

OBD-I/M Program Evaluation

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OVERVIEW OF OBD-I/M PROGRAM EVALUATION

- EPA's Requirements for I/M Program Evaluations
- OBD-I/M Evaluation - What Not to Do
- OBD-I/M Evaluation - One Right Way
- Attributes and Variables
- Statistical Process Control
- OBD-I/M Control Charts:
 - Compare Program to Itself
 - Compare Programs to One Another
 - Additional Ideas
 - Final Thoughts

EPA REQUIREMENTS FOR I/M PROGRAM EVALUATIONS

- 1990 Clean Air Act Amendments §182(c)(3)(C):

Each State shall biennially prepare a report to the Administrator which assesses the emission reductions achieved by the program required under this paragraph based on data collected during inspection and repair of vehicles. The methods used to assess the emission reductions shall be those established by the Administrator.

- Evaluation testing was to be “state administered or monitored” and done using the IM240 test procedure, or equivalent. (40 CFR 51.353, November 5, 1992)
- To date, EPA has released no guidance on how to evaluate the benefit of OBD-I/M programs. The debate has instead focused on how NOT to evaluate these programs.

OBD-I/M EVALUATION (WHAT NOT TO DO)

- I/M tailpipe test results are not a reasonable benchmark for OBD-I/M tests. Tailpipe tests:
 - Do not test performance under all in-use conditions.
 - Have varying degrees of false failures relative to FTP.
 - Have test-to-test variability due to inconsistent preconditioning and lax drive trace tolerances.
- This means in-program and remote sensing data cannot be used to evaluate OBD-I/M programs.
 - All three of the above problems apply to varying degrees to these two methods.
 - The coming influx of low emission vehicles will be a further problem for both methods.
 - That eliminates the cheap way to do an evaluation.

OBD-I/M EVALUATION (ONE RIGHT WAY)

- Conduct rigorously designed test program:
 - Select a truly random sample of vehicles.
 - Use highly controlled FTP and SHED test procedures.
 - Measure vehicle emissions before and after they complete their I/M inspection cycle.
 - Select a large enough sample to reduce sample error to statistically insignificant levels.

- Problems with this approach:
 - Much too costly and obtaining a truly random sample is very difficult.
 - Emissions from new technology/low emission vehicles likely to be in the error band of the instrumentation.
 - Would show only single-cycle I/M benefits.

ATTRIBUTES AND VARIABLES (DIFFERENT APPLES AND ORANGES)

- Attributes are data records with a Yes/No answer:
 - Overall I/M test pass/fail result
 - OBD-I/M pass/fail result
- Variables are recorded data that vary by number or degree:
 - I/M emissions rates
 - Number of inspections or vehicles tested
 - Fraction of passing or failing vehicles

ATTRIBUTES AND VARIABLES (continued)

- I/M program benefits have historically been measured in terms of variables:
 - Average emissions rates
 - Failure rate
 - Percent reduction in emissions
 - Average repair costs
- OBD-I/M may be measured in terms of both variables (but only some) and attributes:
 - Variables: fail rate, average repair costs
 - Attributes: number of failures

STATISTICAL PROCESS CONTROL (CONTROL CHARTS)

- Historically used in manufacturing processes to identify excessive variation so it can be corrected.
- Control charts work best when used with processes that produce relatively homogeneous data.
- Both variables and attributes can be charted.
- Control charts' key advantage is their ability to visually display trends in performance over time.

OBD-I/M CONTROL CHARTS

- OBDII inherently eliminates some heterogeneity in inspection data:
 - Onboard tests considered to be independent of ambient effects, fuels effects, test variability, etc.
 - Should be able to compare results between seasons, areas, etc.
- Attribute charts eliminate additional concern about heterogeneous nature of emissions data.
 - Involves tracking of binary (Yes/No) results rather than variable results.

OBD-I/M CONTROL CHARTS (COMPARE PROGRAM TO ITSELF)

- Use attribute charts to track trends in I/M performance over time:
 - Number of failures (in normalized population).
 - Use subpopulations (e.g., high volume models) to reduce sources of variability.
 - Compare program performance to itself.
 - If OBDII systems and OBD-I/M are working, failures should remain nearly constant.
- Can also track other key attributes and variables:
 - Number of vehicles (normalized) with number of unset readiness codes more than “x.”
 - OBD-I/M failure rate.

OBD-I/M CONTROL CHARTS (COMPARE PROGRAMS TO ONE ANOTHER)

- Generate control charts from multiple programs for homogeneous sample:
 - Track normalized number of failures or failure rates for selected high-volume models.
 - Compare both absolute levels and trends over time among programs.
- Use I/M Lookup Table record number (VCID) to track same vehicles in multiple programs:
 - VCID must be included in test record.
 - VCID must be assigned accurately.
- Can be done relatively cheaply and quickly.
- Can be easily automated using available commercial-off-the-shelf (COTS) software to track on ongoing basis.

OBD-I/M CONTROL CHARTS (ADDITIONAL IDEAS)

- States (assisted by EPA) could set up ongoing cross-comparison program.
- Two possible methods for comparison to benchmark program:
 - Select program (e.g., Phoenix) as benchmark and compare absolute levels and trends over time in other programs to it.
 - Analyze data from programs to identify best performer and then select it as benchmark.
- Same type of data could be collected in special test program from non-I/M area to provide different type of benchmark.
 - This would be less expensive and easier than for current METT-type program evaluations.

OBD-I/M CONTROL CHARTS (MORE ADDITIONAL IDEAS)

- EPA needs to develop guidance on benchmark OBD-I/M program:
 - What rate of failures, etc., is equivalent to enhanced performance standard.
 - Ideally, data should be collected from no-I/M area to determine illuminated MIL rates, etc., in “uncontrolled” areas. Results can be used to establish no-I/M benchmark.

OBD-I/M CONTROL CHARTS (FINAL THOUGHTS)

- Using OBD-I/M control charts would NOT:
 - Show how much emissions are being reduced.
 - Show whether OBDII systems are effective in reducing emissions.
 - Provide any estimate of program cost-effectiveness.
- OBD-I/M control charts provide a low-cost method to:
 - Compare program performance relative to itself and possibly other programs.
 - Produce trend results that policymakers and the public can easily understand.
 - Allow the program to easily keep track of important trends over time (i.e., failures of aging OBDII vehicles).