allow evaluation of OBD I/M areas by comparison. This no I/M RSD case is important for allowing states to evaluate the impact of OBD I/M since no data exists on now a fleet of OBD vehicles operates with out the oversight of an I/M program. This study will produce data over the next three years with interim reports being made available.

4. EPA “Lifecycle” Analysis of OBD benefits

This analysis will evaluate the “preventative” benefits associated with OBD repairs prior to a tailpipe emissions problem. This analysis has been contracted out to Sierra Research and should be completed in the summer of 2002.

5. Colorado Department of Health FTP Study

Author: Rick Barrett
On-Going

- Purpose and Methods

This test program has had its design and results briefed before the FACA OBD Technical Review workgroup since the start of testing. This study design is to recruit 100 MY96 and newer vehicles (limit of 50 MY96 vehicles) which fail back-to-back IM240 lanes tests. Since the inception, this study has changed the IM240 failure criteria to failing two back-to-back (four failures) IM240 test to qualify for recruitment into the FTP test program. The study’s goals are:

- determine if back-to-back IM240's provide accurate assessment of emissions
- determine at what rate OBD identifies back-to-back IM240 failures
- investigate the cause of vehicles failing IM240 with no MIL

- determine how OBD behave in an I/M environment

– Conclusions

This test program is on-going. Therefore, a final report is not available. The following have been reported at this time:

- 40 vehicles tested
- 24 vehicles have had lane failure verified
- 8 of the 24 had MIL illuminated at time of inspection
- 10 of the 24 had the MIL illuminate during the evaluation
- 6 of the 24 had no MIL at any time during the evaluation

With regard to the 16 vehicles which did not have their lane failure verified:

- 7 of the 16 had MIL illuminated
- 12 of the 16 had FTP tests
- 7 of the 12 failed the FTP
- 5 of the 7 had FTP emissions greater than 1.5 times certification standard

The above vehicles were recruited from a population of 140,118 vehicles inspected with 97.6% of the vehicles passing both tests (IM240 and OBD). The study has also looked at the impact of using two back-to-back IM240s in failing vehicles. Of 285 lane failures (single back-to-back) 90 vehicles were issued a second back-to-back IM240 test. The study reports 49 of the 90 vehicles then passed the second back-to-back IM240 sequence.

Colorado has stated that the study will begin to recruit vehicles for the remainder of this test program by applying final EPA IM240 cut points. This has been a concern of the test program by the OBD Technical Review workgroup from the beginning of this test program.

July, 2002 update: Rick Barrett presented updated information on this program at the June, 2002 OBD Policy Work Group and OBD Technical Review Work Group. See Rick's slides for revisions to the above study.

6. **Missouri AAA Study**

Author: Mike Hecht

On-Going

This study is currently on-going and was presented before the FACA OBD Technical Review workgroup for the first time in February 2001. Preliminary data presented to EPA staff show that of 420 vehicles recruited 40 (9.52%) have the MIL illuminated. As a subgroup of the 420 OBD vehicles 117 MY96 vehicles were recruited with 16 MIL illuminations (15.84%). The results also show an "unable to communicate" rate of 2.86%.

Past OBD Studies

EPA Studies

1. Evaluation of On Board Diagnostics for use in Detecting Malfunctioning and High Emitting Vehicles (EPA420-R-00-013)

Authors: Edward Gardetto and Ted Trimble
August 2000

a. Purpose and Methods

This study is better known as the “200 Car OBD Study.” This test program was developed in coordination with the Mobile Source Technical Review Subcommittee recommendation that EPA investigate the use of OBD in I/M. The study’s design was to investigate the following questions:

- Is there a benefit to identifying the emissions problems of vehicles with the OBD system and how does it compare to the available tailpipe tests?
- Will OBD pass any vehicles which are emitting at levels that are of concern in I/M?

This test program was designed as a qualitative comparison between OBD screening and IM240 screening using the Federal Test Procedure (FTP) as the standard. This test program did not evaluate evaporative OBD impacts since a parallel evaporative program was running.

201 vehicles were sampled for this test program at four different labs (National Vehicle Fuel and Emissions Laboratory, Automotive Testing Laboratory, Colorado Department of Health, and California Air Resources Board). Vehicles were identified for procurement if they had the MIL illuminated or were suspected of having high emissions with no MIL illumination.

b. Conclusions

This study concluded that OBD technology could be used for I/M because the emissions reductions from basing repairs on OBD appear to be at least as large as those available from the emissions reduction of tailpipe targeted repairs. The study also stated that OBD I/M would miss some high emitters, but still performed better than available tailpipe tests. The study found that 70% of the vehicles with the MIL illuminated had emissions below their certification standard (but most had broken components). The need for further investigation into the impact of vehicle aging was also discussed since this test program was run very early in the life of OBD vehicles. Lastly, this study found that OBD I/M may realize benefits not customarily included in I/M, such as preventative maintenance.

2. Analyses of the OBDII Data Collected from the Wisconsin I/M Lanes (EPA420-R-

00-0014)

Author: Ted Trimble

August 2000

a. Purpose and Methods

This study is also known as the “Wisconsin Study.” This study was reviewed by the FACA OBD Technical Review workgroup during data gathering and analysis. This study was designed to investigate the level of MIL illuminations and the level of vehicle “readiness” in an actual in-use fleet. Additional information was gathered regarding the ability of lane I/M software to communicate with OBD vehicles and how failure rates compared between OBD I/M and IM240 tailpipe testing. EPA analyzed more than 116,000 OBD equipped vehicles from the Wisconsin I/M lanes from a period beginning in 1998 and ending in 1999.

b. Conclusions

EPA found that model year (MY) 1996 had a higher level of “not ready” than other model years (MY96 level at 5.8%, MY97 level at 2.2%, MY98 at 1.4%). EPA found that if two monitors were allowed to be “not ready” then the “not ready” levels dropped to 2.2%, 0.2%, and 0.2% for the respective model years. The study found that MIL illumination rates tended to increase after 40,000 miles with rates of 2.5% for MY96, 0.7% for MY97, and 0.5% for MY98. With regard to failure levels compared to the IM240 test the study found that the number of vehicles failing each test was roughly the same (when using final cut points for all three pollutants) but that the OBD and IM240 tests failed almost completely different vehicles. The report refers to the “200 Car OBD Study” for how this difference can be explained.

3. Effectiveness of OBDII Evaporative Emission Monitors - 30 Vehicle Study
(EPA420-R-00-012)

Author: Martin Reineman

August 2000

a. Purpose and Methods

The purpose of this study was to determine if OBDII technology is an effective and efficient means of identifying in-use vehicles with excess evaporative emissions. The design and results of this study were reviewed by the OBD Technical workgroup. This test program recruited OBDII vehicles which were equipped with evaporative emissions monitoring systems and induced evaporative leaks in the system. The vehicles were then operated and allowed to determine the state of the evaporative system (leak or no leak). The emissions impact of the induced leaks was evaluated using the Federal Test Procedure evaporative emissions test.

b. Conclusions

Thirty (30) vehicles were tested and the following results reported:

- 22 of 25 OBD systems registered diagnostic trouble codes when evaporative failures were induced.
- OBDII evaporative monitors are a suitable alternative to functional I/M checks on 1996 and newer vehicles which use evaporative emissions monitors

4. **Sierra Research Pilot study (SR98-10-02)**

Source: Sierra Research Contract
October 1998

a. Purpose and Methods

EPA contracted this study to evaluate whether OBD testing can be performed in an I/M lane environment.

b. Conclusions

2,583 vehicles scanned over a two-month period. After testing was completed, scan ware problems were discovered which invalidate the actual scan data from this study. However, the study showed that the mechanical aspects of performing an OBD test in a lane environment were favorable. This testing highlighted concerns with locating data link connectors (DLCs), the need for improved scan ware, and the need for acceptance testing of OBD scan tools.

This study should not be cited or used for any purpose at this time since better data exists for all aspects of OBD I/M testing.

Other Studies

1. **Colorado's I/M240 and OBDII Testing**

Presenter: Rick Barrett
September 2001

a. Purpose and Methods

This presentation to the Colorado Air Quality Control Commission reported basic information regarding the OBD system and included summaries of EPA studies. This presentation compared visual OBD failures to lane IM240 results from the Colorado I/M program.

b. Conclusions

The study looked at 140,118 vehicles and found that 97.6% passed both tests. The IM240 lane test failed 241 vehicles at the Colorado cut points. An additional 1,441 vehicles failed for either the gas cap test or the opacity test. The study found that 2,096 vehicles had a MIL illuminated (visual check not scan tested). The overlap between the

tailpipe failures and the OBD MIL illumination was found to be 42 vehicles. The presentation showed additional data comparing OBD scan data from Colorado to the IM240 results. Of 231,807 vehicles tested 98.1% passed both tests. 2,835 failed OBD and 393 failed the IM240 (at Colorado cut points). The overlap between the two tests was 66 vehicles. The study reports average initial IM240 results of 47 gpm and 2.91 gpm for CO and HC for the 393 vehicles which failed the IM240. These vehicles had an average repair cost of \$226. The average initial IM240 results for the 2,835 vehicles which failed the OBD test were 4.69 gpm for CO and 0.3 for HC. The vehicles had an average repair cost of \$217. This presentation concluded with a discussion of the Colorado FTP based study.

2. **Oregon Department of Environmental Quality - Session 14 of Implementation Training Seminar**

Presenter: Gary Beyer
July 2001

Topic 1

a. Purpose and Methods

This analysis was performed on data gathered in the Oregon OBD I/M lanes from various time periods from September 1999 to June 2001. Oregon first looked at the OBD test compared to the BAR31 tailpipe test.

b. Conclusions

Of 5,173 vehicles which received both tests 94.2% passed both. 259 failed OBD only, 12 failed both, and 29 failed only the BAR31 test (at the time of the study Oregon was using phase-in tailpipe cut points). Because the BAR31 is a single hill which repeats up to four times, Oregon was able to apply a trend analysis to the 29 vehicles which failed the BAR31 with no MIL illumination. Oregon found that 13 of the 29 were projected to pass if the test had continued to run for another two hills.

Topic 2

c. Purpose and Methods

On a separate analysis Oregon looked at lane data totaling 89,349 vehicles. Only the OBD test was performed on these vehicles.

d. Conclusions

2.37% failed the OBD test. 1.05% of the vehicles were “not ready” to test, and 1.47% bypassed the OBD test and received a tailpipe test. Oregon found that the OBD test took less time than either a basic idle test or the BAR31 test in their lanes. Oregon found a fail rate trend by model year (7% for MY96, 3% for MY97, 1.7% for MY98, and 0.83% for MY99). With respect to MIL illumination rates compared to vehicle mileage, Oregon found that vehicles with over 100,000 miles had a MIL rate of 11%, mileage between 76k and 100k had a MIL rate of 7%, mileage between 51k and 75k had a MIL rate of 4%.

Oregon also looked at the “MIL Repair Effectiveness & Not-Ready Rate.” After the first return upon initial failure 72% had no MIL and 11.9% were found to be “not ready.” After the second return inspection 89.9% had no MIL while 3.6% were “not ready.” At retest number three 95.9% had been repaired and 0.9% were “not ready.”

Additional data on “not ready” rates, “bypass” rates, diagnostic trouble codes found, and projected failure rates are available in this report.

3. **OBD Testing in Illinois**

Author: Jim Metheny

January 2001

Topic 1

a. Purpose and Methods

This presentation reviews results from the Illinois OBD I/M advisory period of May 1 to December 31, 2001.

b. Conclusions

The program attempted to perform 257,437 initial OBD tests with 96.5% with a complete OBD read. Additional breakdown of the data showed that 0.9% reported inoperable data link connectors (DLC), 0.8% with inaccessible DLCs, 0.5% with damaged DLCs, and 0.4% with missing DLCs. Of the 250,720 vehicles with successful OBD tests, 94.2% passed. The presentation projects an overall (all model years) increase of 0.9% when compared to performing only tailpipe testing. The state evaluated the diagnostic trouble codes (DTCs) which were most frequently downloaded and determined that 11 of the top 20 did not directly effect exhaust emissions (evap, EGR, cold start, misfire)[IL does not fail for NOx]. The presentation concluded that “vehicles with excessive emissions are more likely to produce excessive emissions in the future and will not be repaired if exhaust testing is required to confirm an OBD failure during program phase-in. Phase-in would ‘send the wrong message’ to owners of vehicles failing the OBD check.”

Topic 2

c. Purpose and Methods

The presentation continued with a comparison of OBD to IM240 by evaluating 11,580 MY96 to 98 vehicles with full IM240 tests (not fast pass). The results show that 6.4% were OBD failures with 26.4% of those being evaporative or NOx related. The remaining 542 vehicles emitted 2.7 times the HC and 2.9 times the CO compared to vehicles passing the OBD inspection.

d. Conclusions

The presentation concludes with a statement regarding the fact that OBD testing will identify vehicles with emissions problems ignored by current IM240 testing. Also, vehicles which fail the OBD test emit significantly more HC and CO as compared to

vehicles with properly functioning emission control systems.

4. **A Comparison of Tailpipe Emissions of On-Board Diagnostics (OBDII) Equipped Vehicles with the Malfunction Indicator Light Illuminated Before and After Repairs**

Authors: T. Durbin, J. Norbeck

Submitted for publication

This report is also known as the “CE-CERT Study” was briefed before the FACA OBD Technical Review workgroup both during its design and data gathering.

a. Abstract

A total of 77 OBDII equipped vehicles with illuminated MILs and non-evaporative diagnostic trouble codes (DTCs) were tested before and after repair. The test cycles included the FTP, IM240 and ASM. A total of 17 vehicles were found with emissions greater than 1.5 times their respective FTP emissions standards. Repair of these vehicles resulted in dramatic reductions in overall emissions for all the cycles. A majority of the remaining vehicles were found to have emissions below the certification standard for the FTP both before and after repair. Repairs for the vehicles with emissions < 1.5 times the standard resulted in some smaller but quantifiable emission reductions over the FTP and IM240 with more significant reductions over the ASM cycles. Misfires, bad oxygen sensors, and Exhaust Gas Recirculation (EGR) problems were the most common non-evaporative causes for the MIL to trigger. The results show some fundamental differences between identifying malfunctioning vehicles using OBDII as opposed to more traditional dynamometer tests. In particular, for many systems, OBDII identifies components that are operating outside their design specification rather than for a specific emissions threshold.

OBD Policy Workgroup Report
Technical Appendix N

ANALYSIS OF IM147 AND OBDII INSPECTION DATA

**Rob Klausmeier -- dKC
October 2002**



BACKGROUND

- ◆ Since January 2002, Arizona has been enforcing mandatory OBDII I/M checks.
- ◆ Arizona's I/M Contractor, Gordon-Darby, performed IM147 tests on a random sample of vehicles that pass or fail the OBDII inspection.
 - About ½ of the sample failed the OBDII inspection.
 - About ½ of the sample passed the OBDII inspection.
- ◆ The dataset includes IM147 test results on 239 vehicles that failed their initial OBDII inspection and passed their final OBDII inspection.

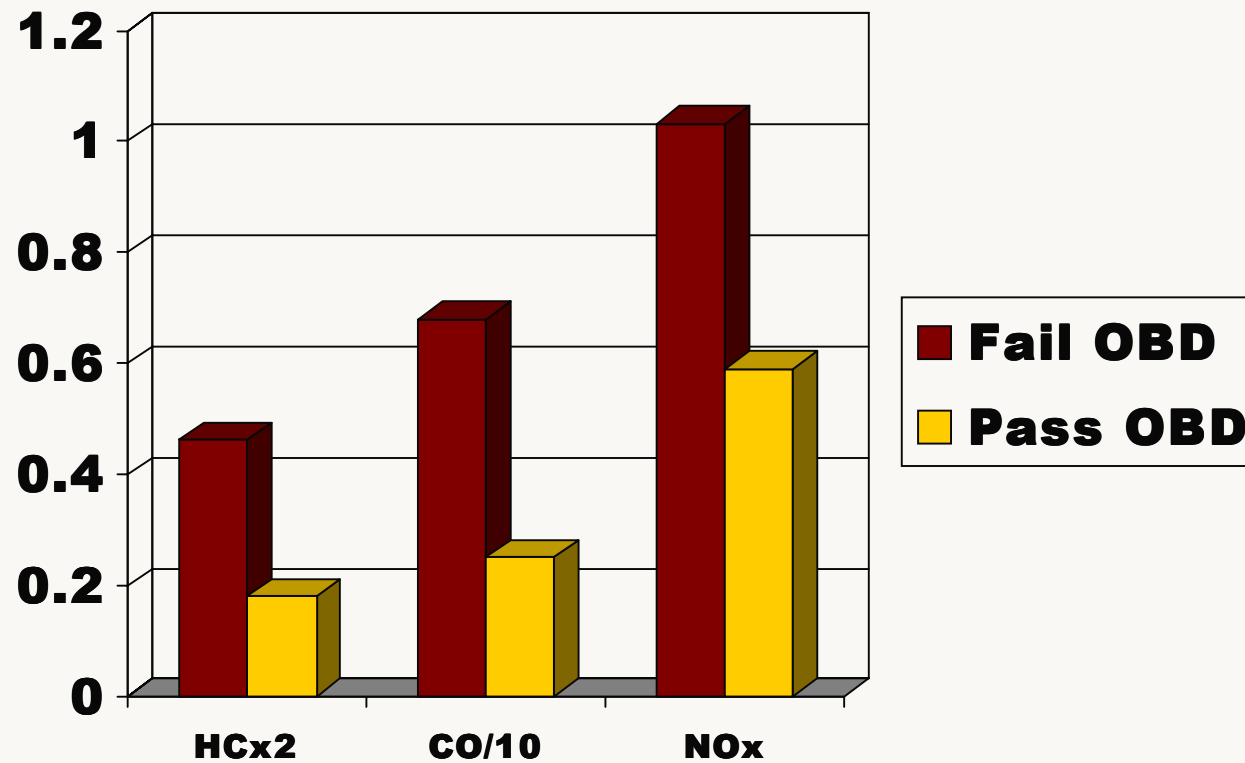


INITIAL TEST RESULTS (FROM JAY GORDON)

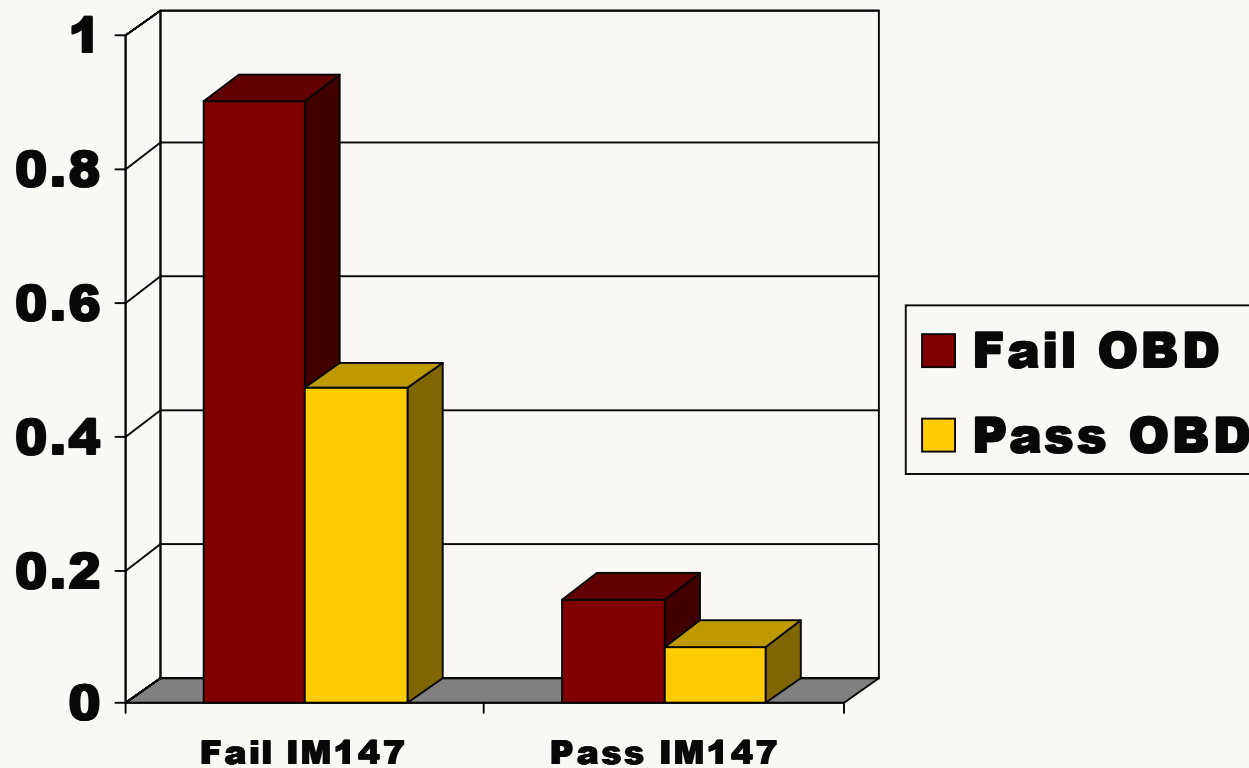
% of Sample	OBD Result	IM147 Result	Readiness Details
79.0%	Pass OBD	Pass IM147	Ready
12.9%	Pass OBD	Pass IM147	NOT Fully Ready
0.1%	Pass OBD	Fail IM147	NOT Fully Ready
1.0%	Pass OBD	Fail IM147	Ready
4.2%	Fail OBD	Pass IM147	Ready
2.1%	Fail OBD	Pass IM147	NOT Fully Ready
0.3%	Fail OBD	Fail IM147	NOT Fully Ready
0.4%	Fail OBD	Fail IM147	Ready



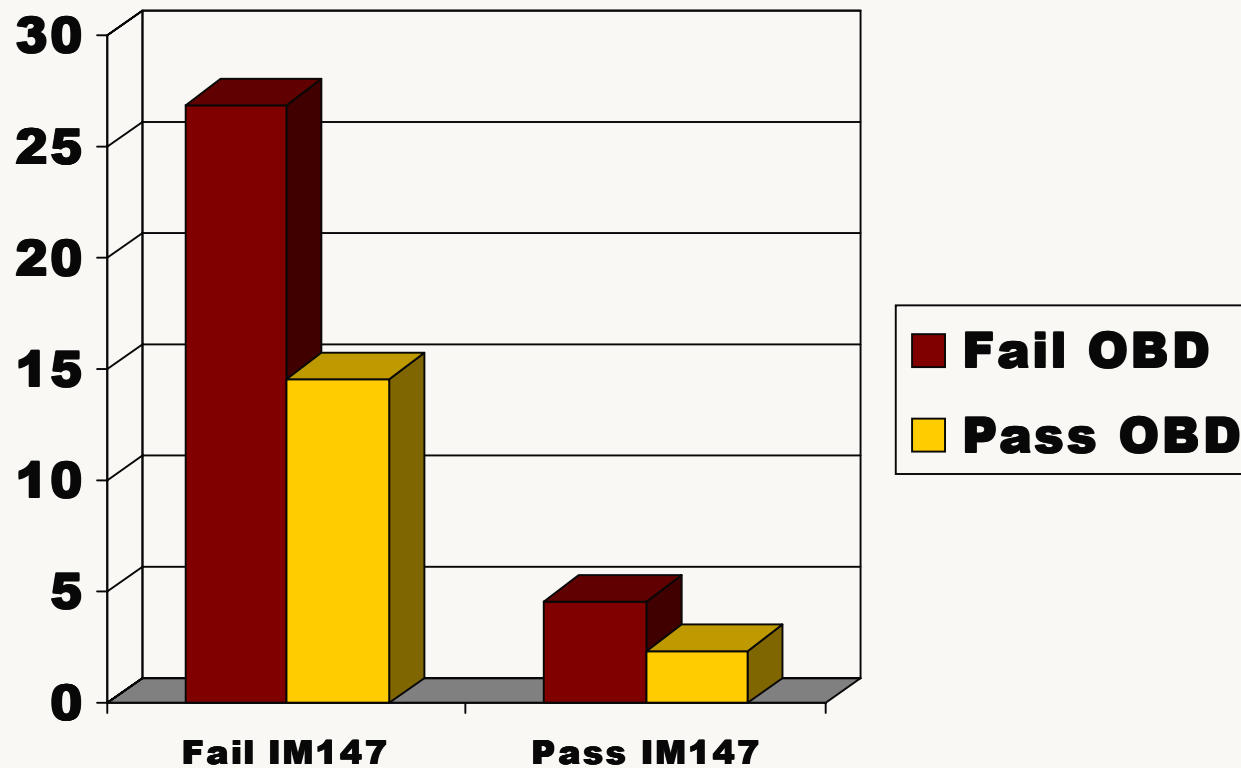
INITIAL IM147 EMISSION LEVELS



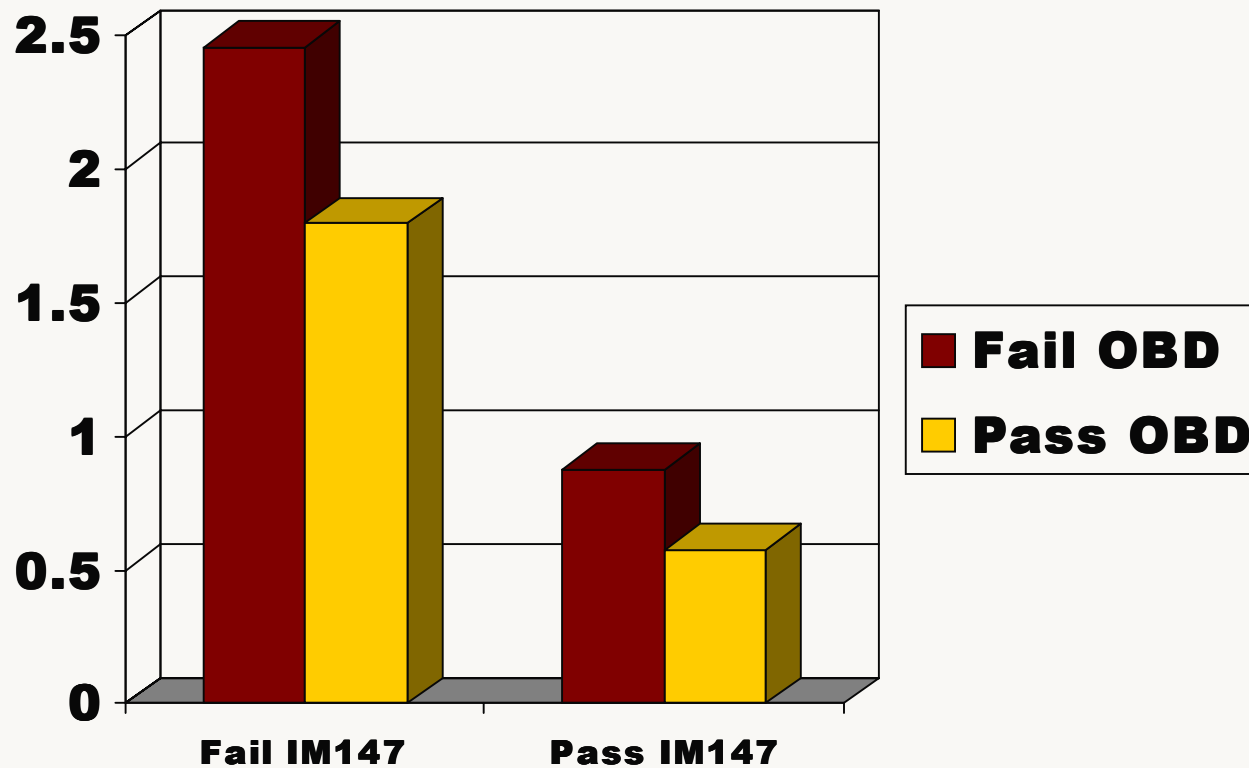
INITIAL IM147 RESULTS vs. OBD RESULTS HC – g/mi.



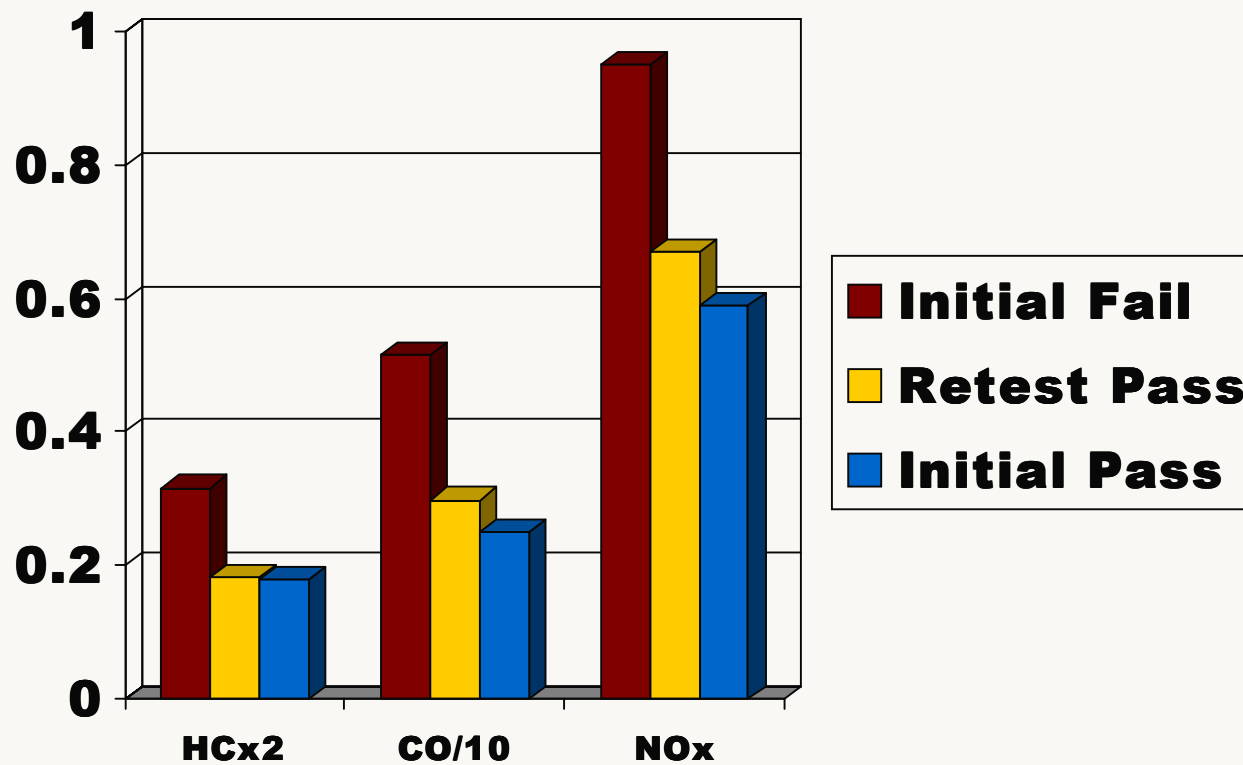
INITIAL IM147 RESULTS vs. OBD RESULTS CO – g/mi.



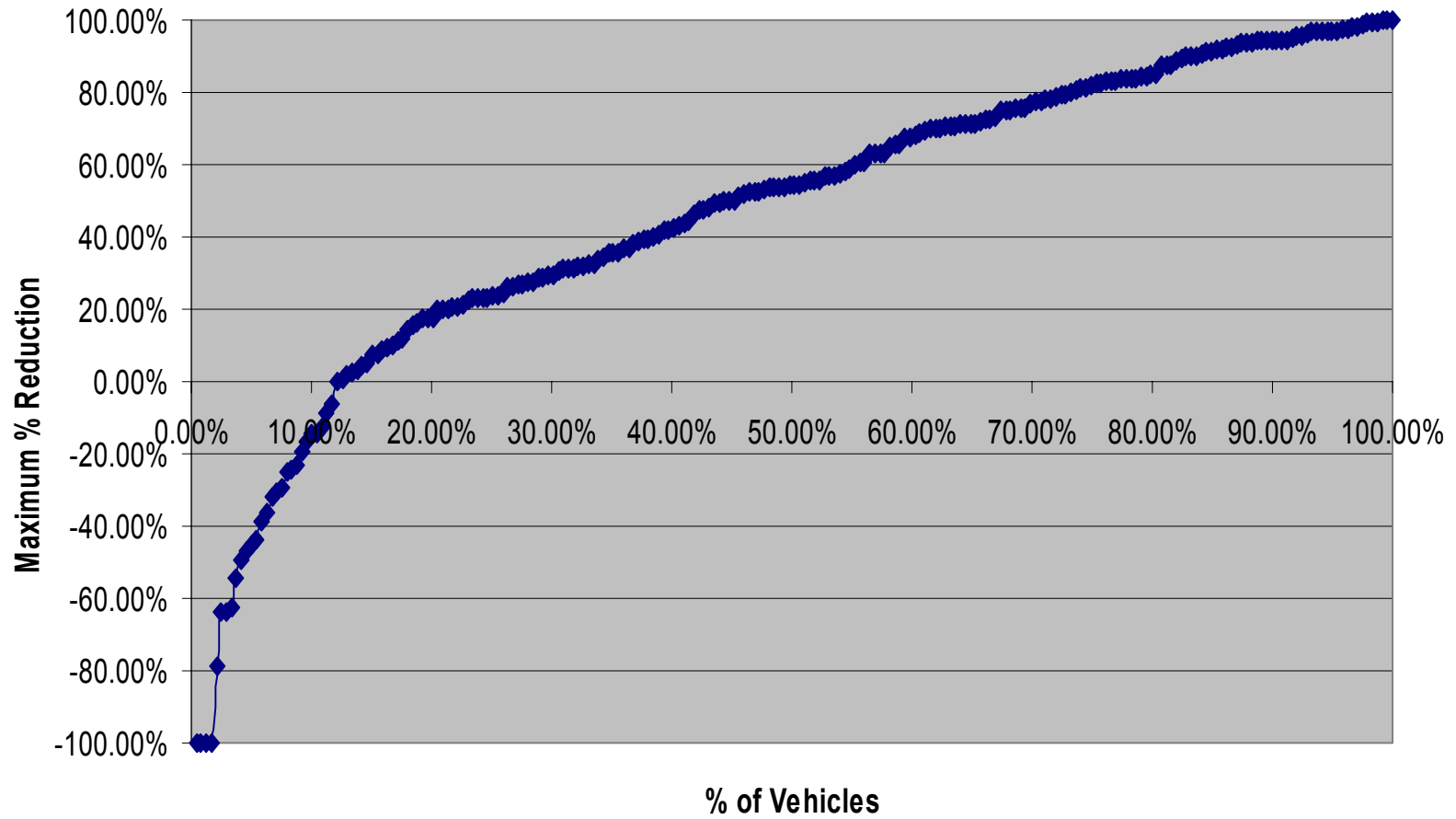
INITIAL IM147 RESULTS vs. OBD RESULTS NOx – g/mi.



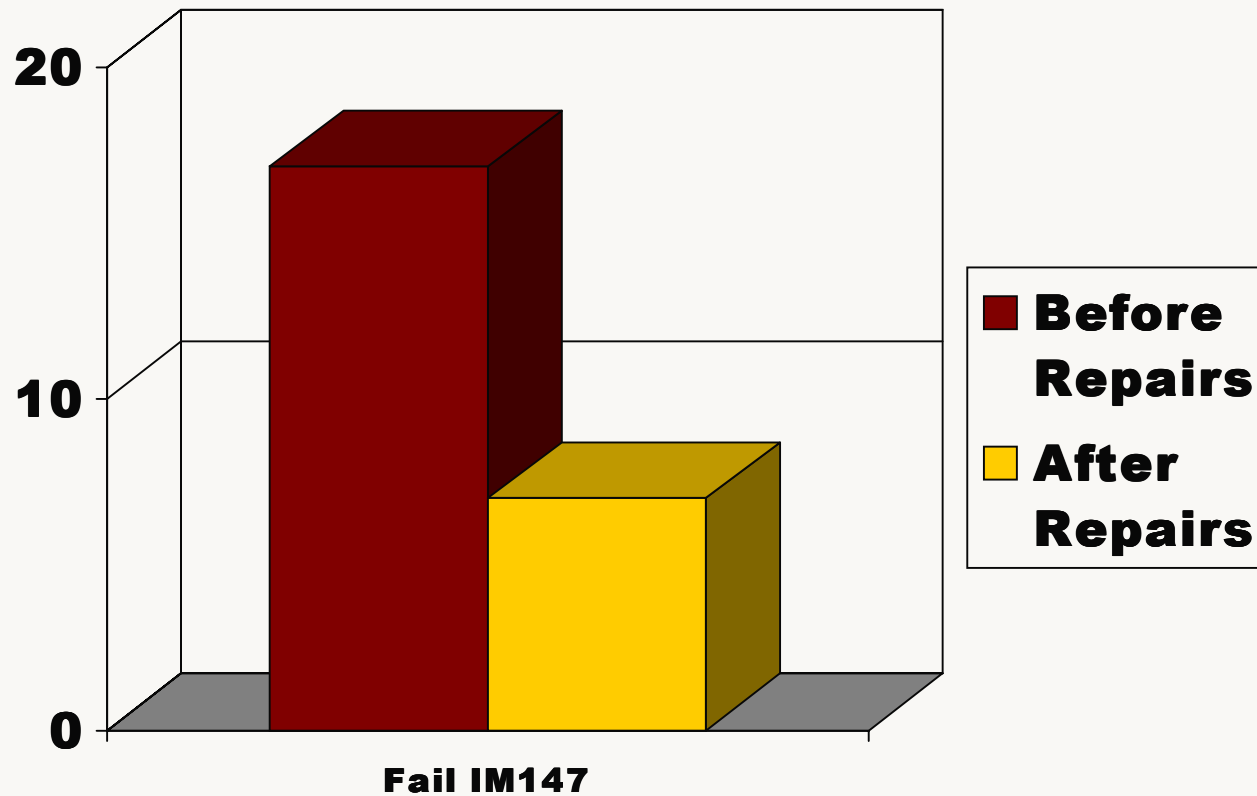
IM147 EMISSION LEVELS BEFORE AND AFTER REPAIR – FAIL OBD BEFORE/PASS AFTER



Maximum % Reduction in IM147 Emissions (Highest of HC, CO, or NOx Reduction per Vehicle)



Number of Vehicles failing IM147 Before and After OBDII Repairs



CONCLUSIONS

- ◆ OBD failures have much higher IM147 Emission Levels than OBD Passes.
- ◆ Average IM147 emissions for vehicles that failed both IM147 and OBD tests are much higher than for vehicles that failed IM147 tests but passed OBD tests.
- ◆ Repairs to bring vehicles into compliance with OBD test standards reduced IM147 emission levels by 42% for HC and CO and 30% for NOx.
- ◆ After repair levels for OBD test failures are similar to the levels for vehicles that passed their initial test.

